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Farmer Managed Natural Regeneration in Kenya

A Primer for Development Practitioners

ERICK OTIENO WANJIRA, JONATHAN MURIUKI & IRENE OJUOK

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FMNR Women group in Laisamis, Marsabit County joined by Tony Rinaudo Senior climate action advisor World Vision Australia

"For there is hope for a tree, when it is cut down, that it will sprout again, and its shoots will not fail". Job 14:7

About The Authors

Erick Otieno Wanjira is a research Assistant, working under the ICRAF Kenya country office. He has specific interests in agroforestry systems (food security and livelihood improvement), farmer participatory research, land restoration approaches, tree nursery enterprise development, and institutional mapping and partnership for scaling. He holds a BSc in Forestry from Moi University and a Master's in Environmental Science from Kenyatta University.

Jonathan Muriuki is an agroforestry scientist with over 15 years of work experience, and holds an MSc and PhD in the same field. He is currently the Kenya Country Representative for the Eastern and Southern Africa region at World Agroforestry. He has conducted research for development activities in agroforestry ranging from tree seed and seedling supply systems, farm productivity research with various categories of tree species notably fodder, medicinal, fertilizer trees and aspects of timber and fruit trees, as well as tree product market-related research. His research activities have spanned the entire Eastern Africa region, and he has undertaken brief assignments in some countries in both Southern and West Africa.

Irene Ojuok is an Environmentalist with over 10 years' experience working with communities in Kenya and holds a degree in Environmental Studies and pursuing Masters in Project planning and Management. She is currently the Environment and Climate Change Advisor and FMNR expert at World Vision Kenya. She has vast experience in project design and implementation, capacity building on FMNR and other land restoration models, documentation and publications including for FMNR, Renewable energy, Policy influence, private sector engagements and gender mainstreaming. She was acknowledged as tree ambassador by Total Eco Challenge in 2016 and is a globally recognized FMNR champion.

FOREWORD

Despite the fact that land degradation is both natural and human induced, it is proven that human activities pose the greatest threat, and these include unsustainable land management practices factors such as destruction of natural vegetation, over cultivation, overgrazing, poor land husbandry and excessive forest conversion. Other than reduced productivity, land degradation also leads to socio-economic problems such as food insecurity, insufficient water and regular loss of livestock which exacerbate poverty, conflicts and gender inequalities that negatively impact mostly women and children especially the rural population. Increased efforts by governments, donors and partners towards reversing land degradation through community led, innovative and effective approaches therefore remain to be crucial today than never before!

Tree planting has been promoted with various levels of success in Kenya but is mainly successful in the humid and sub-humid areas with huge failure in dry lands (arid and semi-arid lands) due to low and unreliable rainfall. The precipitation fails to provide sufficient moisture in the soil to ensure survival of planted tree seedlings. Natural regeneration is proven to be more effective as compared to tree planting especially in areas with existing stock of seeds and stumps in the soil. Low cost alternative approaches for land restoration are therefore necessary in order to enhance tree establishment in arid and semi-arid lands in lure of improving soil health for increased productivity that sustains lives and ecosystem functions.

In response to better and healthier environment, World Vision Kenya through funding from DFAT is safeguarding children's health and well-being by strengthening adaptive capacity and enhancing the natural resource base of communities to build long-term climate resilience through scaling-up sustainable land management (SLM) programmes in order to reverse degradation trends and thereby address a major obstacle to economic growth, food security and environmental protection. Farmer Managed Natural Regeneration (FMNR) is a proven SLM Technology to restore degraded wasteland and improve depleted farmland. This approach has been tested across Africa with high success rates. Pilot projects have also been implemented in Kenya with a high degree of success hence this demonstrates that FMNR can be scaled across the country to help achieve massive land restoration and climate change mitigation. The farmer regulates and facilitates the re-growth of existing trees stumps, or self-sown seeds in the soil, and thus promotes soil fertility and through better ground cover, increases protection from runoff and erosion. FMNR is an easy, low-cost way for farmers to increase the number of trees in the fields while accruing long and short term benefits of the trees on farm.

This manual seeks to contribute to massive adoption of FMNR by providing extension agents, development practitioners, and technocrats with a knowledge base for promoting the approach. The manual builds on several manuals that have been developed in the past to support agroforestry and other sustainable land management initiatives in the country and across Africa including the global FMNR Manual.

We hope that this manual will be broadly disseminated and used by professionals working in rural and agricultural development, land restoration and environmental protection.

