REPUBLIC OF UGANDA

Ministry of Water and Environment

Forest Landscape Restoration Opportunity Assessment for Uganda

2016

Forest Landscape Restoration Opportunity Assessment for Uganda

2016

This Report has been prepared with support from
International Union for Conservation of Nature (IUCN)

Citation: *Forest Landscape Restoration Opportunity Assessment Report for Uganda (2016),* Ministry of Water and Environment – Uganda; IUCN. x + 42pp.

Design & layout: Gordon Arara (IUCN Publications Unit, Nairobi)

Available from: IUCN, International Union for Conservation of Nature
IUCN Uganda Country Office
Plot 39, Babiiha Avenue
P. O. Box 10950
Kampala, Uganda
Tel. +256414233738 / 344508 / +256-312233738
www.iucn.org/

Table of Contents

List of Tables

List of Figures

Foreword, Government of Uganda

I take this opportunity to introduce the Opportunities report for Forest Landscape Restoration in Uganda. Over the years, we, as a country have been concerned about the state of our forests and the increasing trend of deforestation and degradation, despite the various efforts and investments within the sector. This still remains a challenge. This report is another step in the right direction because it provides an opportunity for us to understand exactly where the opportunities for restoration are across the country, along with the appropriate interventions in the various landscapes.

Government of Uganda has prioritized Forest Landscape Restoration (FLR) in the national plans, with an aim to restore forest cover to its 1990 levels by 2020. As a matter of fact, at the UN Climate Summit in September 2014, this goal was translated into a Bonn challenge pledge to restore 2.5million hectares of degraded and deforested land, using the FLR approach. This pledge not only demonstrates Uganda's leadership within the global community in restoring degraded lands and mitigating climate change impacts, but also acknowledges that Uganda forests are a national priority that will increase food productivity, water security, biodiversity, and resilience to climate change, each of which benefit all Ugandans and the global community.

The report actually reveals that Uganda has a total of 8,079,622 hectares of land available for restoration with the highest restoration opportunities being in the Northern moist, Karamoja and South West rangelands. This information will be used to support the sector investments, to ensure that priority is given to the areas with the highest potential. This report is also expected to support ongoing processes like the development of the REDD+ strategy, the Forest Investment Plan and the climate change resilience programme.

I therefore wish to take this opportunity to re-affirm Government's commitment in implementing these restoration options to achieve our set targets.

I specifically extend my gratitude to the International Union for Conservation of Nature (IUCN) for providing both the technical and financial support for this assessment and production of the report. The leadership provided by the Forest Sector Support Department is much appreciated, and the national FLR Core team which spearheaded the application of the Restoration Opportunities Assessment Report (ROAM). The production of this report was participatory in nature, involving key stakeholders both at the national and sub-national level, and this is greatly appreciated for making it a true nationally owned product.

I look forward to a continuous collaboration with partners as we strive towards effective implementation of the restoration options, to achieve our set targets.

For God and My Country

Hon. Samuel Cheptoris
MINISTER OF WATER AND ENVIRONMENT

Acknowledgements

The Ministry of Water and Environment, and specifically the Forest Sector Support Department acknowledges the contribution of various partners, institutions and individuals in undertaking the assessment of the restoration opportunities, and the final production of this report. Special thanks go to the International Union for Conservation of Nature (IUCN) for providing the financial and technical support to this process. In particular, I extend my gratitude to the IUCN Uganda country office, led by the Head of Office (Sophie Kutegeka) for steering this process.

Special thanks go to the National Core team for the tireless efforts in undertaking the entire assessment process, including the GIS mapping, the economic assessments and stakeholder consultations. The core team was led by the Forest Sector Support Department (FSSD) and comprised of representatives from National Forestry Authority (NFA), MMinistry of Agriculture, Animal Industry and Fisheries (MAAIF), Makerere University and IUCN. The GIS team was led by John Diisi (NFA), and comprised of Dr Bernard Barasa (Makerere University), Edward Senyonjo (NFA) and Craig Beatty from IUCN Washington Office. The economics team comprised of Mike Verdone (IUCN Headquarters) and Godfrey Sunday from the Ministry of Agriculture, Animal Industry and Fisheries. The policy team comprised of Bob Kazungu from FSSD, Charles Byaruhanga (FSSD), Polycarp Mwima from IUCN, Sophie Kutegeka from IUCN and Sandra Amongin from IUCN. Dr Patrick Byakagaba from Makerere University is much appreciated for taking keen interest in this assessment and supporting the final compilation of this report. The team also co-opted various experts to support this process and they are all appreciated.

The IUCN and WRI team from the global offices are appreciated for the technical oversight offered to this process. Special gratitude goes to Stewart MAGINNIS and Rob WILD from IUCN and Sean De WITT from World Resources Institute for the technical oversight, the linkages created with the ongoing global processes on Bonn Challenge and FLR.

The contribution of the district local governments and civil society representatives in the consultative meetings and subnational validation workshops is very much appreciated. This enabled the project to secure input from all the relevant stakeholders across the country.

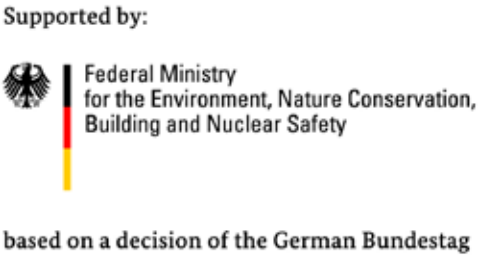
This report gives hope to the country through indicating the landscape opportunities available for restoration. I therefore call upon all the actors to join hands in the implementation of the proposed interventions. We hope to continue developing specific restoration packages, which we shall jointly implement with partners.

Adata Margaret

Commissioner Forestry

IUCN acknowledges the financial support from the KNOWFOR project to produce this report. KNOWFOR is funded by UKaid from the UK Government.

The official launch of this report was supported by the “Scaling up Forest Landscape Restoration” project which is part of the International Climate Initiative (IKI). The German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) supports this initiative on the basis of a decision adopted by the German Bundestag.



List of Acronyms/Abbreviations

BCR ..... Benefit Cost Ratio
CBA ..... Cost Benefit Analysis
CBD ..... Conservation of Biological Diversity
CFM..... Collaborative Forest Management
CFR ..... Central Forest Reserve
EBA..... Ecosystem Based Adaptation
ECO-DRR ..... Ecosystem Based Disaster Risk Reduction
FLR ..... Forest Landscape Restoration
GDP ..... Gross Domestic Product
GDP ..... Gross Domestic Product
IUCN..... International Union for Conservation of Nature
LFR ..... Local Forest Reserve
MAAIF..... Ministry of Agriculture, Animal Industry and Fisheries
MFEPD ..... Ministry of Finance, Economic Planning and Development
MGLSD..... Ministry of Gender, Labour and Social Development
MLG..... Ministry of Local Government
MLHU ..... Ministry of Lands, Housing and Urban Development
MOE ..... Ministry of Education
MWE..... Ministry of Water and Environment
NARO ..... National Agriculture Research Organization
NDP ..... National Development Plan
NEMA ..... National Environmental Management Authority
NFA..... National Forestry Authority
NPV ..... Net Present Value
OPM ..... Office of the Prime Minister
REDD..... Reducing Emissions from Deforestation and Degradation
ROAM..... The Restoration Opportunities Assessment Methodology
THF..... Tropical High Forest
UBOS ..... Uganda Bureau of Statistics
UGX..... Uganda Shillings
UNCCD..... United Nations Convention to combat Desertification
UNFCCC ..... United Nations Framework Convention on Climate Change
PA ..... Protected areas
UWA ..... Uganda Wildlife Authority
WRI..... World Resources Institute

Executive Summary

The degradation of forests is a threat to both the functioning of ecosystems and the well-being of human communities. Nations have for several years grappled with the challenge of finding ways of restoring forest landscapes that suit the ecological constraints of particular sites as well as the socio-economic circumstances of the landowners or land users, and ensure resilience under various future uncertainties. Forest landscape restoration is a feasible option through which these challenges can be addressed. Forest landscape restoration (FLR) is a long-term process of regaining ecological functionality and enhancing human well-being across deforested or degraded landscapes. It is carried out to build a forest-based landscape that can improve biodiversity conservation, ecological functioning and livelihoods.

Uganda made a commitment to restore 2.5 million hectares of deforested and degraded land, as a pledge towards the Bonn Challenge - a global effort intended to restore 150 million hectares of the World's deforested and degraded land by 2020 and 350 million hectares by 2030. The Forest Landscape Restoration approach which World leaders agreed upon in the challenge is what Uganda intends to apply in her restoration efforts. This shared aspiration is in response to the sharp decline in forests cover in the recent decades in Uganda. The forest cover is currently estimated at 9% of the total land cover. This current situation is exacerbated by land degradation due to population pressure and land tenure systems which is resultant into soil erosion and decline in soil fertility.. In order to mitigate this, Uganda has prioritized forest restoration as envisaged in existing targets provided in vision 2040, National Development Plans (I & II), and the National Forestry Plan (2011/12-2021/22). The primary target is to restore forest cover from the current 9% to a national target of 24% of Uganda's land cover. Restoring 2.5 million hectares would contribute about 89% of the aspired 24% considering the current forest cover status.

In order to carry out FLR, it is important to: identify the sites in the different landscapes of the country which are deforested and degraded, determine their size and the most socio-ecologically and economically optimal restoration options or interventions. It is against this backdrop that the Government of Uganda through the Ministry of Water and Environment in partnership with the International Union for Conservation of Nature (IUCN), World Resources Institute (WRI) and other Government Agencies conducted a study to comprehensively assess the potential for forest landscape restoration in Uganda. The specific objectives were to determine: deforestation and land degradation trends in Uganda, available area and 'priority areas' for forest landscape restoration, site specific forest landscape restoration options for various ecological landscapes, profitability of selected landscape restoration options, socio-economic and policy environment for restoration and strategies for addressing major policy and institutional bottlenecks that affect forest landscape restoration interventions.

The Restoration Opportunities Assessment Methodology (ROAM) – an approach that was developed by IUCN and WRI – was used to guide processes of developing forest restoration interventions at landscape level. ROAM is a stepwise and iterative application of a series of analyses used to identify the best set of Forest landscape restoration opportunities applicable to a specific site. Seven classified landscapes were produced through a participatory process by a core team composed of technical staff from ministries and government agencies, academia and IUCN. Climate, vegetation type, Altitude and Farming systems were the key attributes used in developing zones.

The classified landscapes include Western mid-altitude farmlands, Lake Victoria Crescent, Karamoja, South Kyoga floodplains, Afro-montane high altitude, North Moist farmlands, and South west rangelands.

The study revealed that deforestation and forest degradation have occurred mostly in northern moist, southwest rangeland and western mid altitude landscapes of Uganda in the last 10 years mainly due to anthropogenic factors, weak law enforcement and inadequate funding to the natural resources sector. The Northern moist and western mid-altitude landscapes were the most severely deforested landscapes followed by southwest rangelands respectively. The western mid-altitude was the most degraded followed by southwest rangelands and Lake Victoria crescent respectively.

Uganda has a total of 8,079,6221ha of land with opportunities for forest landscape restoration. Northern moist, Karamoja and southwest rangeland landscape zones offer the highest acreage for restoration. Afforestation (planting of trees in areas not under forest for the last ten years), reforestation, agroforestry

and natural regeneration are the most preferred restoration options. Agroforestry has a higher likelihood of creating benefits that far outweigh the costs compared to other options. There were twenty-two priority areas identified for forest landscape restoration. For the purposes of this report a priority area for restoration was defined as those areas that have had severe deforestation and degradation in the last 15 years, with high socio-ecological value and low population density to enable restoration.

The success factors that already exist for restoration interventions include: Legal and policy requirements of FLR, suitable ecological conditions and suitable market conditions. The factors that are missing are awareness of FLR and its role among local communities, well defined tree and forest tenure under “mailo” and customary land tenure system and resources committed to restoration and monitoring system for restoration interventions.

The strategies for addressing major bottlenecks that affect forest landscape restoration interventions are: Providing forest extension services to local communities, promoting establishment of more value addition forest-based industries, providing market-based incentives to those involved in restoration, enhancing capacity of responsible bodies, enhancing security of forest and tree tenure, improving on the coordination of relevant agencies and integrating the value of forests as natural capital into national accounting systems. In addition to addressing the aforementioned bottlenecks, there is need for site-species matching inventories, regular monitoring of restoration interventions, provision of subsidies and building capacity in tree seed selection especially of native species if Uganda is to achieve the Bonn challenge target in the stipulated timeframe. Involvement of non-state actors such as corporate companies, traditional institutions and civil society organizations ought to be explored to address some of the funding bottlenecks.

1. Introduction

1.1. Overview on forest landscape restoration

The degradation of forests continues to be a global concern because of the threat to both the functioning of ecosystems and the well-being of human communities (Lamb, 1998; Orsi & Geneletti, 2010). Global forest cover has reduced by almost half from 62 million sq. km to 33 million sq. km in the last 8000 years (Bryant et al. 1997). Forest decline has majorly occurred in the tropics due to agricultural expansion and high population growth (Wade et al. 2003). This has to a great extent led to significant reduction in biomass, biodiversity and ecosystem services from forests which potentially affects human livelihoods (Fisher et al. 2009).

FLR Guiding Principles

1. Restore entire landscapes rather than sites to balance a mosaic of interdependent land uses.
2. A forward looking approach to restore the functionality of the landscape.
3. Aim to generate a suite of ecosystem goods and services from a range of restoration activities.
4. Actively engage local stakeholders in decisions regarding restoration goals, implementation methods and trade-offs
5. Consider a wide range of eligible technical strategies for restoring trees on the landscape
6. Adapt restoration strategies to fit local social, economic and ecological contexts.
7. Adapt restoration strategies to changes in human knowledge and societal values.
8. Address ongoing loss and conversion of primary and secondary natural forest.

Nations have for several years grappled with the challenge of finding ways of restoring forest cover that suits the ecological constraints of particular sites as well as the socio-economic circumstances of the landowners or land users, and ensure resilience under various future uncertainties (Lamb et al. 2012). One of the approaches being promoted at global level to address this challenge is through Forest Landscape Restoration. It is a long-term process of regaining ecological functionality and enhancing human well-being across deforested or degraded landscapes. It aims at achieving a balance between human needs and those of biodiversity conservation (Dudley et al. 2005). The overarching purpose is to build a forest-based landscape that can improve biodiversity conservation, ecological functioning and the livelihoods of human communities (Orsi & Geneletti, 2010).

Forest landscape restoration is about “forests” because it aims at enhancing the number and/ or health of trees in an area. It is about “landscapes” because it involves entire watersheds, jurisdictions, or even countries in which many land uses interact. It is about “restoration” because it involves bringing back the biological productivity of an area in order to achieve a number of benefits for people and the planet. It is long-term because it requires a multi-year vision of the ecological functions and benefits to human well-being that restoration will produce although tangible deliverables such as jobs, income and carbon sequestration can begin to flow right away. However, in some cases it can be carried out over relatively short time scales (e.g. Shinyanga, Tanzania – 15 years and Cost Rica -25 years).

Forest Landscape Restoration is also called ‘Forest and Landscape Restoration and in Central America – Functional Restoration of Rural Landscapes (FRRL). The names may vary but the guiding principles are to a great extent similar.

It is guided by principles such as considering and restoring entire landscapes as opposed to individual sites, allowing for multiple benefits, considering a wide range of eligible technical strategies for restoring trees on a landscape, actively engaging local stakeholders in decision making, adapting restoration strategies to fit local social, economic and ecological contexts, addressing ongoing loss and conversion of primary and secondary natural forest and applying adaptive management. FLR can be implemented through new tree plantings, managed natural regeneration, agroforestry, or improved land management to accommodate a mosaic of land uses, including agriculture, protected wildlife reserves, managed plantations and riverside plantings. The main goal is to build up a forest-based landscape that is good for both nature and human beings. Landscape is not interpreted at spatial level per se but the principle is to consider an area within which one has to intervene in order to achieve some desired outcome or set of outcomes. For instance, maintenance of forests on hillsides to improve water supplies and prevent erosion of agricultural lands lower down those slopes (Boedhihartono & Sayer, 2012). Forest Landscape Restoration includes tree-based restoration in croplands and rangelands – termed as well as the restoration of forests themselves – and the greatest potential is often in mosaics of land-use.

Forest landscape restoration provides the opportunity for breaking the destructive spiral of decline in forest cover and land degradation, by creating a virtuous upward spiral of recovery, while generating multiple benefits which can facilitate attainment of sustainable development (Roberts et al. 2009). For example, restored landscapes can support livelihoods and enhance biodiversity and ecosystem services such as provision of clean water, reducing soil erosion, providing wildlife habitat, biofuels and other forest products (Benaya et al. 2009). In addition, restoration of forest landscapes plays a critical role in mitigating climate change by sequestering carbon and maintaining diversity of plant and animal communities (De-Souza & Batista, 2004). Restoration of forests and trees in agricultural landscapes can boost food productivity through enhanced soil fertility, moisture conservation and other ecosystem services (Chazdon, 2008). Restoration can also enable countries meet their existing international commitments related to biodiversity conservation and sustainable forest management.

Table 1: Forest cover changes (ha) from 1990 to 2015

Year/Forest cover	Plantation	Tropical high Forest	Woodland	Total forest
1990	34,983	923,984	3,973,857	4,932,824
2000	21,343	930,410	2,834,584	3,786,338
2005	33,144	823,929	2,365,485	3,222,559
2010	64,701	685,653	1,448,806	2,199,161
2015	107,689	630,912	1,212,899	1,951,501

Table 2: Rates of deforestation from 1990 to 2015

Period	Annual deforestation (ha)
1990 - 2000	- 114,648
2000 - 2005	- 112,755
2005 -2010	- 204,679
2010 - 2015	- 49,531

1.2 Forest cover change in Uganda

Tropical high forest - well stocked and woodlands are the major forest cover types in Uganda, followed by tropical high forest-low stocked, conifer and broad leaved. The country has significantly experienced a reduction in the total forest cover since 1990 to 2015. The decrease has majorly been experienced in both woodland and tropical high forest-low stocked than the other forest cover types apart from conifers and broad leaved forest plantations which have gained more land area (Table 1). The forest cover types have been predominantly felled through saw/pit logging and burning to access high value timber and to create more agricultural, industrial and settlement land. The major drivers of percentage loss in forest cover types include high population growth rates, intensification of agricultural activities without external input, land tenure system, weak enforcement of environmental laws, and increased value of forest products. The gains in land area of conifers and broad leaved are attributed to enforcement and monitoring of vegetation in the forest reserves, re-afforestation and restoration programmes being promoted by various actors in the country.

1.3 Land degradation in Uganda

Uganda loses approximately from 4 to 12% of her GDP due to land degradation (Bolwig, 2002). The most severely affected areas include highlands, mountains, areas under agriculture, wetlands, shorelines, forests, rangelands, river banks and bare grounds. Soil erosion has been recorded as a single major physical driver of land degradation in the country. For example, Figure 1 shows estimates of the proportion of land affected by erosion in selected districts. The worst affected districts (85 – 90 percent) include the highland areas in the Southwest, Kabale and Kisoro, and those severely affected (75 – 80 percent) include Mbale, Rakai and Kotido cattle-grazing districts.