Lilian Dodzo

National Director, World Vision Kenya

ACKNOWLEDGEMENTS

The idea to develop a manual to guide practitioners on farmer managed natural regeneration (FMNR) practice and scaling in Kenya has been long coming since the pilot FMNR project in East Africa was implemented by World Vision with ICRAF as partner organizations between 2013 and 2017. The financial support by the Australian government through the Department of Foreign Affairs and Trade (DFAT)'s Australia NGO Cooperation Program (ANCP) in that project and in the follow-on Central-Rift FMNR Scaling-Up Project (CRIFSUP), which has facilitated the development of this manual is highly appreciated. This support will go a long way in the transformation of Kenya's agricultural landscapes as FMNR plays an increasingly significant role in restoring degraded farms and pasture lands in the country.

Writing a book of whatever magnitude has never been the effort of authors alone and this primer is no exception. The content has benefited a lot from reviews by several World Vision staff including, but not limited to Alice Muller, Andy Hunter, Anne Crawford, Mary Morris, Rob Kelly, Sarah Mckenzie, Silvio Dorati and Tony Rinaudo at World Vision Australia, and Festus Chirchir at World Vision, Kenya. The role of Festus Chirchir as CRIFSUP Project Manager in the commissioning and overseeing the writing contract as well as soliciting review from KEFRI staff, cannot be understated. To this end thanks also go to the reviewers from KEFRI, with special recognition to Simon Choge Director KEFRI Baringo. At ICRAF input from Everlyn Obwocha, Grace Koech and Hilda Kegode, with additional support from John Nyaga on private consultancy is highly appreciated.

Content (including pictures) has been drawn from external sources such as ADRA, ADCD in Action Forum, FAO, Bo Tengnas' Agroforestry Manual for Kenya, CARE International Manual on Participatory Monitoring, Evaluation, Reflection and Learning (PMERL) for Community-based Adaptation, Catholic Relief Services Pocket Guide on Climate Change, Northern Rangelands Trust, Hifadhi Ardhi Shinyanga (HASHI) Equator Prize write up, and others for which all due acknowledgement is hereby given. A significant volume of content has been drawn from FMNR Global manual developed by World Vision Australia, while the FMNR value chain development chapter has significantly drawn from the World Vision's LVCD Project Model Handbook for Practitioners prepared by Chris Rowlands with support from Dan Norell. Lessons have been drawn from projects such as the East Africa FMNR Project, Drylands Development Program and ADRA Kenya's Food for Today and Tomorrow (FTT), which have greatly enriched the manual. We are highly indebted to the project officers who implemented these projects as well as members of the community and government extension staff that they worked with.

The authors are indebted to the support provided by back office management at ICRAF and World Vision Kenya, always very useful backstopping in delivery of material of this type. This support came from sector managers such as Lawrence Kiguro and William Marwanga at World Vision Kenya as well as Jeremias Mowo, Peter Gilruth and Catherine Muthuri at ICRAF. Sylvia Afwande at ICRAF Kenya Country office provided logistical support while others at both ICRAF and World Vision Kenya finance offices supported contract processes. Informal consultations with Dennis Garrity and Tony Rinaudo significantly enriched the mind frame by authors in writing this manual while Betty Rabar's editorial skills came in handy once all content was agreed upon. Danyell Odhiambo worked on the designs which finally gave shape to the material you are reading. The foreword by Ms. Lilian Dodzo, the National Director at World Vision Kenya is most acknowledged.

There are several other colleagues and partners who supported this work in various ways formally and informally. While heartfelt appreciation is conveyed to all, the authors take responsibility for material content in the document and errors therein, if any.

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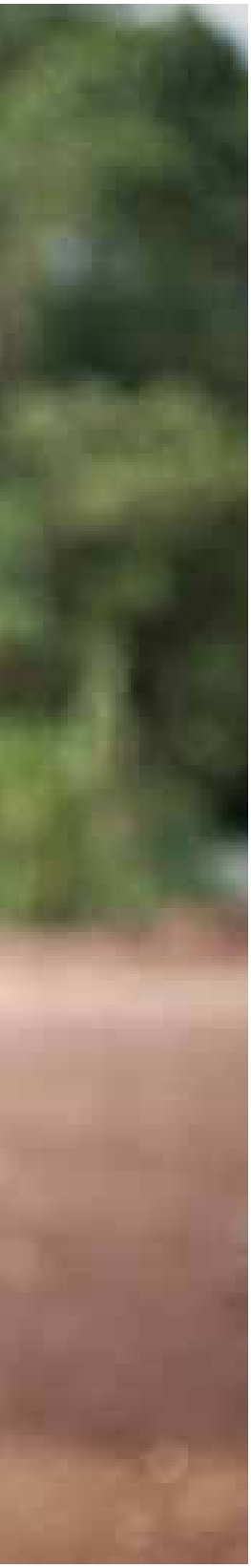
List Of Abbreviations And Acronyms