In terms of cropping systems, land degradation rates are higher under annual crops (17-86.8 mt.ha^{-1}yr^{-1}) and rangeland systems (3.2–53.2 mt.ha^{-1}yr^{-1}) than in the coffee (19.6-44.9 mt.ha^{-1}yr^{-1}) and banana

Table 3: Mean annual soil losses by water erosion measured on runoff plots or predicted using the Universal Soil Loss Equation USLE in the Lake Victoria Crescent of Uganda

Soil Loss (mt.ha^{-1}y^{r-1})	Measured	Predicted (USLE)	
Annual crops	2.5 – 9.0		Brunner et al (2004)
Annual crops	17.0 – 86.8	74.4 – 93	Bagoora (1997); Lufafa et al. (2003); Majaliwa (2003); Mulebeke (2004)
Rangelands	3.2 – 53.2	52 – 91.5	Mulebeke (2004); Majaliwa J.G.M. (2004)
Coffee	19.6 – 44.9	38.0	Majaliwa (2003); Mulebeke (2003)
Banana	25.1 – 27.9	21.3 – 32	Lufafa et al. (2003); Mulebeke (2003); Majaliwa (2003)
Banana-Coffee Intercrop		26.6	Mulebeke (2003)

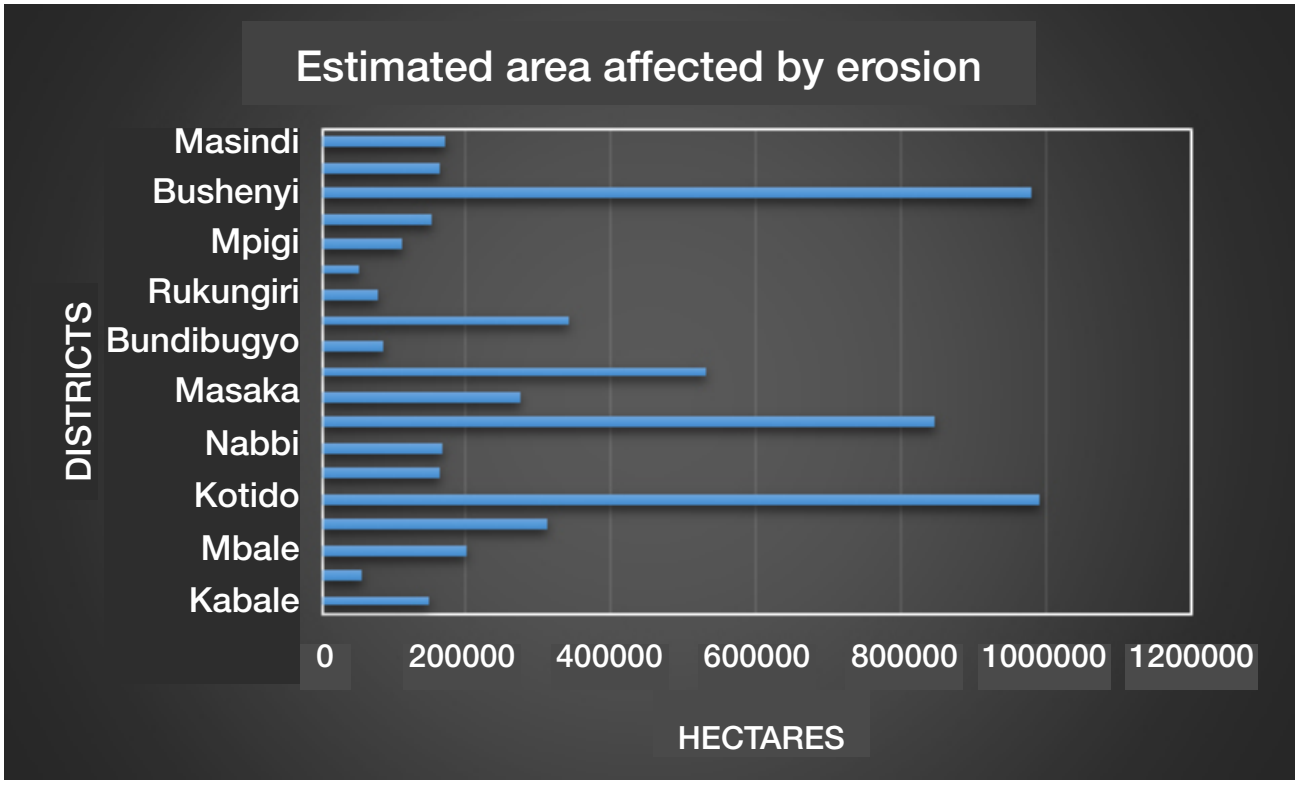


Figure 1: Areas affected by soil erosion (Source: NEMA, 2001)

(25.1-27.9 mt.ha^{-1}yr^{-1}) systems (Table 3). The frequent destabilisation of the soil structure coupled with limited soil and water conservation measures are the causes for the loss of soil in the annual crops, while livestock overstocking and overgrazing are the major drivers of soil loss in the sampled rangelands. Importantly, the magnitude of soil loss is dependent on the frequency, and intensity of amount rainfall received.

Land degradation has implications on Uganda's ability to attain sustainable agricultural growth and overall productivity of the country. Uganda is currently formulating her voluntary targets to achieve land degradation neutrality considering her commitment to the Ankara agreement of United Nations Convention to Combat Desertification (UNCCD) COP 12.

1.4 Context of the study

There has been a sharp decline in forests cover in the recent decades in Uganda. The highest annual rate of deforestation occurs on private and communal lands (3% annual loss) and the lowest in National Parks and Wildlife Reserves (0.4% annual loss). The forest estate outside Protected Areas reduced from 68% of the total forest land area in 1990 to 61% in 2005 and to 38% in 2015. Based on the 2010 Land use/Land cover map, the forest cover in Uganda is estimated at 9% of the total land cover. This already bad situation is worsened by the fact that land degradation which is associated with soil erosion is equally increasing. This trend has negative impacts on the ecological resilience of the different landscapes of Uganda and their ability to provide ecosystem services that support livelihoods of millions of Ugandans and neighbouring countries.

In order to mitigate this, Uganda has prioritized forest restoration as envisaged in existing targets provided in vision 2040, subsequent National Development Plans (I & II), and the National Forestry Plan (2011/12-2021/22). The primary target is to restore forest cover from the current 9% to a national target of 24%. Within this context, the country has a target to plant 200 million trees by the year 2020 (an output of the 2012 National Tree Planting Strategy), and Uganda's desire for a Green Economy.

Uganda translated these commitments by setting a target of restoring 2.5 million hectares through forest landscape restoration in response to the Bonn Challenge commitment. This was made in 2014 during the UN Secretary-General's Climate Summit which increased the global ambition for reducing forest loss and increasing restoration[1]. The Bonn Challenge is a practical, action-orientated platform to facilitate the implementation of several existing international commitments that require restoration, including the CBD Aichi Target 15, the UNFCCC REDD+ goal and the Rio+20 land degradation target. The challenge was established at a ministerial roundtable in September 2011 in Bonn, Germany, and it calls for the restoration of 150 million hectares of deforested and degraded lands by 2020 and 350 million hectares by 2030. Through this commitment, Uganda aims to restore degraded forest landscapes to improve ecosystem quality and resilience, provide new opportunities for rural livelihoods, while securing adequate water and energy supplies and supporting low carbon economic development.

In order to achieve the aforementioned commitment, there is need to identify sites in the different landscapes of the country where degraded land is located, determining the size of degraded land and the most optimal restoration options or interventions. It is therefore against this backdrop that the Government of Uganda, through the Ministry of Water and Environment in partnership with the International Union for Conservation of Nature (IUCN) with technical support of the World Resources Institute (WRI) and other government agencies conducted a study to comprehensively assess the potential for forest landscape restoration in Uganda.

It is envisaged that the outcome of the study will be useful for any interventions by government and other partners involved in forest landscape restoration.

1.5 Aim and Objectives

1.5.1 Aim of the study

Assess Uganda's forest landscape restoration potential.

1.5.2 Specific Objectives

a. Determine deforestation and land degradation trends in Uganda
b. Determine site specific forest landscape restoration options for various ecological landscapes of Uganda
c. Identifying priority areas for forest landscape restoration
d. Determine the profitability of selected landscape restoration options for Uganda
e. Determine existing and non-existent success factors for restoration interventions in Uganda
f. Determine strategies to address major policy and institutional bottlenecks that may affect forest landscape restoration interventions

1 Out of the summit came the expanded Bonn Challenge commitment of 350 million hectares by 2030, in the New York Declaration on Forests. Extract: The New York Declaration on Forests (Section 1) is a non-legally binding political declaration that grew out of dialogue among governments, companies and civil society, spurred by the Secretary General's Climate Summit. For the first time, world leaders endorse a global timeline to cut natural forest loss in half by 2020, and strive to end it by 2030. It also calls for restoring forests and croplands of an area larger than India. Meeting these goals would cut between 4.5 and 8.8 billion tons of carbon pollution every year about as much as the current emissions of the United States. The Declaration is endorsed by dozens of governments, [30] of the world's biggest companies, and [more than 50] influential civil society and indigenous organizations. http://www.bonnchallenge.org/content/uganda

2.0 Study Approach and Data Collection Methods

Restoration Opportunities Assessment Methodology approach

The Restoration Opportunities Assessment Methodology (ROAM) - an approach that was developed by IUCN and the World Resources Institute (WRI) to guide the processes of developing forest restoration interventions at landscape level was applied in the current study. It is a stepwise and iterative application of a series of analyses used to identify the best set of Forest landscape restoration (FLR) opportunities applicable to a specific site (IUCN & WRI 2014). This approach was piloted in Mexico, Ghana, Guatemala and most recently Rwanda (Ministry of Natural Resources – Rwanda 2014). The approach has been published in a hand book and importantly in a 'Road Test' edition implying that the Uganda assessment can feed into future versions of the handbook.

ROAM provides a flexible and affordable framework to rapidly identify and analyse forest landscape restoration (FLR) potential and locate specific areas of opportunity at a national or sub-national level. It provides vital support to move forward with developing restoration programmes and landscape-level strategies.

In Uganda, the initial step of the ROAM process was IUCN and other relevant non-state actors establishing contact with the Ministry of Water and Environment to dialogue on Forest Landscape Restoration. A series of meetings were convened with the Minister and his technical staff to lay ground for the political support of FLR. The ministry had an ongoing Greening the Economy campaign into which FLR could directly feed into to enable the country achieve her aspirations. A key output from the ministerial engagements was signing of a Memorandum of Understanding for the collaboration between the Government of Uganda and IUCN to formalize the partnership for the ROAM assessment.

In addition to the initial contact made with the Ministry of Water and Environment, IUCN established contact with senior staff in the Ministry including the Permanent Secretary and relevant Directors to enhance their knowledge on FLR and also seek their support for the process. IUCN subsequently convened a national multi-stakeholder meeting to introduce, enhance the knowledge and understanding of the Forest Landscape Restoration and ROAM assessment process across national stakeholders. The workshop was attended by multi-sectoral participants who included representatives of Civil Society Organizations, the Private sector, Government, Academia and Development partners. This workshop coincided with the launch of the Greening of the economy campaign by the Ministry of Water and Environment.

A core team of multi-disciplinary specialists representing various categories of participants was subsequently constituted through consensus at the workshop based on mandate and expertise. IUCN and FSSD led the process of identifying and formalizing the core team. The team's mandate and functions were derived from the ROAM Handbook "A guide to the Restoration Opportunities Assessment Methodology" which was applied to support the country's efforts to move forward with developing restoration programmes and strategies.

Specialists were identified with expertise in the fields of GIS and remote sensing, Forest restoration ecology, economics and statistics, Monitoring & Evaluation, Forest Governance and Policy Analysis.

The institutions represented by the core team members were; Makerere University, National Forestry Authority, Ministry of Agriculture, Animal Industry, Fisheries (MAIAF), Forest Sector Support Department (FSSD) and IUCN which played the role of a secretariat for the team (Annex 2). In order to empower the team to deliver on their mandate, a two-day capacity building workshop to create a general understanding of the ROAM process and its application was organized and held by IUCN. The key purpose of the workshop was conceptualization of FLR and ROAM process.

The workshop was facilitated by the IUCN-Global team that had operationalized the ROAM process in other countries such as Rwanda prior to Uganda. The training themes were as follows;

1. Introduction to FLR and the broader picture
2. Lessons learnt from the Rwanda assessment
3. Understanding the Bonn Challenge
4. Introduction to the InVest model and practical demonstration
5. Understanding the ROAM methodology and its application to the Uganda FLR process

The workshop resulted into the following key outputs; (1) a draft zonation map for Uganda (2) better understanding and appreciation of the ROAM and the rationale of using ROAM and not any other methodology to identify restoration opportunities for Uganda (3) an action plan clearly defining the roadmap and the specific roles and responsibilities for each of the core team members. The immediate task for the core team that was constituted was to conduct sub-national consultation workshops.

Seven sub-national consultation workshops were conducted in selected regions for restoration assessment.

The specific objectives of the consultations were to;

1. Create a common understanding of Forest Landscape Restoration (what it is, clarifying the misconceptions, providing key examples of where it has worked, and the broader picture – Bonn Challenge)
2. Identify communities' goals for forest landscape restoration (i.e. what do they hope to achieve through restoration)
3. Visual validation of maps on degraded land and Identifying priority areas for restoration
4. Create a short list of the most relevant and feasible restoration interventions across different types of degraded landscapes
5. Suggest restoration interventions by describing tree species that could be used
6. Identify the institutional, financial, and ecological barriers that currently prevent people from restoring degraded land

The workshops were multi-sectoral and involved the participation of District Local Government technical staff, cultural and opinion leaders, farmers' groups, political leaders, members of the media and the private sector. The overarching purpose of the workshops was to suggest and discuss well-defined goals that articulated the land to be restored; in what ways and for which purposes, identify barriers that could prevent achievement of these goals and make recommendation to reduce the barriers. Figure 2 illustrates schematically the process through which the ROAM process was followed.

The ROAM process aimed to attain the following:

- Identifying priority areas for restoration
- Identifying the most relevant and feasible restoration intervention types across the assessment area
- Quantifying costs and benefits of each intervention type
- Analysis of the finance and investment options for restoration in the assessment area
- Diagnosing 'restoration readiness' and strategies for addressing major policy and institutional bottlenecks.

Validation of the ROAM preliminary findings

Validation of the Uganda ROAM process and ROAM findings was through a multi-stakeholder process that was conducted during the Annual National Forest Consultative Forum of 2015.

This particular forum was aimed at raising awareness for sustainable management, conservation and sustainable development of all types of forests for the benefit of current and future generations as well as characterizing linkages between forestry and climate change. This was an opportunity for state actors, non-governmental organizations, and development partners in the forest sector to raise awareness for sustainable development of all types of forests for the benefit of current and future generations. Not only did the forum provide a platform for information sharing but was an avenue for launching of the forestry week that was tagged to the week proceeding to 21st March. The ROAM assessment core team presented its preliminary findings from the FLR assessment to stakeholders for validation.

The presentation gave an insight of the following issues in the process;

- The political partnership built by IUCN with the Ministry of Water and Environment
- The process of constituting the core assessment team
- The preliminary findings from the regional sub-national consultations; restoration opportunities
- Presentation of the draft degradation and deforestation maps

Stakeholders provided input especially on restoration opportunities that ought to be pursued.

They were provided with open ended checklists on restoration options and suitable sites for their application. This information was used to validate what had been collected from the sub-national workshops.

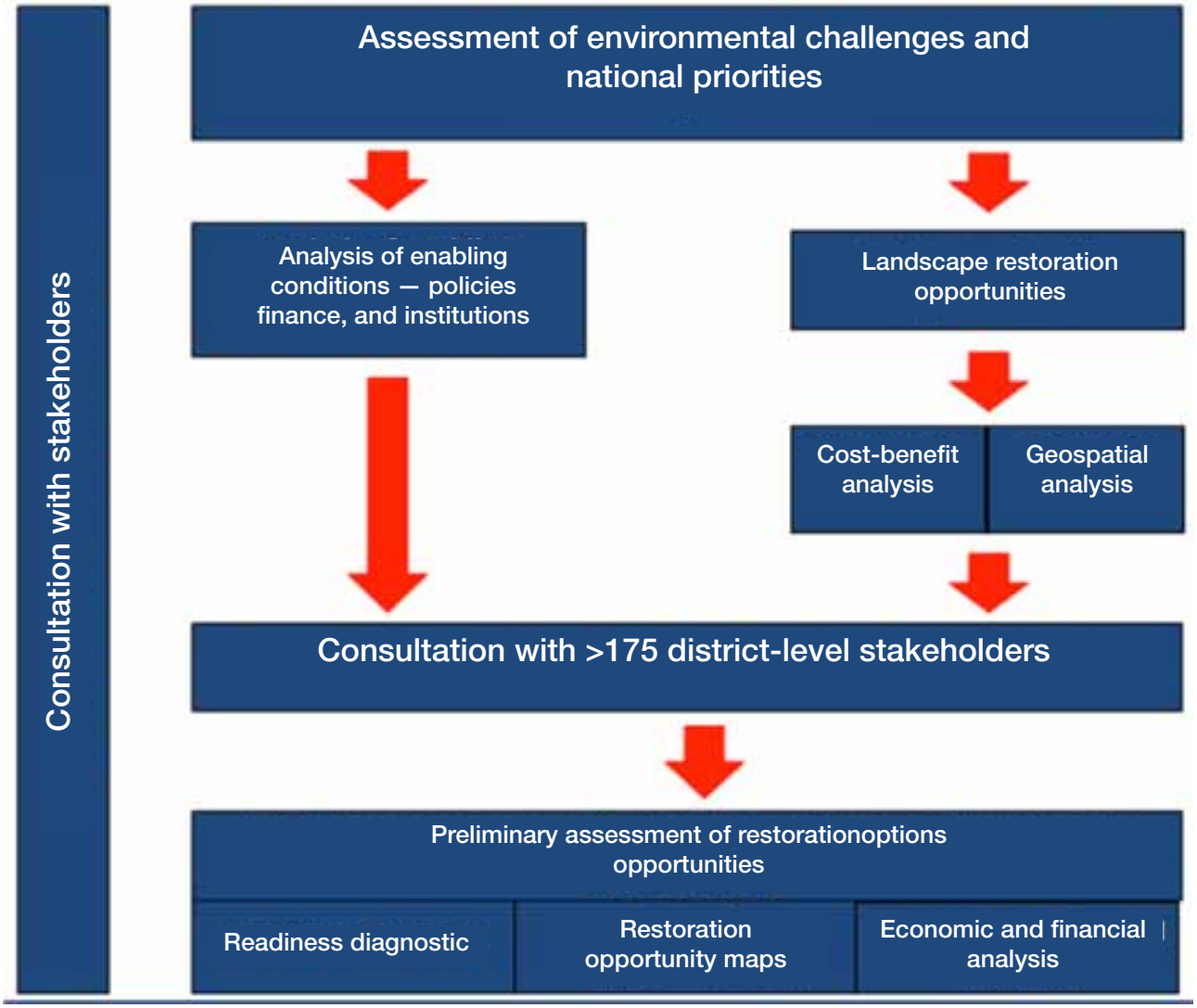


Figure 2: ROAM process for Uganda

2.1 Geospatial analysis

To quantify the areas of degraded land use that are opportunity areas for forest and landscape restoration, a geospatial analysis was performed incorporating more than a dozen national datasets including soil, slope, landcover, rainfall, water bodies, protected areas, and administrative boundaries were consolidated into GIS, where criteria associated with each type of potential restoration intervention were applied. Datasets including elevation, slope, land cover, forest cover, water bodies, parks and reserves, and administrative areas, were consolidated into a geographic information system (GIS), where criteria associated with each type of potential restoration intervention were applied. This criteria represented the means to identify the areas best suited for implementing the intervention and are presented in Appendix 1. The datasets representing the criteria were overlaid and combined with each other, and areas where they intersected were identified as opportunity areas. This process was replicated for each of the restoration interventions to create maps of opportunity areas. Areas were summarized at various administrative levels (e.g., province and district) to convey the level of opportunity within an applicable context.

2.1.1 Identification and classification of land degradation proxies

The ROAM team identified and classified land degradation proxies (indicators for land degradation) and the intervention priorities that could improve landscape quality (socio-ecological functions). These indicators were assessed and prioritised to determine the magnitude of land degradation in the country. The degraded landscapes and proposed interventions are presented in appendix 1

2.1.2 Stratification of Uganda into landscape type zones

A map showing seven classified landscapes was produced through a participatory process by a core team composed of seconded technical staff from ministries and government agencies (MWE, MAAIF, NFA), Makerere University, and IUCN in June 2014.