ABCD - Asset-Based Community Development
AEZ - Agro-ecological Zone
AFR100 - African Forest Landscape Restoration Initiative
ANR - Assisted Natural Regeneration
ASAL - Arid and Semi-Arid Land
CAP - Community Action Plan
CBO - Community-Based Organization
CFA - Community Forest Association
CIDP - County Integrated Development Plan
CLMC - Community Land Management Committee
DRYDEV - Drylands Development Programme
EMCA - Environmental Management and Coordination Act
FAO - Food and Agriculture Organization of the United Nations
FGD - Focus Group Discussion
FMNR - Farmer-managed Natural Regeneration
GAP - Good Agronomic Practices
GIS - Geographic Information System
GPS - Global Positioning System
HASHI - Hifadhi Ardhi Shinyanga
ICRAF - World Agroforestry
ICT - Information and Communication Technology
LVCD - Local Value Chain Development
KEFRI - Kenya Forestry Research Institute
KFS - Kenya Forest Service
MEL - Monitoring, Evaluation and Learning
M&E - Monitoring and Evaluation
NDMA - National Drought Management Authority
NEMA - National Environment Management Authority
NGO - Non-Governmental Organization
NRCS - Natural Resources Conservation Service
NRM - Natural Resource Management
NRT - Northern Rangelands Trust
ODK - Open Data Kit
PM&E - Participatory Monitoring and Evaluation
PMNR - Pastoralist-Managed Natural Regeneration
S4T - Savings for Transformation
SCMP - Sub-catchment Management Plan
SILCs - Savings and Internal Lending Communities
SIM - Serving in Mission
UN - United Nations
UNCCD - United Nations Convention to Combat Desertification
UNHCR - United Nations High Commission for Refugees
USD - United States Dollar
USDA - United States Department of Agriculture
VC - Value Chain
VCA - Value Chain Analysis
VCD - Value Chain Development
VSLA - Village Savings and Loan Association
WRA - Water Resources Authority
WRUA - Water Resources' Users Association



INTRODUCTION

On March 1, 2019 the UN General Assembly declared 2021–2030 the UN Decade on Ecosystem Restoration. The focus during this period will be to "massively scale up the restoration of degraded and destroyed ecosystems as a proven measure to fight the climate crisis and enhance food security, water supply and biodiversity". This is in recognition of the extensive degradation of land (including forests) and marine resources and the danger it poses to human livelihoods. Kenya's economy heavily relies on agriculture, but poor management practices have caused serious land degradation especially in marginal areas. Land degradation manifests in forms of reduction of biodiversity, depletion of vegetative cover, wind and water erosion, salinization and deterioration of physical, chemical and biological soil properties[R39].

Definition of Land Degradation

UNCCD defines land degradation in the context of drylands as: *"a reduction or loss, in arid and semi-arid and dry sub-humid areas, of the biological or economic productivity and complexity of rain-fed cropland, irrigated cropland, or range, pasture, forest and woodlands resulting from land uses or from a process or combination of processes, including processes arising from human activities and habitation patterns".* [R41]

The Millennium Assessment defines land degradation as *"reduction in the capacity of land to perform ecosystem goods, functions and services that support society and development"* [R5&37].

A land degradation assessment conducted by Resource Plan in 2016, showed an overall deterioration of vegetation cover in Kenya over the previous two decades. Furthermore, the cost of land degradation in Kenya was estimated to be equivalent to USD 1.3 billion annually between 2001 and 2009, whereas any resources invested in land restoration were estimated to yield four-fold returns[R41]. Land degradation and underinvestment have seen food crop yields fall below potential in most parts of the country. A quarter of Kenya's population is thus under perpetual hunger and low dietary diversity. About a quarter (26%) of Kenyan children under five were stunted (chronic malnutrition) in 2014, especially in rural areas (e.g., 46% in Kitui and West Pokot Counties)[1]. It is imperative that the country pursue an appropriate land restoration agenda to reverse degradation of productive landscapes in order to increase food and income security while sustainably providing other environmental goods and services.