The purpose of the zoning was to stratify the country into relatively homogeneous landscapes in terms of restoration-relevant characteristics, for national forest restoration initiatives. The production of the stratification map involved overlays of the MAAIF Agro-ecological and administrative boundary GIS layers, with specific focus on three main attributes namely:

1. Climatic factors,
2. Altitude
3. Farming systems

The core team stratified the country into seven landscape zones. The zones included Western mid-altitude farmlands (150,151.5sqkm), Lake Victoria Crescent (115,947.6sqkm), Karamoja (105,941.0sqkm), South Kyoga floodplains (122,560.0sqkm), Afro-montane high altitude (113,342.0sqkm), North Moist farmlands (132,484.1sqkm), and South west rangelands (126,593.6sqkm). The overall characteristics of each zone are summarized in the Table 4.

Within each classification, there are bound to be similarities or minimal differences in possible challenges and options to promote forest landscape restoration and other related initiatives.

This classification was validated and subsequently recommended for adoption by the technical workshop on development of REDD+ National Baseline Scenario (reference emission level and/or forest reference level-FREL/FRLs) and National Forest Monitoring System. This was to ensure that future REDD+ initiatives can also find the classification in this report relevant and applicable. The outcome of this analysis was a map of Uganda stratified into the zones as indicated in Figure 3.

The purpose of classification was majorly to generate a manageable number of relatively homogeneous landscape types in terms of restoration-relevant characteristics to enable restoration interventions.

Table 4 Characteristics of landscape zones for ROAM assessment

	Zone	Main characteristics
1	Afro-montane landscapes	Bimodal high rainfall (>1,200 mm/year); banana, coffee, Irish potato, and vegetables farming systems
2	Karamoja	Unimodal low rainfall (400–700 mm/year); with majorly pastoral livestock system
3	Lake Victoria Crescent	Bimodal high rainfall >1,200 mm/year; banana-coffee farming system
4	North Moist Landscape	Unimodal low to high rainfall (1000-1200mm/yr) and majorly grow cereal & tuber crops, cotton and legumes
5	South East L. Kyoga Flood Plain	Bimodal high rainfall >1,200 mm/year; Finger millet, banana, maize farming system
6	Southwest Rangeland	Bimodal low to medium rainfall (900–1,200 mm/year); banana, cereal and livestock farming system
7	Western Mid-Altitude Landscape	Bimodal average rainfall of 1,270 mm with high variability, Western Banana-coffee system, maize, beans, Irish potato, sorghum and vegetables

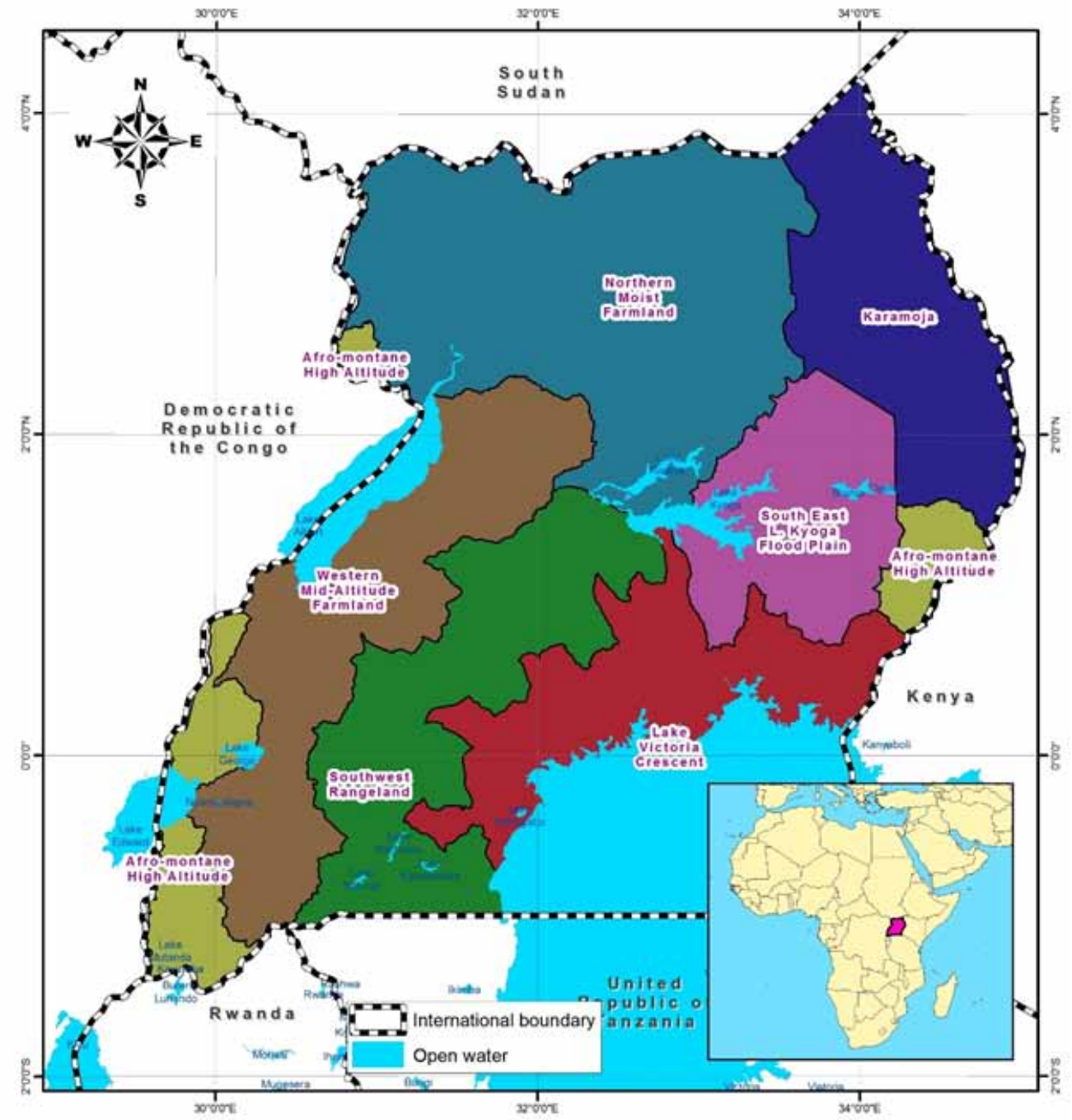


Figure 3: Zones for the ROAM process

2.2 Data collection and pre-processing of land degradation

The prioritized land degradation proxy geo-spatial layers and non-spatial datasets were collected from the mandated Government institutions, Agencies and International organizations e.g. National Forestry Authority (NFA), Uganda Bureau of Statistics (UBOS), Uganda Wildlife Authority (UWA), National Agricultural Research Organisation (NARO), Ministry of Water and Environment (MWE), Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) and National Aeronautics and Space Administration (NASA).

2.2.1 Spatial datasets

The degraded landscape categories in Uganda include forests (central and local forest reserves, community forests, private and riverine forests), mountain slopes, bare hills, river banks and watersheds, wetlands, agricultural lands, rangelands and woodlands. The extent and severity of land degradation at the national level were examined using spatial datasets. The study utilized several spatial datasets and information needs, ranging from socio-economic to bio-physical acquired from the mandated institutions in Uganda and online data sources. The collected datasets, methods of data capture and mandated institutions are presented in the Table 5.

Table 5: Sources of collected spatial datasets

No	Data sets	Methods of data capture	Data sources/institutions	Year
1	Population	Household questionnaire	Uganda Bureau of Statistics (UBOS)	2014
2	Soil	Soil sampling	National Agricultural Research Institute (NARO)	2015
3	Land use and cover	Image segmentation	National Forestry Authority (NFA)	2010
4	Wetland	Heads-up digitizing	Ministry of Water and Environment (MWE)	2009
5	Livestock	Household questionnaire and institutional farms questionnaire	Ministry of Agriculture, Animal Industry and Fisheries (MAAIF)	2008
6	Rainfall	Satellite imagery and in-situ station data	Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS)	2016
7	Hydrography	Watershed delineation	Shuttle Radar Topographic Mission (SRTM) Digital Elevation Model (30m)	2015
8	Slope	Surface analysis	Shuttle Radar Topographic Mission (SRTM) Digital Elevation Model (30m)	2015
9	Vegetation health	Normalized Difference Vegetation Index	SPOT-VEG	2011
10	Protected areas	De-gazattement	National Forestry Authority (NFA)	2009

2.2.2 Socio-economic data set

A series of multi stakeholder consultations were conducted taking into consideration of a vast range of actors in the private sector, academia, agriculture, legislators and several government institutions. Selection of participants was based on knowledge and experience on the trends of land degradation and degradation hotspot in their areas of jurisdiction. Six sub-national consultations were organized and convened in the regions of; the Lake Victoria crescent, Western Mid Altitude, Southwest rangelands, South East Lake Kyoga flood plains, Karamoja and the Northern moist farm land which represented the central, southwestern, eastern, northeastern and the northern parts of the country respectively.

The consultations took place in Kampala for the Lake Victoria Crescent, Moroto for Karamoja, Fort portal for the Western mid-altitude farmlands, Gulu for Northern Moist farmlands, and Mbarara for South west rangelands. The choice of selection for the areas of consultation was dependent on accessibility and regional impact. The consultations were directed towards the identification and categorization of degraded lands, specific districts and feasible restoration interventions.

In addition, secondary data sources such as reports and maps were collected and used to extract information on demographic characteristics and categorization of degraded lands in the country.

2.2.3 Quality Control

The collected spatial datasets were checked and corrected for consistency prior to identification of degraded lands. The quality measures and checks that were undertaken included spatial data extent assessment, projection, attribute data and polygon completeness. The online data sources were collated with data from the mandated Government Agencies.

2.2.4 Processing

The spatial datasets were pre-processed and processed to extract information on land degradation. The datasets were pre-processed through transformation geographical coordinate systems to WGS 1984 zone 36N for degraded sites computations and display. The vectors were also topologically cleaned for connectivity errors. The vector layers were spatially converted into rasters for easy simulation. The parameters and intermediate outputs are shown in figure 4. The population dataset comprised of human and livestock population counts. The human and livestock counts were the total of people and livestock counted in each district.

The aridity of the landscape dictated the intensity of livestock rearing. While, the country's human population density is 174 persons per square kilometre. The soil organic matter, saturation and texture were included in the workflow because of their significant roles on the productivity of land to support plant growth. The slope length and steepness greatly determine the erodibility of the top soil particles to the valleys. The slope shape influences soil erosion and runoff rates that are largely dependent on the amount and intensity of rainfall received. The drainage network was included because the rivers currently face bank erosion which is attributed to poor agricultural practices, unstable bank materials, and high rainfall runoff events resulting into the narrowing and widening of the river channels and sedimentation. The conversion of natural land cover other land use activities plays an important role in determining the erodibility of the soil and thus affects soil fertility due to deforestation and wetland reclamation to create cultivable and settlement land. The derived intermediate parameters were combined to form a potential land degradation map. Figure 4 show the Land degradation workflow that was followed.

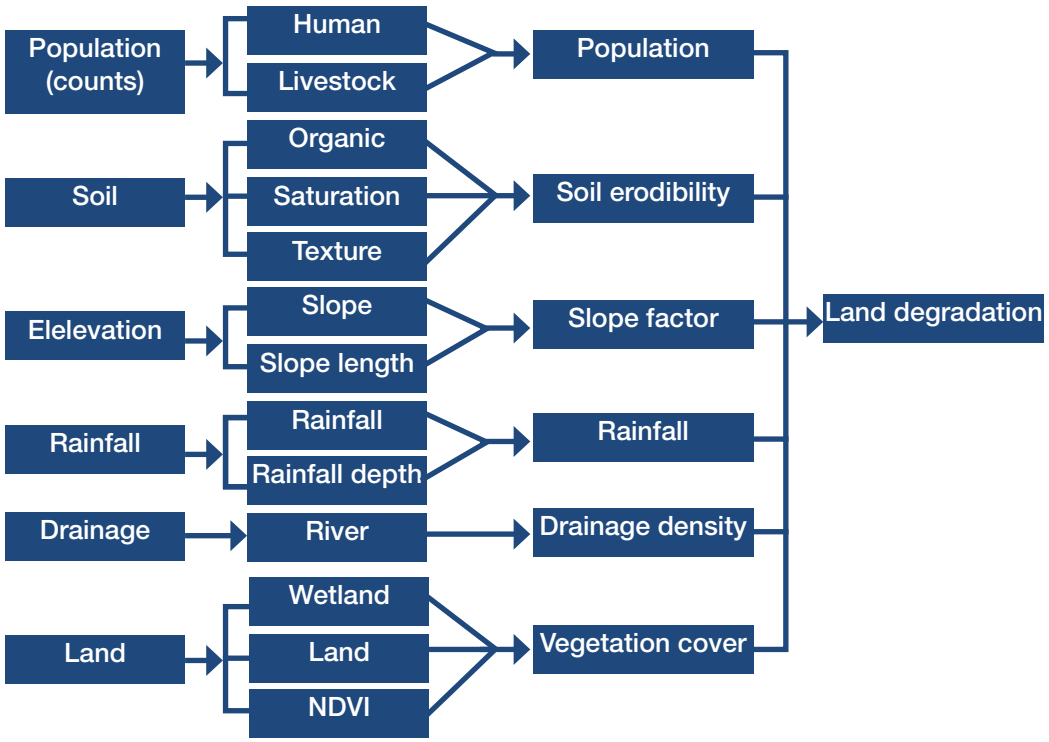


Figure 4: Opportunity areas for new agroforestry areas on steeply sloping lands (3-30 degrees/5-55% incline).

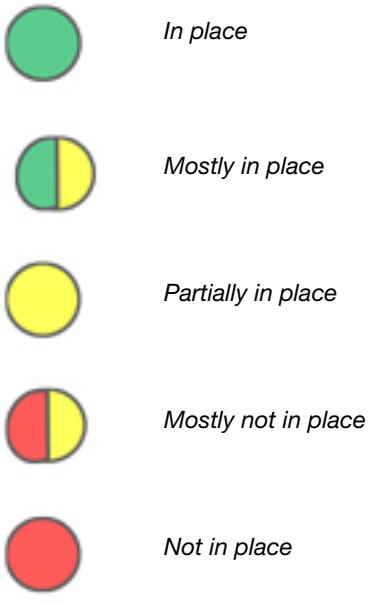
2.2.5 Validation

The preliminary land degradation map was validated through the identification of degraded land sites and categories from series of multi-stakeholder consultations across the country.

2.2.6 Identifying of priority areas for forest landscape restoration

The sub-national and National consultations generated criteria for selecting priority areas for restoration in each zone which included; extent of deforestation in the last 15 years, steepness of the site, human population pressure and ecological value.

Box 1: Key for Traffic Light Scale



2.2.7 Validation of Priority Areas for Restoration

The selected sites were presented at a workshop involving the technical team that was preparing the reference level for deforestation, and forest degradation for Uganda's REDD+ strategy. Their comments were integrated in the development of maps showing priority areas in each of the zones.

2.3 Determining restoration options and policy environment

Relevant government and other stakeholders currently involved in restoration activities in Uganda were consulted in six regional workshops held across the country. The workshops were held in Kabarole (Fort Portal), Moroto, Mbarara, Soroti, Gulu and Mukono. This was to identify suitable restoration options, tree

Table 6: Distribution of categories of participants in sub-national workshops

District	No. of District officials from Civil society	Key stakeholders and Lead Agencies organizations
Gulu	111	4
Mukono	82	7
Moroto	42	14
Soroti	57	5
Kabarole	64	5
Mbarara	60	11

species, information on costs and benefits from each option and key success factors for forest landscape restoration, strategies for addressing major policy and institutional bottlenecks that affect forest landscape restoration intervention in Uganda. Approximately 416 district local government officials and 46 other key stakeholders from civil society organisations were consulted (Table 6).

Civil society organizations that participated at the workshops were selected based on expertise, physical presence in the regions selected and their involvement in forest restoration initiatives.

2.3.1 Determining existing and missing success factors for restoration interventions

The rapid restoration diagnostic tool developed by WRI and IUCN was applied in regional workshops and key informant interviews to identify which success factors currently exist and which are missing (or partially missing) within landscapes being considered for restoration. This was primarily done to determine whether there was a motivation for restoration, an enabling environment, and capacity and resources to facilitate restoration. The factors that were missing were perceived as bottlenecks. The tool uses 5 point 'traffic lights' graphic to allow rapid appreciation of the status of the particular variable under consideration (Box 1).

Stakeholders were consulted to produce preliminary results of the assessment of key success factors for forest landscape restoration in Uganda and these were validated in a National workshop.

2.3.2 Economic Analysis of Restoration options

The core team in consultation with relevant agencies and stakeholders carried out the following activities in order to have reliable data to carryout investment analysis of the selected restoration options:

a) Compiled secondary data and literature to identify current degraded land management practices (i.e. rotation/coppice intervals, species types, cropping decisions, pastoral stocking densities) for degraded forests, agricultural, and pastoral land.
b) Defined management practices of restoration technologies, including, rotation/coppice intervals, species types, cropping decisions, pastoral stocking densities.
c) Constructed detailed annual land management budgets of inputs (i.e. labor and material inputs) for degraded forests, agricultural, and pastoral land use systems and each restoration technology.
d) Collected agricultural, forestry, and pastoral survey data to estimate outputs (i.e. crop yields, timber yields, livestock yields) from degraded forests, agricultural, and pastoral land use systems and restoration technologies.
e) Identified sources of data to value market (e.g. crop and timber yields) and ecosystem (e.g. carbon and avoided erosion) goods and services.
f) Mapped the economic costs and benefits of degraded land uses and restoration technologies using GIS data layers to estimate crop yields, timber yields, livestock yields based on ecological characteristics of each grid-cell (e.g. land use, slope, soil type, ecological zone and precipitation)

2.3.3 Analysis of Profitability of selected landscape restoration optionsrestoration interventions

Cost-Benefit Analysis

Cost-benefit analysis (CBA) is a tool for evaluating the desirability of a specific restoration activity or comparing the desirability of several alternative activities. Restoration projects create costs through the inputs and activities that are needed to make them successful. If the benefits of the project are larger than the costs, then the project can be said to be desirable. However, if the costs are greater than the benefits, then the financial resources could have achieved a larger impact by being spent on alternative activities. CBA takes an inherently anthropogenic perspective to evaluating costs and benefits by valuing them based on their human impacts. This does not mean that nature's value in a CBA is zero if restoration does not directly impact humans because people can benefit from nature even without using it and these benefits can be valued with non-market valuation methods.

One difficulty of evaluating restoration activities is that the costs and benefits are received at different points in time. Often the costs of restoration activities are paid upfront while the benefits are received in the future. Values from two different points in time cannot be compared on equal terms because people discount events that happen in the future. The CBA method addresses this challenge by aggregating the flow of costs and benefits over time and discounting them to their present values with some rate of interest.

The difference between the discounted sums of benefits and costs is known as the Net Present Value (NPV) and it is the standard decision metric used in CBA. Other decision metrics, like the cost-benefit-ratio, return-on-investment, and internal-rate-of-return can also be used to evaluate the efficiency of such projects.

Another useful decision metric is the Benefit-Cost Ratio (BCR). The BCR measures the value of benefits that would be expected from a restoration activity for each UGX of cost and projects with higher BCRs are recommended over projects with relatively smaller BCRs.

For example, a BCR of 2 would suggest that for every UGX 1,000 of cost paid for a restoration activity UGX 2,000 worth of benefits would be expected over the time horizon of the activity. Enterprise budgets were created for each restoration options based on the information provided by stakeholders during the regional workshops. During the workshops stakeholders reported the annual fixed and variable costs associated with each activity.

2.3.4 Strategies for addressing major policy and institutional bottlenecks

The assessment team conducted desk research to get more insights on strategies for addressing major policy and institutional bottlenecks based on literature on forest governance in Uganda. This was enriched by the views generated through regional workshops and the national validation workshop. The views were further triangulated with key informant interviews of staff in the Ministry of Water and Environment and other non-state actors in the environment and natural resource sub-sector.

2.3.5 Analysis for qualitative data

Content and narrative analyses were the major tools used in analyzing data from workshops and key informant interviews. Net present value and benefit-cost ratios were generated to compare restoration options agreed up on by participants of all the stakeholder engagements across the seven landscapes. Restoration activities with positive NPVs are recommended since the discounted flow of benefits outweighs the discounted flow of costs, while activities with negative NPVs are not recommended because the discounted flow of costs outweighs the discounted flow of benefits.

Both the NPV and BCR are sensitive to the discount rate that is used in the cost-benefit analysis so a sensitivity analysis was carried to determine how the results change when the discount rate changes. The historical minimum and highest interest rate of Bank of Uganda (2000-2015) were used as discount rates in the analysis.

3.0 FINDINGS

3.1 Deforestation and land degradation trends in Uganda

Uganda has experienced significant forest loss to deforestation and forest degradation since 1990. The rates of deforestation have generally increased from an annual average of about 114,648 hectares per annum for the period 1990-2000 to a record high of about 204,679 hectares annually in the period 2005 to 2010 (Figure 5).

It is important to note that the rate of deforestation in protected areas under Uganda Wildlife Authority and National Forestry Authority is significantly lower than that on privately owned natural forests (Figure 6).

More so, UWA has the most stable forest cover compared to that under NFA's mandate and this is majorly due to two reasons; 1, UWA applies the highest level of natural resource protection and the resource there is managed under strict conservation. On the other hand, forests under NFA are managed at a lower level of protection and are accessible for controlled extractive harvesting or sustainable forest management. The map in Figure 7 shows how forests around Bugoma central forest reserve have declined from 1990-2015.

Most of the deforestation took place in western and Northern region of the country as indicated in Figure 8 below.

However, forest degradation is more widely spread and varied than forest degradation. In most cases Forest degradation is a precursor to deforestation. This implies that the all degraded forest whether protected or not are at risk of being deforested.

3.2 Deforestation trends in the selected landscapes

The northern moist, southwest rangeland and western mid altitude were the most deforested and degraded landscape zones between 2005 and 2015 (Figure 9) both in terms of coverage and magnitude. These were followed by South East Lake Kyoga flood plain, Afro-montane and Karamoja respectively (Table 7). Forest deforestation and degradation are mainly as a result of high population pressure that results into uncontrolled conversion of forests into other landuses, uncontrolled bush burning, poor agricultural practices, illegal saw-logging activities, unregulated charcoal burning, poor land tenure system, weak enforcement of forestry laws

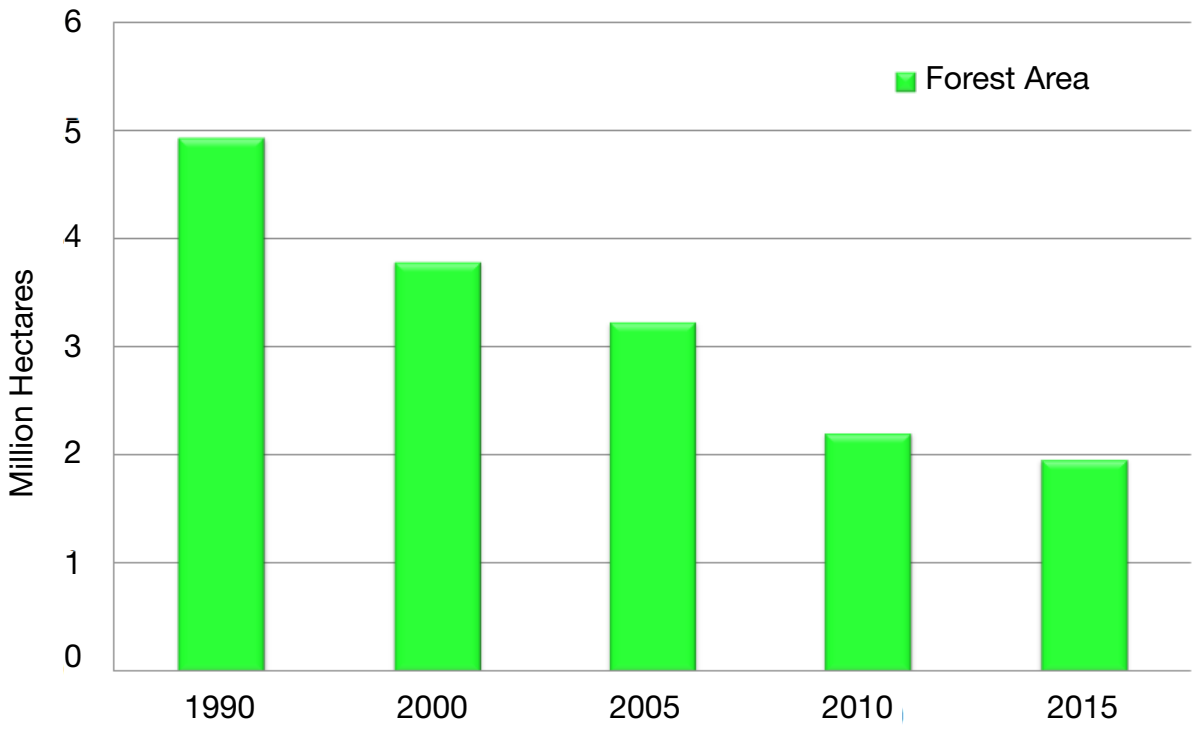


Figure 5: Forest change in Uganda 1990-2015

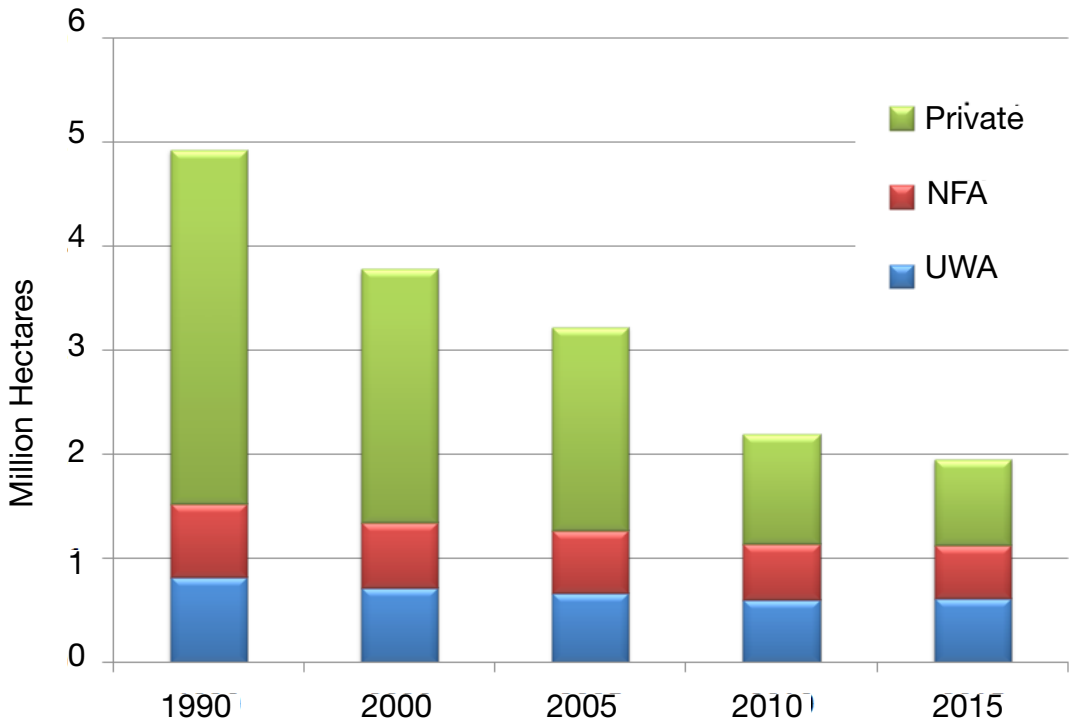


Figure 6: Forest cover change by management regime

and inadequate funding of the forestry sector. The type of vegetation and encroachment of forest reserves across the landscape zones were the major determinants of the extent of deforestation and degradation. Deforestation has led to loss of biological diversity and long-term maintenance of local ecosystem services such as watershed and soil protection (Naughton-Treves et al. 2007).

1. Agroforestry
   a) Fruit trees grown with annual crops
   b) Other trees grown with annual crops
   c) Contour bunds
   d) Fodder banks
   e) Boundary planting
2. Afforestation
   a) Pure stand establishment
   b) Mixed stand establishment (Multi-layered stands of different species)
3. Reforestation
   a) Enrichment planting
   b) Establishment of new stands that are either pure or mixed
4. Natural regeneration of degraded sites
5. Riparian vegetation restoration/ riverine buffer zoning

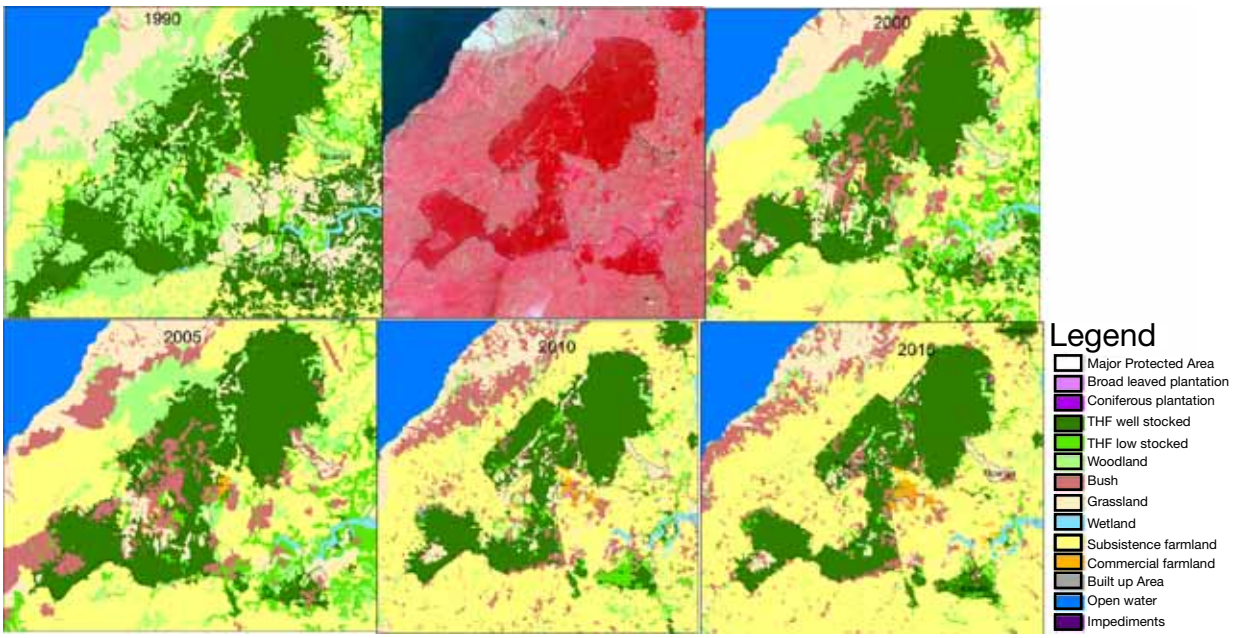


Figure 7: Deforestation trend around Bugoma Central Forest Reserve (1990 - 2015)

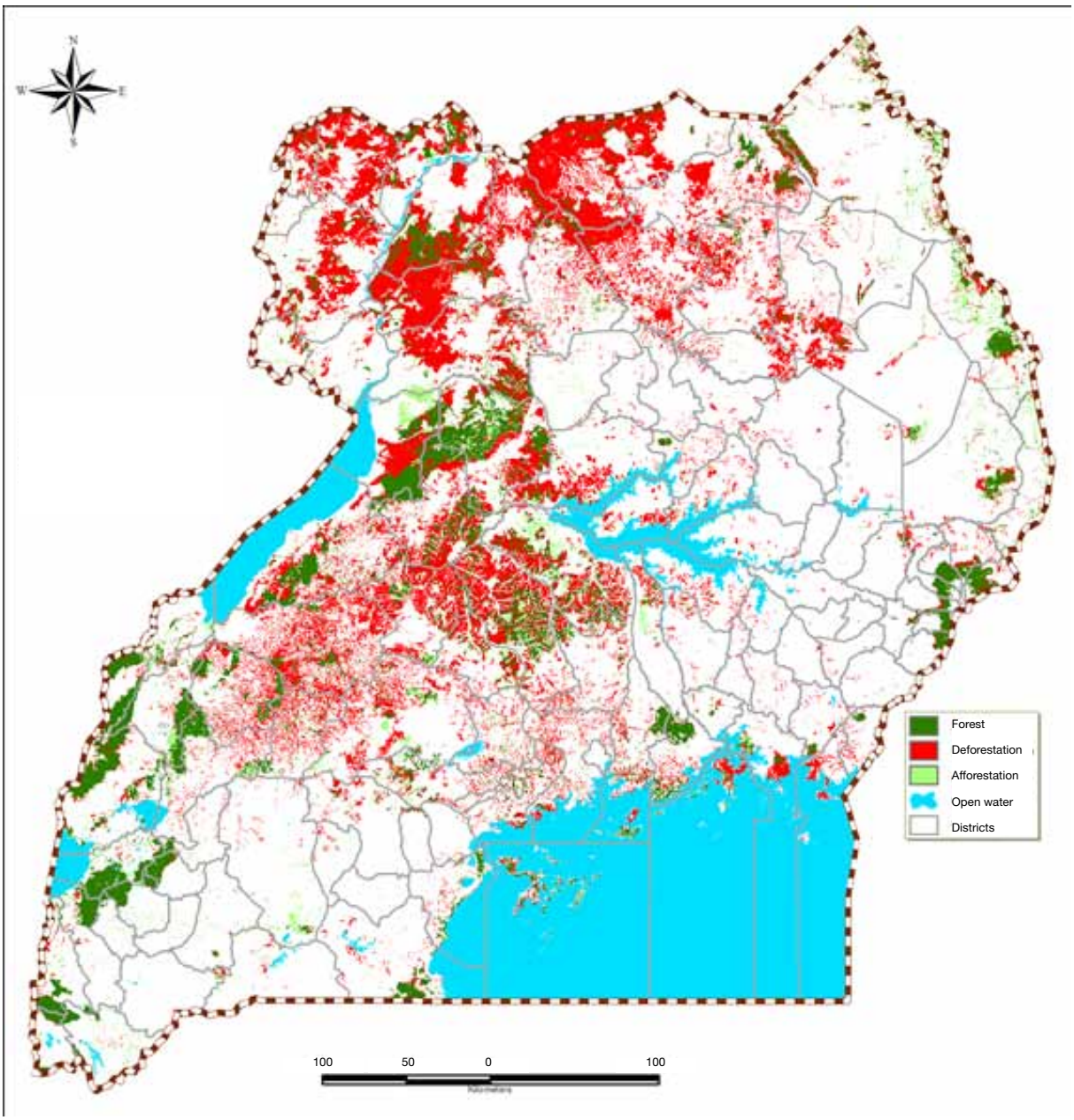


Figure 8: Deforestation in Uganda for the period 1990 - 2000

The severity and extent of land degradation varied across the identified zones in the country. Figure 7 shows that the South west rangeland (26%) and Western mid-altitude farmland (21%) are the most severely degraded zones followed by South east Kyoga flood plains (16%), Lake Victoria Crescent (15%), Afro-montane high altitude (12%), North Moist farmlands (8%) and lastly Karamoja region with 0.8%. Table 8 shows the level and scale of land degradation in the seven zones.

3.3 Land degradation trends in the selected landscape

The scale of land degradation varies across various landscape type zones in Uganda. Seventeen percent of the total land area is severely degraded, 30% is highly degraded, and 31% is moderately degraded, while the area that can be characterized as low to no degradation is 5.8% and 15% respectively (Table 9). The Northern moist and Karamoja landscape zones are the most severely degraded landscapes followed by south west rangelands, and western mid altitude that are moderately degraded. Whilst, Lake Victoria Crescent, Afro-montane and South East Kyoga floodplain are the least degraded areas (Figure 9 and 10).

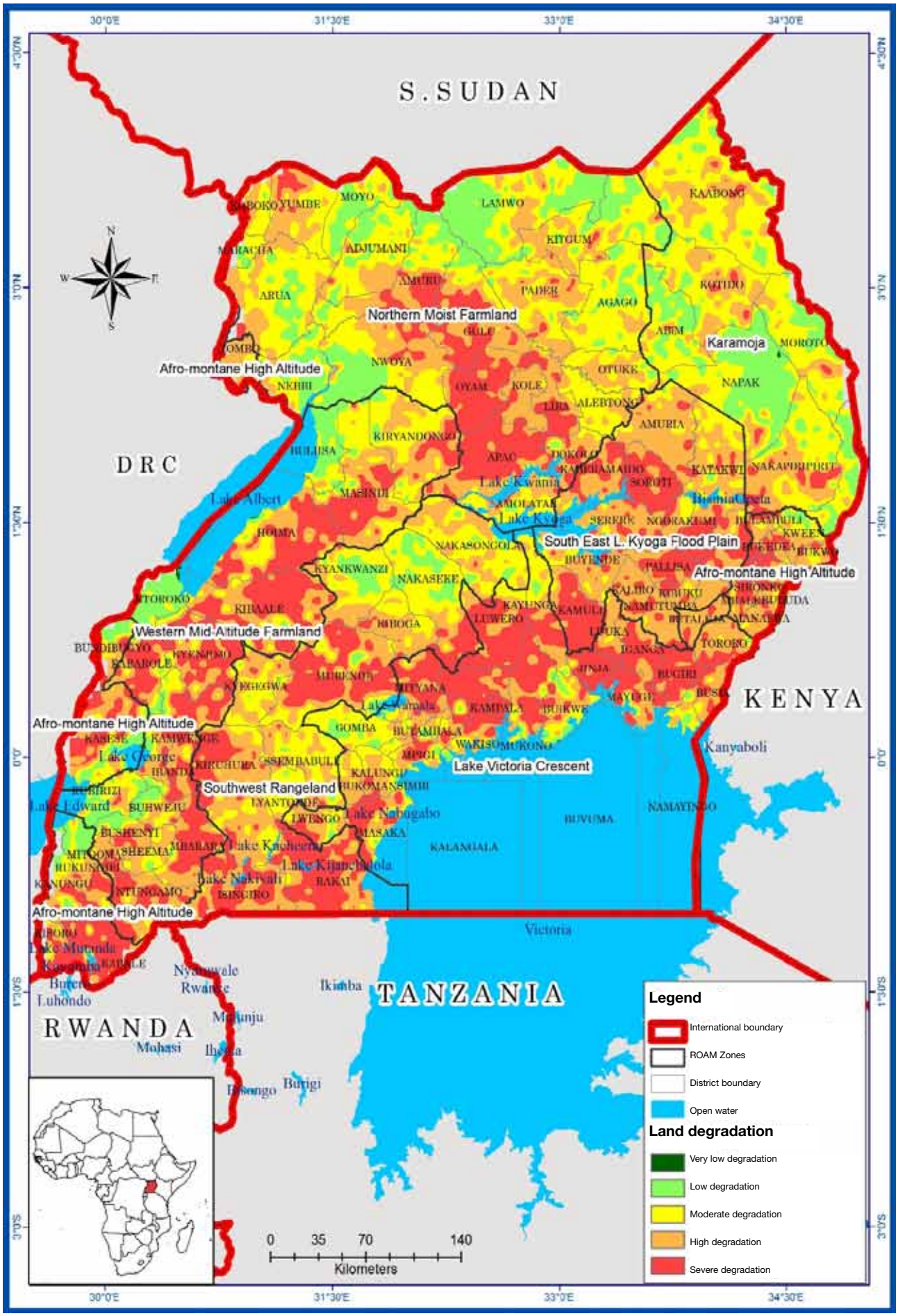


Figure 9: Land degradation levels in each selected zone

Table 7: Forest deforestation and degradation at landscape level between 2005 and 2015

	Landscape zonation (Ha)	Deforested land (Ha)	Degraded land
1	Afro-montane	133,613	8,997
2	Lake Victoria crescent	706,376	205,640
3	Northern moist	4,553,045	932
4	South East Lake Kyoga flood plain	193,094	9,002
5	Southwest rangeland	1,506,253	347,428
6	Western mid-altitude	1,890,117	554,055
7	Karamoja	684,161	0

The extent and severity of land degradation is primarily due to human interactions with the functions of ecosystems for a long period with inadequate support to help them recover. Land degradation in these regions is manifested through exposure of land surface, erosion scalds, gullies, decline in soil fertility and spread of invasive plants which potentially can affect the composition and distribution of plants and animal species. Studies (e.g. Maitima et al. 2009; Lamprey & Mitchelmore, 1996) have shown that wildlife especially mammals have declined in some of the landscapes due to land degradation which contributes to low net primary productivity.

3.4 Priority areas for Forest landscape restoration

Priority areas for restoration based on predetermined criteria were identified as shown in Figure 11.

A total of twenty-two priority areas (Figure 12 and Table 10) that are referred to as “hot spots” in this report were identified in the different zones following three criteria i.e. deforestation and degradation levels, population density and socio-ecological value of the landscapes. The sites that had experienced high rates

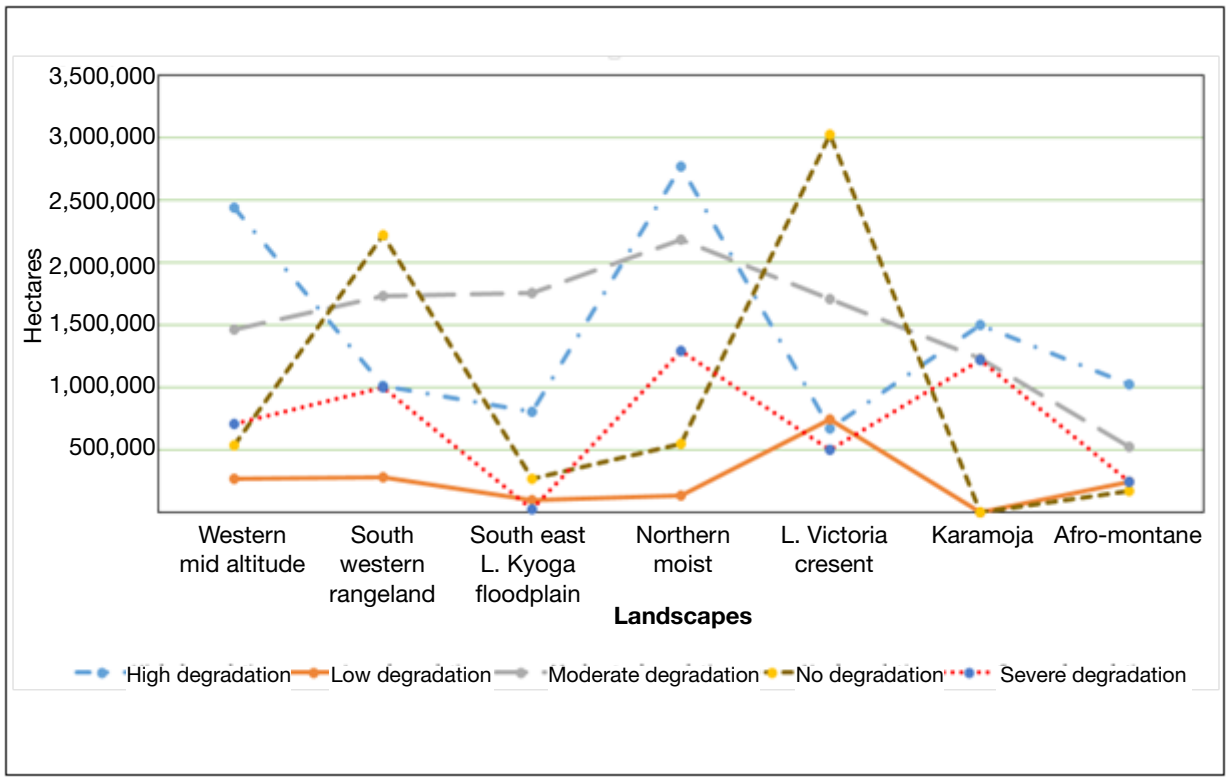


Figure 10: Land degradation per landscape zone

Table 8 Level and scale of land degradation

	Land degradation									
	Severe		High		Moderate		Low		Very low	
ROAM zones	**Sq.km**	**%**	**Sq.km**	**%**	**Sq.km**	**%**	**Sq.km**	**%**	**Sq.km**	**%**
Northern moist farmland	8,136.3	8.2	64,754.7	15.6	45,160.9	16.7	14,432.2	26.8	0.0	0.0
South east L. Kyoga floodplain	16,464.3	16.7	57,554.0	13.8	45,053.2	16.7	3,488.6	6.5	0.0	0.0
Western mid-altitude farmland	21,073.1	21.4	58,215.1	14.0	61,041.6	22.6	8,898.8	16.5	922.8	3.3
South west rangeland	26,266.8	26.6	58,190.1	14.0	22,331.9	8.3	6,311.4	11.7	13,493.4	48.2
Afro montane high altitude	11,329.2	11.5	58,449.3	14.0	38,907.2	14.4	4,628.5	8.6	27.9	0.1
Lake Victoria crescent	14,582.3	14.8	58,162.6	14.0	22,156.3	8.2	7,527.7	14.0	13,518.7	48.3
Karamoja	824.5	0.8	60,821.3	14.6	35,769.0	13.2	8,514.2	15.8	12.1	0.0

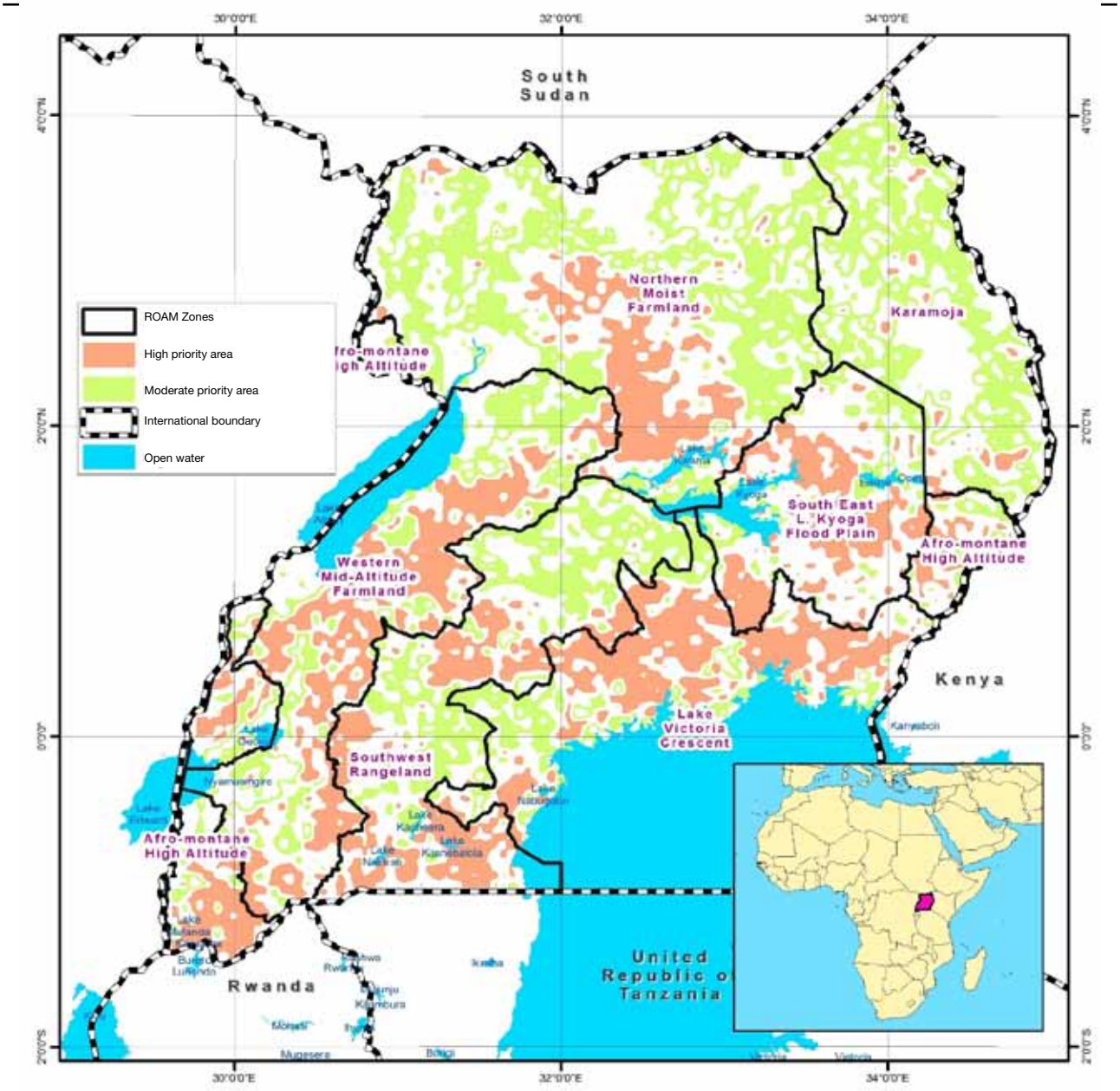


Figure 11: Location of priority areas for Forest landscape restoration

of deforestation and degradation in the last 15 years, had landscapes with important ecological values such as water catchment, river basins etc. with a low population density to enable restoration due to its inherent high demand for land were selected in each region as hot spots.

All the hot spots identified are located in protected areas because of the readily available data that can be validated for protected areas, compared to forests on private land.

3.5 Available area for forest landscape restoration

Table 9: Extent of land degradation in Uganda

Degradation levels	Hectares	%
Severely degraded	4,324,864	17.9
Highly degraded	7,296,298	30.3
Moderately degraded	7,397,499	31.2
Low degradation	1,406,406	5.8
No degradation	3,691,750	15.3
Total	24,116,816	100

Northern moist, Karamoja and southwest rangeland landscape zones offer the highest acreage for restoration followed by Lake Victoria crescent, south east Lake Kyoga floodplain and western mid-altitude. The Afro-montane landscape offers the least acreage for restoration (Table 11 and Figure 11). The major underlying factors for restoration potential include population size, land tenure system, land and civil conflicts, urbanization, conservation programmes among others.

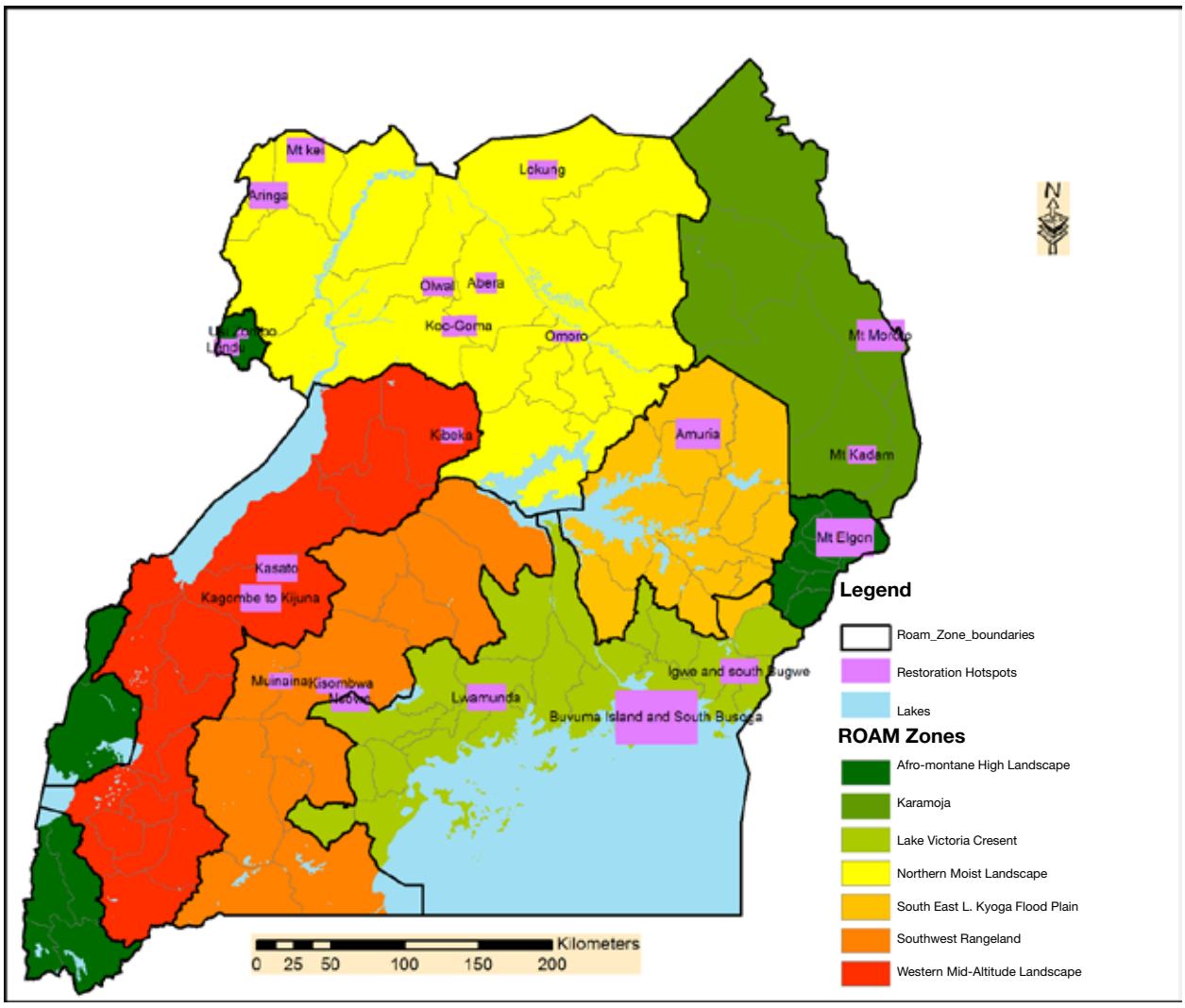


Figure 12: Restoration hot spots in the different zones

3.6 FLR options for various landscapes

During the workshops, stakeholders generated a short list of the most relevant and feasible restoration options across different types of degraded land categories. They proposed restoration activities by describing tree species that could be used and which management practices would be implemented to improve existing land uses. The suitability of the species proposed in the workshops for each landscape was triangulated and confirmed by the National Forest Authority, Forest Sector Support Department and available literature.

Afforestation (for sites that have not been under forest for the last ten years), reforestation, agroforestry and natural regeneration (passive restoration) were found to be the most preferred and feasible restoration interventions across the landscapes.

It was emphasized that the sites being proposed should have previously been under forest cover but had been degraded. Although, the restoration options were relatively similar across landscapes, the options were further classified into sub-options.

Riparian vegetation restoration/ and natural regeneration were unique to a few landscapes unlike agroforestry, afforestation and reforestation that were cross-cutting.

Natural regeneration was considered suitable for restoration in the Karamoja landscape and western mid altitude whereas Riparian vegetation restoration/ riverine buffer zoning was highly recommended by the stakeholders in the Lake Victoria crescent. Natural regeneration could be through allowing seeds in the soil to germinate or maintaining re-sprouts after a landscape has experienced some form of disturbance. Natural

Table 10: List of Hot spots and their location

No.	Name of Hot Spot	Central Forest Reserve	Zone
1	Mt Kadam	Kadam	Karamoja
2	Mt Moroto	Moroto	Karamoja
3	Buvuma Island and South Busoga	Bukaibale, Kakonwa, Olamusa, SBusoga	Lake Victoria crescent
4	Igwe and south Bugwe	Ige, W.Bugwe, Sitambogo, Luvunya	Lake Victoria crescent
5	Lwamunda	Lwamunda, Watanyi, Katablalu	Lake Victoria crescent
6	Nsowe	Nsowe	Lake Victoria crescent
7	Lendu	Lendu	Afro-montane high landscape
8	Mt Elgon	Mt Elgon	Afro-montane high landscape
9	Kisombwa	Kisombwa	South-west rangeland
10	Muinaina	Muinaina, Rwensambya	South-west rangeland
11	Kagombe to Kijuna	Kanaga, Ruzaire, Nyabiku, Kijuna	Western mid- altitude landscape
12	Kasato	Kasato, Kyamurangi, Rwengeye	Western mid- altitude landscape
13	Kibeka	Kibeka	Western mid- altitude landscape
14	Amuria	Ochomai	South-East lake Kyoga flood plain
15	Abera	Abera, Lagute, Amuka	Northern moist landscape
16	Aringa	Ozubu, Liru,Lodonga, Kulua	Northern moist landscape
17	Koc-Goma	Koc Goma	Northern moist landscape
18	Lokung	Lokung, Lalak	Northern moist landscape
19	Mt kei	Mt Kei	Northern moist landscape
20	Olwal	Olwal, Got-Gweno, Keyo	Northern moist landscape
21	Omoro	Olia, Ayami	Northern moist landscape
22	Usi Zombo	Usi	Northern moist landscape

regeneration can also be augmented through control of fires and grazing. It is recommended in sites that have not experienced extreme degradation (Holl & Aide, 2011). To minimize the risk of only having prolific species that easily recover after disturbance, enrichment planting or seeding of less common, often later successional, species after a canopy has established can facilitate maximization of diversity and to attain the original species composition (Cole et al. 2011).

Clipping of plants around established tree seedlings may be a useful management tool to improve growth and survival of naturally regenerating species (Vieira & Scariot, 2006).

Indigenous tree species were widely preferred for restoration and this was attributed to their high ecological value while the exotic trees; *Pinus caribaea* and *Eucalyptus grandis* were considered for their higher commercial value. *Albizia* spp, *Maesoposis eminii, Markhamia lutea* and *Cordia* spp were the most highly regarded indigenous species for restoration. The restoration options, the most suitable intervention and the species for each landscape as proposed by participants are provided in Annex 1.

Table 11: Potential acreage for restoration in each landscape

No	Landscape zonation	Acreage of restoration (Ha)
1	Afro-montane	691,161.1
2	Karamoja	1,775,156.2
3	Lake Victoria crescent	394,491.0
4	Northern moist	2,631,314.7
5	South East Lake Kyoga flood plain	393,639.5
6	Southwest rangeland	1,154,340.1
7	Western mid-altitude	103,9519.5

3.7 Site specific restoration options

The area available in each landscape for any of the three restorations options (Agroforestry, woodlots and natural regeneration) is shown in Table 12 and appropriate sites for each option in Figure 13.

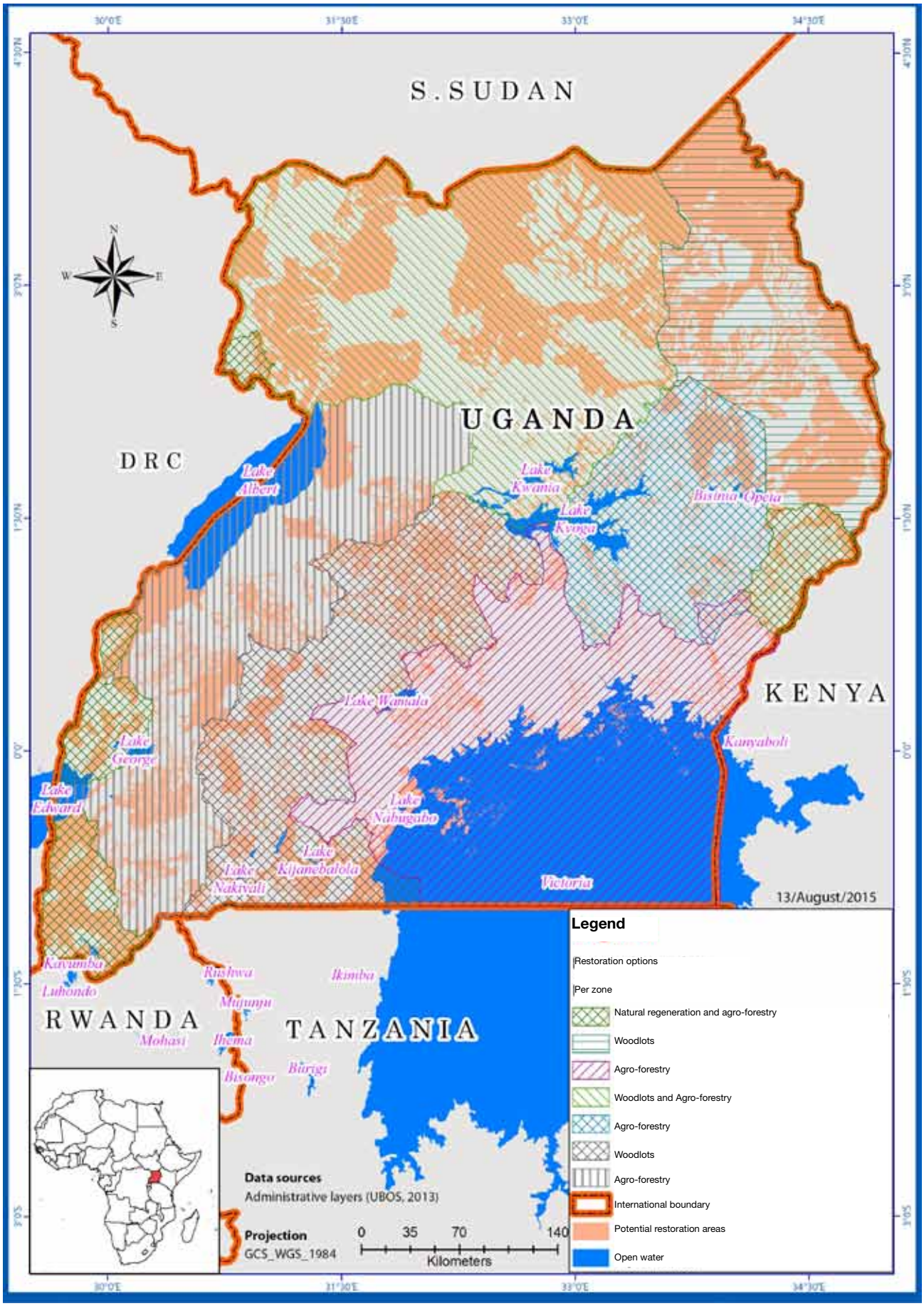


Figure 13: Recommended restoration options for each site in all landscapes

Table 12 Available area for the selected restoration options in each landscape

No	Landscape zonation	Acreage of restoration (Ha)	Options
1	Afro-montane	691,161.1	Natural regeneration and agro-forestry
2	Karamoja	1,775,156.2	Woodlots
3	Lake Victoria crescent	394,491.0	Agroforestry
4	Northern moist	2,631,314.7	Woodlots and agroforestry
5	South East Lake Kyoga flood plain	393,639.5	Agroforestry
6	Southwest rangeland	1,154,340.1	Woodlots
7	Western mid-altitude	103,9519.5	Agroforestry

3.8 Profitability of selected landscape restoration options

Enterprise Budgets

The data presented in the enterprise budgets are based on stakeholders' consensus over values and can therefore be considered as approximate averages. Table 13 displays the enterprise budgets for agroforestry, woodlots, and natural regeneration. Table 14 shows the cost and revenue structure for agroforestry, woodlots, and natural regeneration restoration options. Agriculture in Uganda is a low-input activity where there is almost no mechanization and relies on very few inputs because most farmers cannot afford the investment necessary to intensify production. Labour is the largest cost across all activities and enters the budget through the following activities: Site preparation; planting; patrolling/protection; weeding; thinning; pruning; and harvesting.

The material costs of each activity include seedlings and small farm equipment such as hand hoes. The largest cost of agroforestry and woodlots is harvesting timber, which costs UGX 3M per hectare for agroforestry and UGX 6M per hectare for woodlots. Natural regeneration has the lowest establishment costs since the trees naturally regenerate without any seeding by humans, however the costs of protecting the land from encroachers and fire is estimated to cost approximately UGX 2.1M per hectare, annually.

The costs of protection/patrolling were calculated based on information from Namatale Central Forest Reserve, where efforts are in place to protect it and enhance restoration of the reserve through natural regeneration. The 662-hectare reserve is employing six guards to protect the forest from both fires and encroachers at a total cost of UGX 5.76M. When the total cost is divided by the number of hectares the total cost of protecting each hectare is found to be UGX 8,700 Ha^{-1} $Year^{-1}$. To be conservative the estimate was rounded off up to UGX 10,000 Ha^{-1} $Year^{-1}$.

Table 13 Enterprise Budget for Agroforestry, Woodlots, and Natural Regeneration

	Agroforestry Value (UGX/Ha)	Woodlots Value (UGX /Ha)	Natural regeneration Value (UGXha)
Variable costs			
Pruning	20,000	50,000	-
Seedlings	50,000	555,500	-
Planting	10,000	222,200	-
Thinning	-	300,000	-
Timber harvest	3,000,000	6,000,000	-
Fixed costs			
Site preparation	300,000	300,000	-
Weeding	60,000	360,000	-
Protection/Patrolling	10,000	10,000	10,000
Revenue			
Crop yields	1,250,000	-	
Timber	35,000,000	10,500,000	
Firewood	200,000	400,000	100,000
Firewood from second thinning	-	400,000	
Firewood from third thinning	-	10,800,000	
Above ground biomass carbon	840,000	1,680,000	1,680,000
Belowground biomass carbon	1,400,000	1,400,000	1,400,000
Watershed protection (quantity and quality)	346,000	346,000	346,000

The total benefits (in nominal terms) from each restoration activity ranges between UGX 86M per hectare for agroforestry to UGX 34M per hectare for woodlots to UGX 2.6M per hectare for natural regeneration. Agroforestry systems generate benefits from several sources, including crop yields, timber, firewood, carbon, and watershed protection. Crop benefits are received each year, while firewood and watershed protection benefits are only received after the 5th year. The benefits from carbon and timber are received at the end of the time horizon at year 30. Carbon benefits are envisaged to be offered by existing buyers using voluntary carbon markets.

Woodlots generate similar types of benefits to agroforestry with the exception being that woodlots produce no crop benefits. The fuelwood benefits of woodlots begin to flow in the 5th year of the enterprise when the first thinning operation takes place.

Additional thinning operations occur between years 6-9 and years 9-12, respectively. Benefits from carbon and timber are received from woodlots at the end of the time horizon at year 30.

Natural regeneration has a more limited benefit structure in this analysis because many of the benefits that are included in the analysis are provisioning rather than regulating and cultural ecosystem services. After the 5th year of natural regeneration it is assumed that approximately UGX 100,000 per hectare of fuelwood is collected from each site and that the increased vegetation yields UGX 346,000 per hectare in watershed protection services.

This was determined based on the FAO study on the contribution of forests on Mt. Kenya as watersheds (Watkins & Imbumi, 2007). At the end of the thirty-year time horizon it is assumed that carbon sequestration benefits from natural regeneration will be worth UGX 1.68M per hectare for carbon stored in above-ground biomass and UGX 1.4M per hectare for carbon stored in below-ground biomass, respectively. Other ecosystem services such as pollination, soil erosion control, nutrient cycling and bee foraging are not included in the analysis because of the difficulty in determining their values and market, however it's acknowledged that they can potentially be marketable. The results of the CBA are shown in Table 14.

Table 14 shows that the NPV and BCR are positive for agroforestry under both discount rates. Under a 10% discount rate agroforestry creates approximately UGX 17.3M in present value benefits and UGX 1.3M in present value costs. The NPV of this scenario is UGX 16M. The BCR ratio of this scenario is 13.60, which means for every UGX 1,000 invested in agroforestry UGX 13,600 of benefits would be received over the thirty-year time horizon of the activity. Under a 16% discount rate the NPV of agroforestry declines and equals UGX 8.1M.

Part of the reason the decline in NPV is so large is that many of the benefits of agroforestry are received in the future and a 16% rate of discount reduces the value of events that occur many years ahead.

Still, the BCR in this scenario is still a favorable 8.95, which means for every UGX 1,000 invested in agroforestry UGX 8,950 of benefits would be received over the thirty-year time horizon of the activity.

The NPV and BCR are positive for woodlots under the 10% and 16% discount rates. Under a 10% discount rate the NPV of woodlots is UGX 2,615,513. The BCR ratio of this scenario is 1.49, which means for every UGX 1,000 invested in woodlots UGX 1,490 of benefits would be received over the thirty-year time horizon of the activity. Under a 16% discount rate the NPV of woodlots equals UGX 934,669. Part of the reason for this decline in NPV is that the timber benefits of fuelwood lots are not received until the thirtieth year of the activity and a 16% discount rate only gives a weight of 0.01 to events that occur in that year. In other words, at a 16% rate of discount events that occur in year thirty are valued at 1% of the value that the same event would produce in year one. The BCR in this scenario is 1.26, which means for every UGX 1,000 invested in agroforestry UGX 1,260 of benefits would be received over the thirty-year time horizon of the activity.

The NPV and BCR are positive for natural regeneration under both discount rates. Under a 10% discount rate the NPV of natural regeneration is UGX 2,872,885. The BCR ratio of this scenario is 31.48, which means for every UGX 1,000 invested in natural regeneration UGX 31,480 of benefits would be received over the thirty-year time horizon of the activity. Under a 16% discount rate the NPV of natural regeneration equals UGX 1,481,147. The BCR in this scenario is also 24.98 and the interpretation is the same as BCR under a 10% discount rate.

Table 14: Results from Cost Benefit Analysis of Restoration Activities in Uganda

	Agroforestry		**Woodlots**		**Natural regeneration**	
Discount Rate	10%	16%	10%	16%	10%	16%
	Value (UGX/Ha)	Value (UGX/Ha)	Value (UGX/Ha)	Value (UGX/Ha)	Value (UGX)	Value (UGX)
Present Value of Costs	1,274,893	908,642	5,377,609	3,567,785	94,269	61,772
Present Value of Benefits	17,334,162	8,135,547	7,993,122	4,502,454	2,967,154	1,542,919
NPV	16,059,269	7,226,905	2,615,513	934,669	2,872,885	1,481,147
Benefit Cost Ratio	13.60	8.95	1.49	1.26	31.48	24.98

Interpretation

The results of the CBA analysis show that the option of agroforestry evaluated here has a high likelihood of creating benefits that far outweigh the costs. Additionally, the benefit sources from agroforestry are well diversified in the sense that they would benefit landowners and society alike.

Even if the benefits from carbon sequestration, fuelwood, and timber were ignored, the crop benefits alone would still create benefits in excess of the costs. Woodlots are more sensitive to the assumptions of the CBA model.

Under a 10% discount rate woodlots would produce benefits in excess of the costs, however the benefit cost ratio of 1.48 is quite low and small changes in the assumptions of the enterprise budget could easily move the benefit cost ratio below 1 even at a 10% rate of discount.

At a 16% rate of discount, the high upfront costs of woodlots justify waiting for benefits that occur so far into the future, but just barely. The CBA is even very favourable to natural regeneration mostly because the costs of protecting the sites from encroachers are relatively low compared to the benefits natural regeneration creates.

Moreover, natural regeneration is the most efficient option analyzed since each unit Uganda shilling (UGX) invested returns substantially more benefits than either agroforestry or woodlots. This is not to say that these options should be overlooked in favour of natural regeneration because an efficient landscape requires a suite of land uses that work together to create the goods and services people demand. However, it could be considered for areas that are under protection such as national parks and forest reserves. The results of this analysis should be taken as evidence that the restoration activities being considered in support of Uganda's pledge to the Bonn Challenge have the potential to create real impacts for nature and people that justify the expense of restoring degraded land.

Agroforestry and natural regeneration restoration options have a potential to have more landscape mosaics and heterogeneity than woodlots. Heterogenous landscapes are more socio-ecologically resilient and with high species richness (Atauri & de Lucio, 2001; Fuhlendorf, & Engle, 2001). This is because they provide more niches and different ways of exploiting environmental resources hence increasing species diversity (Tews et al. 2004). Cognizant of the fact that FLR is about addressing human needs while enhancing the ecological value of landscapes, Agroforestry and natural regeneration ought to be given priority. This however will require harnessing of existing markets for ecosystem services to make these restoration options attractive to land owners. Markets with relatively low transactions costs especially in voluntary markets ought to be prioritized

3.9 Success factors that currently exist and those missing for restoration interventions

3.9.1 Motivation

There is fair level of awareness on FLR approach and the associated benefits among bureaucrats but very limited in the local communities. The statutory laws and cultural practices are supportive however enforcement is still weak due to various bottlenecks (Table 15). The low level of awareness of FLR is linked to poor forest extension service in the country.

The District Forest Officers are expected to carry out forest extension services but most local governments' budgets do not prioritize forestry. The vacuum has been partially filled by civil society organisations involved in conservation interventions. However, these have limitations such as being project based and therefore limited sustainability, limited coordination with other actors and narrow coverage.

3.9.2 Enabling conditions

The ecological conditions are generally very good and suitable for restoration interventions. However, there is need to have more information on site species matching for various landscapes. The policy environment is supportive, although implementation has been a challenge for most responsible agencies due to various structural and fiscal bottlenecks (Table 16).

3.9.3 Implementation capacity and resources

The support for forest restoration is reflected in the policy, plans and legal frameworks of Uganda. However, commitment of resources has been very low and the little funding available is mainly provided by Development partners and it is scattered hence it is not feasible to have a significant outcome (Table 17). Local communities are ill-equipped in terms of knowledge and skills of forest restoration yet they are critical actors in restoration interventions.

3.9.4 Institutional framework for FLR in Uganda

Over all, institutions relevant to FLR in the country are appropriate. FLR provides an opportunity for different sectors to engage and promote the approach and these sectors include: agriculture, water and environment (including forestry subsector), land, education, academia and research. These sectors have implementing institutions that have been formed and they are functional. Figure 14 shows an illustration of the institutions, their mandates and how they may link with each other to support FLR.

3.9.5 Strategies for addressing major policy and institutional bottlenecks that affect forest landscape restoration interventions

There is need for a paradigm shift in the current forestry extension approach. Forestry extension agents need to be readily available at least up to sub-county level to ensure that community members have access to knowledge and skills in implementing forest restoration in their landscapes. Forest extension services ought to be provided as a subsidy to communities because most of them cannot afford to pay for the actual cost of a trained forestry extension agent. The extension agents should also be involved in raising awareness on the value of FLR in the communities that they are serving.

Adoption of policies and laws that promote establishment of more value addition forest-based industries is necessary. This can be through economic instruments that encourage investors to establish industries that increase the benefits that can accrue from restoration interventions.

Ensure that the economic value of forests and trees is enhanced and acknowledged as natural capital. This can be through providing market-based incentives such as paying communities involved in forest restoration for the ecosystem services e.g. carbon sequestration, soil fertility enhancement and water availability, aesthetic and scientific values, biodiversity and species protection that their restored forests provide. This will motivate land owners to allow natural regeneration of forests on their land.

Table 15: Diagnostic analysis of motivation for FLR

Feature	*Preliminary Result*	*Preliminary Rationale*	*Ability to Improve*
Awareness: To what extent are stakeholders aware about FLR	 *Partially in place*	Although there is a fairly wide understanding of the need and actual restoration, there is limited knowledge on what it entails to undertake restoration using a landscape approach, to balance ecological and livelihood aspects. At the political and policy level, there is commitment and it is recognized that quite a number of FLR related activities are on-going although it is not often recognised as such	High: Despite the gains in understanding and growing support for forest restoration, there is great opportunity to enhance awareness of FLR due to the various ongoing processes
Multiple Benefits: To what extent is there a specific understanding of the multiple benefits of FLR?	 *Partially in place*	There is a growing and broad understanding of FLR in Uganda, with some understanding of its multiple benefits. However, there seems to be a disconnect between the FLR interventions and the direct benefits at different levels.	High: There is a high potential for a much greater understanding of the multiple and integrated benefits of FLR including ecological, social, cultural and economic dimensions
Crisis events: To what extent is ecosystem based linkages to crisis and disaster and the role of Ecosystem-based Disaster Risk Reduction (Eco DRR) that can be addressed by FLR understood?	 *Partially in place*	At the higher level, there is a clear understanding of the role of FLR and ECO-DRR to crisis and disasters. However, this understanding is limited at the local level where the actual crisis and disasters occur, hence the need to integrate FLR and Eco-DRR interventions.	Medium: The opportunity is there because there are many actors interested and recently government has prioritized the use of EBA, ECO-DRR and FLR approaches to address crisis and disasters. However, there is need for sustained engagement of the communities that are prone to these disasters to appreciate the long term, landscape and integrated approaches and coordination of efforts by various actors.
Legal requirements of FLR	 *Mostly in place*	Uganda has a robust legal framework that enables and support FLR. The critical laws in place are the National Forestry and Tree Planting Act, 2003 and related regulations, National Environment Act, 1995, Uganda Wildlife Act, 1995, the Land Act , 1998 and Local Government Act, 1997	Medium: Although the legal frameworks are in place, there are still challenges with enforcement due to weak governance across scales
Culture (dimensions of FLR)	 *Mostly in place*	There is a wide range of cultural aspects that attach a lot of value to forestry and related restoration activities. It is observed in Uganda that women play a significant role/participate in restoration activities to a greater degree than men. However, this participation is limited by the lack of ability to make decisions due to some cultural norms which don't allow women to own land and sometimes trees.	High: There are various active cultural institutions that can be partnered with to promote FLR. Some communities have traditional norms and values that promote forest and tree conservation

Integrate FLR and Eco-DRR interventions at the local level to encourage communities to participate. This will require joint planning and implementation by the relevant agencies or government departments.

The capacity of responsible bodies involved in the enforcement of the laws and regulations governing forests needs to be enhanced for them to execute their mandate. The agencies should ensure that they adhere to professional ethos in order to promote sustainable management of forests and trees.

Table 16: Diagnostic analysis of enabling conditions

Feature	*Preliminary Result*	*Preliminary Rationale*	*Ability to Improve*
Ecological Conditions	 *Mostly in place*	Ecological conditions across the all landscapes suit restoration activities because of the suitable edaphic and climatic factors. The main elements could be selecting of the restoration interventions including aspects of species site matching and land use dynamics.	High: With the right technical support and coordination, there is high potential to restore most of the degraded landscapes in the country, because of the favorable ecological conditions (arable soils, relatively high and stable rainfall and suitable altitude) for tree planting in most parts of Uganda
Market Conditions	 *Mostly in place*	There is generally high demand for forest products both internally and externally. Market trends studies by Government and partners show that by 2025, the supply of timber will not be sufficient to sustain the booming construction industry, which is mainly fed by restoration activities. Increasingly carbon buyers are buying carbon credits from Uganda and there is potential to widen the market through REDD+ initiatives	High: There is high potential to tap into the increasing demand for the various forest products and services
Policy Conditions	 *Mostly in place*	Uganda has adequate policy framework relevant to FLR. Vision 2040 framework observes the need to address the increasing rate of landscape degradation and recommends restoration back to the 1990 target of 24% of Uganda's land as forested area. This is supported in other frameworks like the NDP II and policies like the National Land policy (2013), National land use policy (2007), Forestry policy (2001), Agricultural policy (2011), Draft Rangeland management and pastoralism policy (2014).	Medium: Whereas the policies and planning frameworks are in place, implementation has been weak due to capacity and resource constraints.
Social Conditions	 *Partially in place*	Most of the restoration activities require well defined land tenure and land use planning. Whereas the Land use policy is in place, the scale of land use planning for the entire country in the different landscapes is very low. This coupled with unclear land and tree tenure especially under customary land tenure compromises efforts to restore degraded lands in a coordinated and sustained manner.	High: the ongoing efforts to enhance security of tenure and community forestry present an opportunity to address the challenges. Government's model of providing licensing land in reserves to individuals to plant trees is also an opportunity to harness
Institutional Conditions	 *Mostly in place*	The institutional conditions are very conducive, with clear structures and linkages at the national, subnational and local levels. There are also ongoing interventions to strengthen the regional / trans-boundary management of key landscapes.	Medium: Despite the existence of the institutional structures, there is limited capacity, resources and lack of effective coordination which are all key in promoting forest landscape restoration.

Enhance staffing levels of key institutions through a deliberate recruitment drive and filling up of vacant positions where they exist will be necessary. This should be coupled with retooling staff with new knowledge and acquiring of equipment to facilitate their work.

Existing policies and laws need to be reviewed to provide security of forest and tree tenure for women living on customary land to enhance their participation in forest restoration. Similarly, the forest and tree rights of bonafide and lawful occupants on mailo land need to be clarified in regulations and fully enforced to ensure participation of more local communities in forest restoration.

Table 17 Implementation capacity and resources

Feature	*Preliminary Result*	*Preliminary Rationale*	*Ability to Improve*
Leadership	 *Partially in place*	The assessment indicates that although the country has appropriate policy and institutional framework, strategic leadership for forestry at lower levels has remained a challenge hence limited commitment of resources to facilitate restoration interventions	**Medium**: There is need to increase the level of advocacy to enhance financing of restoration interventions
Knowledge	 *Partially in place*	Despite the increased awareness about the value of restoration as seen from the engagement and activities being undertaken at various levels, there is still need to build capacity of the communities who engage in actual restoration activities in order to promote appropriate FLR technologies. The science of restoration is concentrated merely among the technical staff within the institutions that lead and coordinate implementation of restoration interventions in the country and yet this knowledge has not been effectively conveyed to the communities that are involved in the actual restoration.	**High:** There are many actors engaged in forest landscape restoration in the country, hence presenting an opportunity for mobilizing the communities and creating a platform for practical implementation of appropriate FLR options
Finance & Incentives	 *Partially in place*	Although there are various stakeholders that are providing finance and incentives for restoration activities in the country, these have remained low, scattered and un-coordinated.	**Medium:** Most of the models for incentivizing and financing restoration interventions are donor-driven. There is need for mobilization of financial resources internally for better coordination, sustainability and ownership.
Feedback mechanism	 *Partially in place*	Although there are many players in the sector, the platforms for information sharing are limited and there is no clear mechanism for feedback and follow up.	**High:** There a number of on-going processes to strengthen communication and participation of stakeholders in forest management which FLR can take advantage of, e.g. REDD+ and FLEGT

Provide a legal requirement for relevant government agencies to effectively coordinate their planning and implementation of their activities in order to benefit from existing synergies. This should be supported with a framework for regular monitoring of the level and quality of coordination by a responsible body that has statutory authority to enforce it.

Integrate the value of forests as natural capital into national accounting and reporting processes to demonstrate the economic value of forests so to advocate for commitment of more resources to forest restoration programs and determine Uganda's path to sustainable growth.

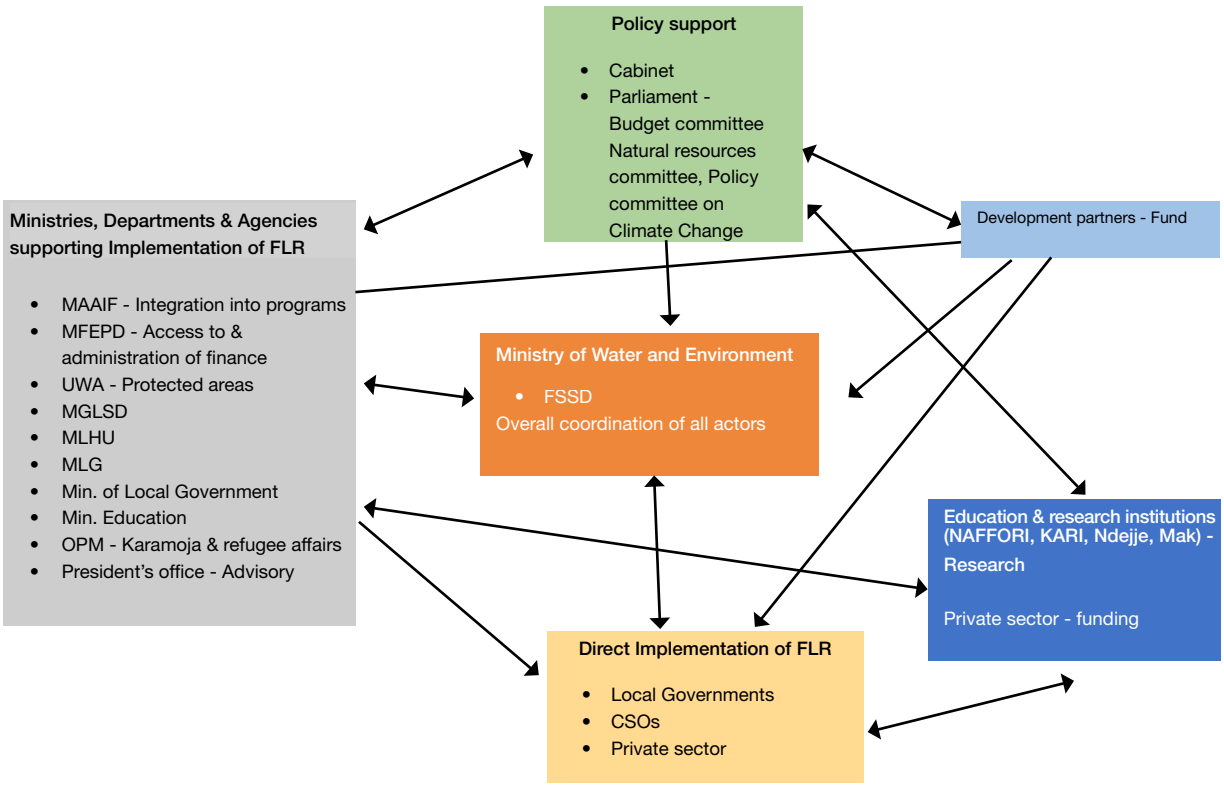


Figure 14: An illustration of the institutions, their mandates and how they link with each other to support FLR

4.0 Conclusions and recommendations

4.1 Conclusions

Deforestation and forest degradation have occurred mostly in northern moist, southwest rangeland and western mid altitude landscapes in the last 10 years. This is mainly due to anthropogenic factors, weak law enforcement and poor funding to the forestry sector. The Northern moist and Karamoja landscapes are the most severely degraded followed by south west rangelands, and western mid altitude that are moderately degraded. Land degradation is due to excessive use of the land without replenishment. Uganda has a total of 8,079,622.1ha of land for forest landscape restoration with about twenty-two priority areas. Most of the priority areas for restoration are found in the northern moist landscape of the restoration zones of Uganda.

Afforestation, reforestation, agroforestry and natural regeneration (passive restoration) are the most preferred and feasible restoration options. Agroforestry has a high likelihood of creating benefits that far outweigh the costs compared to other restoration options. While natural regeneration has potential to have more social-ecological benefits albeit difficult to price.

The success factors that already exist for restoration interventions include: Legal and policy requirements of FLR, suitable ecological conditions and suitable market conditions. The factors that are missing are awareness of FLR and its role among local communities, well defined tree and forest tenure under mailo and customary land tenure system, resources committed to restoration and monitoring system for restoration interventions.

The major strategies for addressing major policy and institutional bottlenecks that affect forest landscape restoration interventions are: Providing reliable and timely forest extension services to local communities, promoting establishment of more value addition forest-based industries, providing market-based incentives to those involved in restoration, enhance capacity of responsible bodies in the forest sector, enhance security of forest and tree tenure, improve on the coordination of relevant agencies and integrate the value of forests as natural capital into national accounting and reporting systems.

4.2 General Recommendations

Planting of mainly native/indigenous species from different functional groups will be necessary under all restoration options preferred by land owners to restore degraded forests. This is because of the associated ecological benefits of indigenous tree species compared to exotic species in the ecosystem. The species grown should be suited for the ecological conditions of each landscape and existing natural disturbances. The focus should be to have species mosaics within a landscape that enhance socio-ecological robustness.

Agroforestry ought to be used in the transition phase early in forest restoration in protected areas that have been encroached on to overcome socioeconomic and ecological obstacles to restoring former forest lands that were turned into agriculture. It should also be promoted in areas that are densely populated to minimize encroaching on crop land.

Natural regeneration should be promoted in reserves and private land committed to forest restoration but this will require prevention of disturbances such as fire and cultivation that may hinder natural succession process. Emerging seedlings and re-sprouts should be protected from competition by clipping plants around them.

There will be need to have regular monitoring of restoration sites in order to understand the sites' forest restoration trajectory and for guiding management and intervention practices.

Subsidies in form of planting materials, training and forest extension services will be critical in implementing restoration interventions in all the landscapes.

There is need to develop capacity in tree seed especially of native species that can be used for restoration. Involving local communities in building a good reliable seedbank system will be useful.

Trials for restoration models that can lead to ecological and economic benefits in different landscapes need to be implemented and cascaded to communities.

There is need for a policy and legal requirement for all landowners who degrade forests to restore them and there should be a mechanism to monitor their progress to minimize fragmentation.

Involvement of non-state actors such as corporate companies, traditional institutions and civil society organisations should be pursued to address funding bottlenecks for forest restoration programmes.

Implementers of FLR initiatives should as much as possible avoid conversion of other natural ecosystems such as wetlands and grasslands into forests to avoid loss of the ecosystem services they provide.

Much as exotic species may have fast growth and high economic returns, it's important that they are not planted in sites that were formerly covered by indigenous species because of the potential to change the micro-conditions.

Colonizing species ought to be prioritized in restoration of heavily degraded sites to provide ecological conditions that enhance late successional species.

Maximizing ecological benefits of restored riparian vegetation will require farmers to "sacrifice" significant buffer widths, and restoration should adopt a multi-species riparian buffer strip system including trees and grasses.

References

Aide, T. M., Zimmerman, J. K., Pascarella, J. B., Rivera, L., & Marcano-Vega, H. (2000). Forest regeneration in a chronosequence of tropical abandoned pastures: implications for restoration ecology. *Restoration ecology, 8*(4), 328-338

Alkemade, R., Reid, R. S., van den Berg, M., de Leeuw, J., & Jeuken, M. (2013). Assessing the impacts of livestock production on biodiversity in rangeland ecosystems. *Proceedings of the National Academy of Sciences,110*(52), 20900-20905.

Atauri, J. A., & de Lucio, J. V. (2001). The role of landscape structure in species richness distribution of birds, amphibians, reptiles and lepidopterans in Mediterranean landscapes*. Landscape ecology, 16*(2), 147-159.

Bagoora, D.F.K., (1990). Soil erosion and mass wasting risk in the highland areas of Uganda. Africa Mountains and highlands, Problems and perspectives; B. Messerhirwa and H. Hurni (Eds.) African Mountain Association, Walsmorth Press .USA. pp., 133-155Baigorria GA, Jones JW, O'Brien JJ (2007) Understanding rainfall spatial variability in southwest USA at different timescales. Int. J. Climatol., 27: 749–760.

Benayas, J. M. R., Newton, A. C., Diaz, A., & Bullock, J. M. (2009). Enhancement of biodiversity and ecosystem services by ecological restoration: a meta-analysis. *science,* 325(5944), 1121-1124.

Boedhihartono, A. K., & Sayer, J. (2012). Forest landscape restoration: restoring what and for whom?. In *Forest Landscape Restoration* (pp. 309-323). Springer Netherlands.

Bolwig, S. (2002). Land use change and soil degradation in the Southwestern highlands of Uganda. A contribution to the strategic criteria for rural investments in productivity (SCRIP) program of the USAID Uganda Mission. Washington, DC: The International Food Policy Research Institute.

Brunner AB, Park SJ, Rücker GR, Dikau R, Vlek PLG (2004) Catenary soil development influencing erosion susceptibility along a hillslope in Uganda. Catena 58:1-22

Bryant, D., Nielsen, D., & Tangley, L. (1997). The last frontier forests: Ecosystems and economies on the edge. Washington, DC: World Resources Institute.

Chazdon, R. L. (2008). Beyond deforestation: restoring forests and ecosystem services on degraded lands. *science*, 320(5882), 1458-1460.

Cole, R. J., Holl, K. D., Keene, C. L., & Zahawi, R. A. (2011). Direct seeding of late-successional trees to restore tropical montane *forest. Forest Ecology and Management, 261*(10), 1590-1597.

De- Souza, F. M., & Batista, J. L. F. (2004). Restoration of seasonal semideciduous forests in Brazil: influence of age and restoration design on forest structure. *Forest ecology and Management, 191*(1), 185-200.

Dudley, N., Mansourian, S., & Vallauri, D. (2005). Forest landscape restoration in context. In *Forest Restoration in Landscapes* (pp. 3-7). Springer New York.

Fisher, B., Turner, R. K., & Morling, P. (2009). Defining and classifying ecosystem services for decision making. *Ecological economics, 68*(3), 643-653.

Fuhlendorf, S. D., & Engle, D. M. (2001). Restoring Heterogeneity on Rangelands: Ecosystem Management Based on Evolutionary Grazing Patterns We propose a paradigm that enhances heterogeneity instead of homogeneity to promote biological diversity and wildlife habitat on rangelands grazed by livestock. *BioScience, 51*(8), 625-632.

Holl, K. D., & Aide, T. M. (2011). When and where to actively restore ecosystems?. *Forest Ecology and Management, 261*(10), 1558-1563.

IUCN and WRI (2014). A guide to the Restoration Opportunities Assessment Methodology (ROAM): Assessing forest landscape restoration opportunities at the national or sub-national level. Working Paper (Road-test edition). Gland, Switzerland: IUCN. 125pp.

Lamb, D. (1998). Large- scale Ecological Restoration of Degraded Tropical Forest Lands: The Potential Role of Timber Plantations. *Restoration ecology,6*(3), 271-279.

Lamb, D., Stanturf, J., & Madsen, P. (2012). What is forest landscape restoration?. In *Forest Landscape Restoration* (pp. 3-23). Springer Netherlands.

Lamprey R.H & Mitchelmore, F. (1996). Survey of wildlife in protected areas of Uganda. Kampala, Uganda, Ugandan Wildlife Authority.

Lufafa, A. (2006). Land use and climate change effects on terrestrial c stocks in Uganda's cattle corridor. End of project technical report submitted to start. Faculty of Agriculture, Makerere University

Maitima, J. M., Mugatha, S. M., Reid, R. S., Gachimbi, L. N., Majule, A., Lyaruu, H., ... & Mugisha, S. (2009). The linkages between land use change, land degradation and biodiversity across East Africa. *African Journal of Environmental Science and Technology, 3*(10).

Majaliwa, J. G. M. 2003. Soil and plant nutrient losses from major agricultural land use types and associated pollution loading in selected micro-catchments of the Lake Victoria catchment. Ph.D. diss., Makerere University, Kampala, Uganda.

Ministry of Natural Resources – Rwanda (2014). *Forest Landscape Restoration Opportunity Assessment for Rwanda*. MINIRENA (Rwanda), IUCN, WRI. viii + 51pp.

Mulebeke, R. (2003). Validation of a GIS-USLE model in a banana-based micro-catchment of the Lake Victoria basin, Msc. Thesis, Makerere University.

Naughton-Treves, L., Kammen, D. M., & Chapman, C. (2007). Burning biodiversity: woody biomass use by commercial and subsistence groups in western Uganda's forests. *Biological conservation, 134*(2), 232-241.

Roberts, L., Stone, R., & Sugden, A. (2009). The rise of restoration *ecology.Science*, 325(5940), 555-555.

Tews, J., Brose, U., Grimm, V., Tielbörger, K., Wichmann, M. C., Schwager, M., & Jeltsch, F. (2004). Animal species diversity driven by habitat heterogeneity/diversity: the importance of keystone structures. *Journal of biogeography, 31*(1), 79-92.

Vieira, D. L., & Scariot, A. (2006). Principles of natural regeneration of tropical dry forests for restoration. *Restoration Ecology, 14*(1), 11-20.

Wade, T. G., Riitters, K. H., Wickham, J. D., & Jones, K. B. (2003). Distribution and causes of global forest fragmentation. *Conservation Ecology, 7*(2), 7.

Watkins, T. Y., & Imbumi, M. (2007). Forests of Mount Kulal, Kenya: source of water and support to local livelihoods. *Unasylva (English ed.), 58*(229), 33-37.

Data sources

Administrative layers (UBOS, 2013)
Open water (MWE, 2014)

Projection

GCS_WGS_1984

Annexes

Annex 1: Landscape level restoration interventions for all restoration zones

A. Western Mid-Altitude Farmlands

Category of Degraded Lands	Proposed Restoration Interventions
Forests • Central Forest Reserves • Local Forest Reserves • Private forests	• Boundary re-opening and demarcation for all forest reserves • Enrichment Planting of forest reserves • Re-afforestation of completely cleared forests • Agroforestry for initial reforestation initiatives • Boundary tree planting • Establishment of Plantations/ woodlots • Collaborative Forest Management programmes in forest reserves • Alternative income generating activities for the communities currently deriving livelihoods from forests • Continued enforcement of forest and environmental laws • Implement evictions from forest reserves
Communal land	• Re-afforestation on communal lands • Plant live markers along the boundaries • Enrichment planting of degraded communal forests • Fruit tree growing
Mountain Slopes	• Establishment of woodlots • Tree bands along Contours • Scattered trees on agricultural farms
Bare Hills	• Afforestation with appropriate species
River Banks and water sheds	• Boundary planting using indigenous tree species in the protected zones • Maintenance of riparian buffer grass
Wetlands	• Continued enforcement of environmental laws to secure wetlands • Creation of buffer zones with live markers • Afforestation with appropriate species in buffer zones
Road Reserves and Burrow pits	• Afforestation with indigenous tree species
Agricultural and pasture lands (Private lands)	• Agroforestry • Farmer managed Natural Regeneration • Soil and water conservation technologies e.g. use of contours
Woodlands	• Registration of these woodlands as private forests • Development of management plans • Re-afforestation in some areas • Enrichment planting • Farmer managed Natural Regeneration • Fire protection

Characterisation of restoration interventions, tree spp preferred and management practices for western mid-altitude farmlands

Initiative	Characterisation
Re-afforestation and Enrichment planting in previously forested landscapes	Use of indigenous tree species such as *Melicia excelsa*, *Maesopsis emnii*, *Albizzia gummifera*, *Albizzia coriaria*, *Croton macrostachyus*, *Dombeya* spp, *Dichrostachys cinera*, *Markhamia lutei*, *Celtis durandii*, *Bridelia micrantha*, *Sapium ellipticum*, *Warbugia Ugandensis*
Afforestation of Bare Hills	-Plantations of Pine, Eucalyptus and *Maesopsis eminii* - Agroforestry using leguminous shrubs, fruit trees, coffee
Agroforestry systems for agricultural lands	-Tree bands of *Grevellia robusta*, *Sesbania sesban, Calliandra calothyrsus* -Scattered trees of *Melicia excelsa*, *Warbugia ugandensis* *Prunus africana* -Crops for intercropping: Coffee, Cocoa
Restoration of swamp forests	-Plant *Entandadrophragma angolensis, Albizia coriaria*, *Hallea stipulosa* as riparian buffer strips

B. Lake Victoria Crescent

Category of Degraded Lands	Proposed Restoration Interventions
Forests • Central Forest Reserves • Local Forest Reserves • Riverine forests (Water catchments)	• Boundary re-opening and demarcation for all forest reserves e.g. through Boundary tree planting • Enrichment Planting • Evicting of all encroachers on the CFRs and LFRs • Continued enforcement of forest and environmental laws • Re-afforestation of areas with completely cleared forests • Afforestation/ woodlots • Assisted Natural regeneration (Proper management of tree stumps) • Collaborative Forest Management programmes for the CFRs and LFRs • Awareness creation and Training of local communities • Recruitment of staff and providing adequate resources • Increased monitoring and inspection • Formulation of forest Bye laws and ordinances • Alternative income generating activities for the communities currently deriving livelihoods from forests
Forests on Private and communal land	• Registration of private forests • Tree planting (woodlots/Plantations) • Promoting alternative energy sources to reduce pressure on forests on private land • Formalisation of ownership of communal forests
Forests on Public land e.g. Gwamba Forest area (4 Sq. miles)	• Gazettment/designation of forest landscapes into reserves • Enrichment planting
Public land and land for public institutions	• Re-afforestation of landscapes with completely cleared forests • Afforestation/woodlots • Promoting sustainable agricultural practices • Promote forestry extension education
Bare Hills	• Woodlots of Pine, *Maesopsis emnii* • Tree Planting/Plantations (Pine, Eucalyptus spp) • Agroforestry using *Grevellia robusta, Maesopsis eminii* • Soil and water conservation technologies (stone lines, contour bands)
River Banks and water sheds	• Tree planting on boundaries

Agricultural lands (Private lands and rangelands)	• Agroforestry (*Grevellia robusta, Calliandra calothyrsu*s Fruit trees such as mangoes, guavas, citrus)
	• Woodlots (Eucalyptus spp, Pine, *Maesopsis eminii*)
	• Contour hedges and soil bands
	• Fertilizer application
	• Cropland improvement through Sustainable Land Management approaches
	  o Conservation agriculture
	  o Soil and water conservation
	• Improved fallowing with *Calliandra calothyrsus*

Wetlands and watersheds	• Tree planting in watersheds • Agroforestry (Hedgerows) • Soil and water conservation technologies (Soil bands, Contour hedgerows) • Wetland mapping by Department of wetlands and Local Governments) • Livelihood support projects e.g. Aquaculture, IGAs in drylands = Simple irrigation technologies e.g. drip irrigation) • Watershed Management (SLM) • Maintenance of riparian buffer grass

Characterisation of restoration interventions, tree spp preferred and management practices for Lake Victoria Crescent

Initiative	Characterisation
Re-afforestation and Enrichment planting in previously forested areas	Use of indigenous tree species such as *Milicia excelsa, Antiaris toxicaria, Erythrina excelsa, Funtumia Africana, Ficus exasperata, Ficus Africana, Ficus mu*cuso *Entandrophragma angolense*, *Maesopsis eminii*, *Celtis africana, Alstonia boonei, Antiaris toxicaria, Piptadeniastrum africana, Fagara angolense, Khaya anthotheca, Albizzia* spp., *Milbraediodendron excelsum, Lovoa* spp., *Podocarpus* spp.
Afforestation of Bare Hills	Plantations of Pine, Eucalyptus and *Maesopsis eminii*
Agroforestry systems for agricultural lands	Tree bands of *Grevellia robusta, Sesbania sesban, Calliandra calothyrus* Scattered trees of *Melicia excelsa Ficus spp., Artocarpus heterophyllus Mangifera indica, Maesopsis eminii ,Psidium guajava , Persea Americana, Entrandrophragma angolense, Markhamia spp, Albizzia spp. Passiflora edulis, Canarium schwenfurthii Citrus sinensis ,Citrus limon, Ricinus communis* in crop land
Tree planting around wetlands	Plant *Entandadrophragma angolensis, Hallea stipulosa*

C. Karamoja

Category of Degraded Lands	Proposed Restoration Interventions
Forests on • Central Forest Reserves • Local Forest Reserves	• Establishing Woodlots • Facilitate natural regeneration of trees through control of wild fires /creating fire lines • Planting indigenous trees in former riverine forests • Awareness creation on importance of trees and forests • Boundary opening and demarcation • Support cultural practices towards forest and tree conservation. • Operationalize forest and environment committees at local level • Improve funding and functionality of relevant agencies in forestry • Address the issue of tree cutting for charcoal through regulations and bye laws • Address agricultural encroachment into protected areas • Legislation and institutional strengthening • Alternative income generating activities for the communities currently deriving livelihoods from forests
Forests on Private land	• Encourage use of live fences for homesteads • Establish woodlots • Agroforestry • Improve coordination of various actors and interventionists • Improve forests and tree tenure on customary land • Control tree pests and diseases • Plant trees for poles used in construction • Protect regenerating trees on farmland • Provide subsidies in form of seedlings • Regulate bush burning and grazing movements • Sensitize local communities on the values of forests and trees • Implement water harvesting initiatives to water trees during establishment
Forests on communal land	• Protect regenerating trees on farmland • Establish Woodlots • Facilitate Natural re generation of trees through control of wild fires /creating fire lines • Plant indigenous trees in former riverine forests • Regulate cutting of trees for brick burning
Public land and public institutions	• Protect regenerating trees • Establish Woodlots • Facilitate Natural re generation of trees through control of wild fires /creating fire lines • Plant indigenous trees in former riverine forests • Regulate cutting of trees for brick burning • Resolve conflicts on land between local communities and public institutions
Bare Hills	• Plant Napier grass, elephant grass, bamboo & star grass • Establish terraces on steep landscapes • Alley cropping system with *Acacia saligna* • Woodlots of Acacia spp
Agricultural lands (Private lands and rangelands)	• Support Farmer managed natural regeneration on hill slopes • Plant fruit trees such • Maintain some tree species such as *Balanites aegyptica* on crop land
Wetlands and watersheds	• Use watershed management principles • Restore degraded areas with some riparian trees and grasses

Characterisation of restoration interventions, tree spp preferred and management practices for Karamoja

Initiative	Characterisation
Re-afforestation and Enrichment planting in previously forested areas	Use of indigenous tree species such as *Balanites aegyptiaca, Albizia amara, Albizia coriaria, Harrisonia abyssinica, Warburgia salutaris, Zanthoxylum chalybeum, Carissa spinarum, Acacia senagal, Terminalia spp, Indigofera erecta, Grewia holstii, Acacia seyal, Milicia excelsa, Ziziphus mauritana*
Afforestation of Bare Hills	-Maintain natural grass -Plant exotic spp such as Pine, *Tectona grandis, Cordia* sinensis
Agroforestry systems for agricultural lands	Intercrop with Citrus, *Faidherbia albida, Mangifera indica, Artocarpus heterophyllus, Acacia spp, Leucaena leucocephala*, *Vitellaria paradoxa, Senna spectabilis, Azadirachta indica*, *Markhamia lutea, Jacaranda mimosifolia*, *Gliricidia sepium*, *Sclerocarya birrea, Albizia coriaria*
River Banks and water sheds	-Planting of Terminalia *brownie, Melia volkensii*, *Hyhaena ciriacea*, *Entandrophragma angolense, Vachellia xanthophloea, Acacia camplyacantha, Syzegium guinensis, Albizia zygia* and *Acacia nilotica* -Maintenance of grass and sedges around river banks
Farmer managed natural regeneration	*Vitellaria paradoxa, Tamarindus indica, Acacia tortilis, Acacia xanthoplea, Ziziphus abyssinica, Ximenia americana*
Establishment of hedgerows	Plant hedgerow species such as Kei apple (*Dovyalis caffra*), *Cassia siamea, Gliricidia sepium* and *Leucaena leucocephala, Euphorbia trucalli*
Plant cover enhancement of bare surfaces	Plant sisal and Aloevera to reduce soil erosion
Maintenance of grass strips, minimum tillage, use of trenches, proper cropping methods	Soil and water conservation practices especially in hilly landscapes
Filling sand mines/pits/burrows and Vegetating the sand mines	use sand from within the landscape to fill sand mines and burrows

D. EASTERN KYOGA FLOOD PLAINS

Category of Degraded Lands	Proposed Restoration Interventions
Forests on • Central Forest Reserves • Local Forest Reserves	• Establish woodlots of indigenous tree species • Lift the Executive order on leasing of forest reserve land for tree planting • Provide more financial resources to the forestry sector • Enforce fire regulation measures to protect forest reserves • Provide more protection of forest reserves from encroachers • Address land ownership and boundary conflicts • Provide Local and national political support to forest conservation and tree planting • Monitor and enforce forest laws and regulations • Provide alternative income generating activities for the communities currently deriving livelihoods from forests
Forests on Private land	• Establish woodlots • Implement Agroforestry • Develop and implement land use plans to secure forest land
Forests on communal land	• Enact and enforce bye laws on trees and forests on communal land • Minimize land fragmentation • Implement Agroforestry • Establish community forest woodlots • Foster natural regeneration of trees • Improve access to quality planting materials through establishment of community nurseries • Carry out community sensitization on forest conservation • Develop and implement land use plans to protect forests on communal land • Address land tenure issues among the communities
Agricultural lands (Private lands and rangelands)	• Implement Agroforestry practices such as fodder banks, • Plant fruit trees and other multipurpose tree species • Regulate livestock density and movement among cattle keepers to reduce forest degradation
Wetlands, river banks and watersheds	• Demarcation of wetland boundaries • Implement Soil and water conservation practices • Promotion of rainwater harvesting technologies • Protecting wetlands, river banks and watersheds from encroachers • Formulate and implement environmental action plans at local and district level • Maintain riparian vegetated strips

Characterisation of restoration interventions, tree spp preferred and management practices for Eastern Kyoga flood plains

Initiative	Characterisation
Farmer managed natural regeneration	Facilitate regeneration of *Vitellaria paradoxa, Tamarindus indica, Acacia spp, Piliostigma thonningii, Erythrina abyssinica, Terminalia macroptera, Combretum spp, Grewia mollis*, *Bridelia scleroneura, Harrisonia abyssinic*a and Ficus spp.
Re-afforestation and Enrichment planting in previously forested areas	• Plant exotic spp such as *Eucalyptus grandis*, Pine spp on marginal land • Plant indigenous species such as *Markhamia lutea, Cordia Africana, Ficus spp, Milicia excelsa, Khaya senegalensis, Albizia spp, Acacia polycantha*
Growing of ornamental tree species around homesteads	Plant *Croton macrostachyus*, *Dovyalis caffra* (kei-apple)
Restoring of river banks using vegetative buffer strips	Plant *Ficus sycomorus, Acacia xanthophloea, Acacia tortilis, Faidherbia albida, Syzygium cordatum and Croton macrostachyus, Beilschmiedia ugandensis*
Agroforestry	• Intercrop with Cordia spp, Grevellia *robusta*, *Leucaena leucocephala, Calliandra calothyrsus,* Fruit trees especially *Mangifera indica, Citrus and Jack fruit* other woody species such as *Sesbania sesban, Azadirachta indica*, *Tectona grandis, Albizia spp, Terminalia spp, Clonal eucalyptus*, *Melia azedarach* can also be grown with agricultural crops
Filling burrows	Fill burrows where sand has been mined
Establishment of contour bands and digging trenches grass strips, use of cover crops, water basins, mulching, use of trash lines	Implement soil and water conservation practices in areas of high elevation
Establishment of hedgerows	Plant hedgerow species such as *Dovyalis caffra* (kei-apple), *Gliricidia sepium, Grevillea robusta*, *Senna siamea*, *Senna spectabilis, Croton megalocarpus, Morus alba, Calliandra calothyrsus, Gmelina arborea and Leucaena leucocephala*

E. NORTH MOIST FARMLANDS

Category of Degraded Lands	Proposed Restoration Interventions
Forests on • Central Forest Reserves • Local Forest Reserves	• Enrichment planting • Afforestation and reforestation • Promote ecotourism to raise resources for protecting forest reserves • Improve on enforcement of forest laws and regulations • Implement collaborative forest management initiatives • Provide more logistical support to the forestry sector at district level • Avail alternative income generating activities for the communities currently deriving livelihoods from forests
Forests on Private land	• Sensitization &awareness creation on the value of conserving forests on private land • Providing alternative energy sources from wood • Providing inputs for tree and forest establishment • Establish woodlots for poles, timber • Increasing species diversity of planted forests • Introduce fruit tree growing
Forests on communal land	• Sensitization &awareness creation on the value of conserving forests on private land and the threats associated with forest degradation • Plant trees where there has been degradation due to charcoal production • Establish woodlots for fuelwood • Implement agroforestry practices
Public land and public institutions	• Designation of public land into reserved land for forests • Establishment of woodlots
Bare Hills	• Planting of trees in form of woodlots
Agricultural lands (Private lands and rangelands)	• Practice agroforestry including planting of trees for bee keeping
Wetlands and watersheds	• Plant trees to protect wetlands

Characterisation of restoration interventions, tree spp preferred and management practices for North moist farmlands

Initiative	Characterisation
Re-afforestation and Enrichment planting in previously forested areas	• Planting of exotic species such as *Pinus carribaea*, Eucalyptus spp, *Grevellia robusta* and *Tectona grandis* as woodlots • Planting of indigenous spp such as *Maesopsis eminii, Albizia spp, Prunus africana, Mahogany spp, Milicia excelsa, Albizia* spp,
Natural regeneration of forest reserves and private land	Facilitate regeneration and establishment of *Terminalia spp, Vitellaria paradoxa, Albizia grandbracteata, Grewia mollis, Khaya grandifoliola, Lonchocarpus laxiflorus, Pseudocedrela kotschyi, Combretum mole, Ficus spp* and *Ziziphus abyssinica,*
Afforestation of Bare Hills	Plant *Melia volkensii*
Agroforestry systems for agricultural land	-Intercropping with fruit trees such as Mangoes, oranges, Jackfruit and avocado -Intercropping with other tree species such as *Gmelina arborea, Afzelia Africana, Mahogany spp, Melicia excelsa, Terminalia superba, Maesopsis eminii, Azadrachta indica (*Neem tree*), Prunus africana, Albizia spp, Senna siamea,* *Senna sepctabilis*, Giant lira*, Acacia spp, Grevillea robusta, Markhamia lutea, Lonchocarpus laxiflorus*
Protect water catchment forests	-Maintaining *Borassus palms,* *-Plant* Lovoa trichilioides, *Entandadrophragma angolensis, Hallea stipulosa* as riparian buffer strips.
Implement good farming practices	Implementing practices such as crop rotation and good tillage to reduce soil erosion
Protect water sources from siltation	-Maintaining grass and tree around water sources
Establish woodlots for fuel wood, charcoal timber and poles communities	Planting *Tectona grandis, Azadrachta indica, Giant Lira, Grevillea robusta, Senna siamea, Senna spectabilis, Gmelina aborea, Albizia spp*
Initiate soil and water conservation practices and soil fertility improvement	Carrying out mulching and use of cover crops to control water and nutrient loss
Diversify tree species planted by land owners	Planting different species to reduce risks associated with pure stands
Plant trees for boundary marking	Planting Markhamia *lutea, Ficus natalensis, Euphorbia tirucalli* on boundaries
Plant trees on bare lands	Planting Eucalyptus spp and Pine spp

F. SOUTH WEST RANGELANDS

Category of Degraded Lands	Proposed Restoration Interventions
Forests on • Central Forest Reserves • Local Forest Reserves	-Boundary opening and demarcation -Eviction of encroachers & restoration of degraded reserves -Regular monitoring of trees and woody biomass stocks -Enact Bye-laws and enforce them -Establishment and maintenance of buffer zones around forest reserves -Selective logging to minimise impacts in areas currently under logging -Enrichment planting in reserves
Forests on Private land	-Sensitization and training of communities -Establishing community tree nursery beds -Establishment of woodlots
Forests on communal land	-Using bye-laws to protect forests on communal land -Formalisation of ownership of communal forests -Enrichment planting of forests on communal land -Establishment of woodlots on communal land
Agricultural lands (Private lands and rangelands)	-Practicing agroforestry e.g. boundary planting, planting fruit trees and Nitrogen fixing tree species

Characterisation of restoration interventions, tree spp preferred and management practices for South west rangelands

Initiative	Characterisation
Farmer managed natural regeneration	-Regenerating tree species of socio-economic and ecological importance especially *Prunus Africana, Grewia bicolor, Carisa edulis, Acacia albida, Acacia abyssinica and Acacia tortilis*
Re-afforestation and Enrichment planting in previously forested areas on private and communal land	- Planting *Acacia spp*, *Terminalia brownii*, - Planting Eucalyptus and Pine spp
Growing of ornamental tree species around homesteads	-Planting *Grevellia robusta* , *Terminalia mantaly*
Agroforestry	-Promoting multi-purpose tree planting for soil fertility improvement and bee keeping such as *Leucaena leucocephala, Callindra calothyrsus, Croton megalocarpus, Sesbania sesban, Senna siamea* -Planting shade trees such as *Ficus natalensis* -Mixing crops with indigenous tree species such as *Erythrina abyssinica*
Boundary planting	Planting *Spathodea campanulate, Acacia hockii*
Improve quality and access to water for livestock	-Construct valley dams and protect them with grass layer by avoiding grazing around them -Planting of indigenous swamp forest species Plant *Beilschmeidia ugandensis, Entandadrophragma angolensis, Macaranga* schweinfurthii *Phoenix reclinata, Hallea stipulosa, Albizia coriaria*
Practice good agronomic practices	- controlling stocking rate, promote improved breeds, and diversification of crop and livestock.
Vegetate bare lands to improve pastures	Planting *Morus alba, Acacia tortilis*
Establish woodlots for fuel wood sources	Planting *Acacia hockii, Gliricidia sepium, Senna spectabilis*

G. AFROMONTANE ALTITUDE

Category of Degraded Lands	Proposed Restoration Interventions
Forests on • Central Forest Reserves • Local Forest Reserves	• Enrichment planting of forest reserves • Planting indigenous tree species in degraded forest reserves • Evicting encroachers in forest reserves • Enforcing bye laws & ordinances on forests and trees • Ensuring selective logging principles are followed in areas given out for logging • Enhancing the staffing of the forest department at local level • Promoting alternative income generating activities for the communities currently deriving livelihoods from forests
Forests on Private land	• Establishing woodlots • Implementing agroforestry practices where fruit trees are grown with other crops, • Improving Legislation on tree harvesting and management • Providing forestry extension services to local communities
Forests on communal land	• Sensitization and training of communities on forest management • Enforcing bye laws & ordinances • Providing planting materials to households interested in tree planting • Improving Legislation on tree harvesting and management • Monitoring of compliance of the laws and policies on forests and trees • Establishing woodlots
Bare Hills and sand mines	• Filling sand mines/pits/burrows • Vegetating sand mines • Planting trees on bare hills
Agricultural lands	• Intercropping agricultural crops such as coffee with shade trees and leguminous shrubs • Using improved fallows in crop production • Establishing woodlots for fuel-wood and building materials • Minimizing land fragmentation
Wetlands and watersheds	• Planting trees to protect wetlands and water sources • Maintaining riparian grassland to act as buffer strips

Annex 2: The National FLR Core Team

		Designation	INSTITUTION
1.	John Dissi	GIS Specialist	National Forest Authority
2.	Charles Byaruhanga	Principle Forest Officer, Monitoring and Assessment	National Forest Authority
3.	Bob Kazungu	Senior Forest Officer (Monitoring and Inspection)	Forest Sector Support Department
4.	Edward Ssenyonjo	Remote Sensing / GIS	National Forest Authority
5.	Sunday Godfrey	Statistician	Ministry of Agriculture, Animal Industry and Fisheries
6.	Bernard Barasa	GIS Centre	Makerere University
7.	Patrick Byakagaba	Lecturer	School of Forestry, Environmental and Geographical Sciences, Makerere University
8.	Craig Beatty	GIS Specialist	IUCN USA
9.	Adata Margaret	Commissioner FSSD	Ministry of Water and Environment
10.	Robert Wild	Technical Coordinator	Landscapes Programme-IUCN Nairobi
11.	Sophie Kutegeka	Senior Programme Officer	IUCN- Uganda
12.	Stewart Maginnis	Global Director, Nature Based Solutions	IUCN Switzerland
13.	Mike Verdone	Programme Officer	IUCN- USA
14.	Polycarp M. Mwima	Program Officer	IUCN- Uganda
15.	DE WITT Sean	Director	World Resources Institute