In 2016 Kenya committed to restore 5.1 million hectares of degraded land by 2030 under the African Forest Landscape Restoration Initiative (AFR100)[2]. Land restoration has largely been associated with an increase in tree cover over crop- and pasturelands, coupled with an increase in tree species diversity. This is premised on the key roles played by trees in ecosystem service provision such as climate moderation by providing shade and windbreak services, regulating water distribution in the soil (and thereby improving nutrient and water balance), attracting pollinators, and controlling pest and pathogen populations in agricultural lands, among others.

[1] Kenya National Bureau of Statistics (et, al.) (2015).Kenya Demographic and Health Survey. 2014
[2] *https://afr100.org/content/kenya*

Tree planting has been promoted with various levels of success in Kenya. It is largely successful in the humid and sub-humid areas albeit based on a narrow range of tree species which yield high economic returns in present markets. It has however, been a huge failure in drylands (arid and semi-arid lands) due to low and unreliable rainfall. The precipitation fails to provide sufficient moisture in the soil to ensure survival of planted tree seedlings.

Tree establishment in arid and semi-arid lands (ASALs) is usually enhanced by adopting various micro-catchment water harvesting techniques that increase water storage at the root zone of each seedling for use when the rain spell ends. Such techniques include zai pits, semi-circular/half-moon bunds, square shape/circular catchments and V-shaped bunds. Besides capturing maximum rainwater to increase moisture around the tree seedling, these techniques help in increasing soil fertility especially where hard pans, soil crusting or degraded soils commonly occur[R31]. However, the increased labour requirement to utilize these techniques is usually a disincentive in tree planting and investment is justifiable only for high-value species. Low-cost alternative approaches for land restoration are therefore necessary.

In the last few decades, farmer-managed natural regeneration (FMNR) of trees has been promoted across Africa as a low-cost approach to tree establishment and land restoration. Pilot projects have also been implemented in Kenya with a high degree of success. This demonstrates that FMNR can be scaled across the country and help achieve massive land restoration and climate change mitigation.

This manual seeks to contribute to massive adoption of FMNR by providing extension agents with a knowledge base for promoting the approach. It builds on several publications that have been developed in the past to support agroforestry initiatives in the country. It draws heavily from the Global FMNR manual developed by World Vision Australia; the discourse is based on the FMNR theory of change presented in the global manual (Figure 1[R49]).

In the last few decades, farmer-managed natural regeneration (FMNR) of trees has been promoted across Africa as a low-cost approach to tree establishment and land restoration. Pilot projects have also been implemented in Kenya with a high degree of success. This demonstrates that FMNR can be scaled across the country and help achieve massive land restoration and climate change mitigation.

The publication comprises six chapters and 10 annexes that seek to bridge agro-ecological contexts in Kenya, with FMNR fitness as well as value chain and policy-institutional support for promoting FMNR. Chapter 1 presents the agro-ecological zones of the country largely building on the Agroforestry Extension Manual for Kenya[R56] in order to lay a background on the contextual fit for FMNR upscaling in the country. It presents a situational analysis of the agroecology and agricultural landscape with respect to the biophysical context (farm productivity, tree cover and diversity) and the socio-economic aspects (population, household income and food security, culture and land tenure). Annex 4 is provided to support this, linking the main farming systems to agroforestry options.

Chapters 2 and 3 introduce FMNR and how it can be a suitable solution to livelihood challenges. In Chapter 2, FMNR is appreciated as a community empowerment practice that involves change of mindsets and retooling community relationship with nature, as well as the landscape. The principles underpinning FMNR and the associated land management practices are also outlined. Chapter 3 embeds FMNR in the Kenya agricultural production context which involves croplands, unmanaged bushlands as well as bare and denuded lands. The uniqueness of each context in terms of productivity or soil fertility, tree cover and diversity is elucidated. Guidance

is given on issues of community mobilization, tree species selection and management, as well as the necessary soil management practices that could boost success.

Chapters 4, 5 and 6 seek to guide the process of taking FMNR to scale in Kenya. Chapter 4 outlines scaling approaches necessary for FMNR such as: community assessments, organization of farmer groups and identification of FMNR change agents, among others. Chapter 5 guides in identification of relevant value chains that could potentially spur FMNR adoption and provides advice on how to develop these further to gain optimal value from FMNR products. Chapter 6 concludes the primer by presenting approaches for uptake monitoring, evaluation and learning. This will help in tracking changes at both farm and community level, and documentation of best practices as well as lessons learnt.

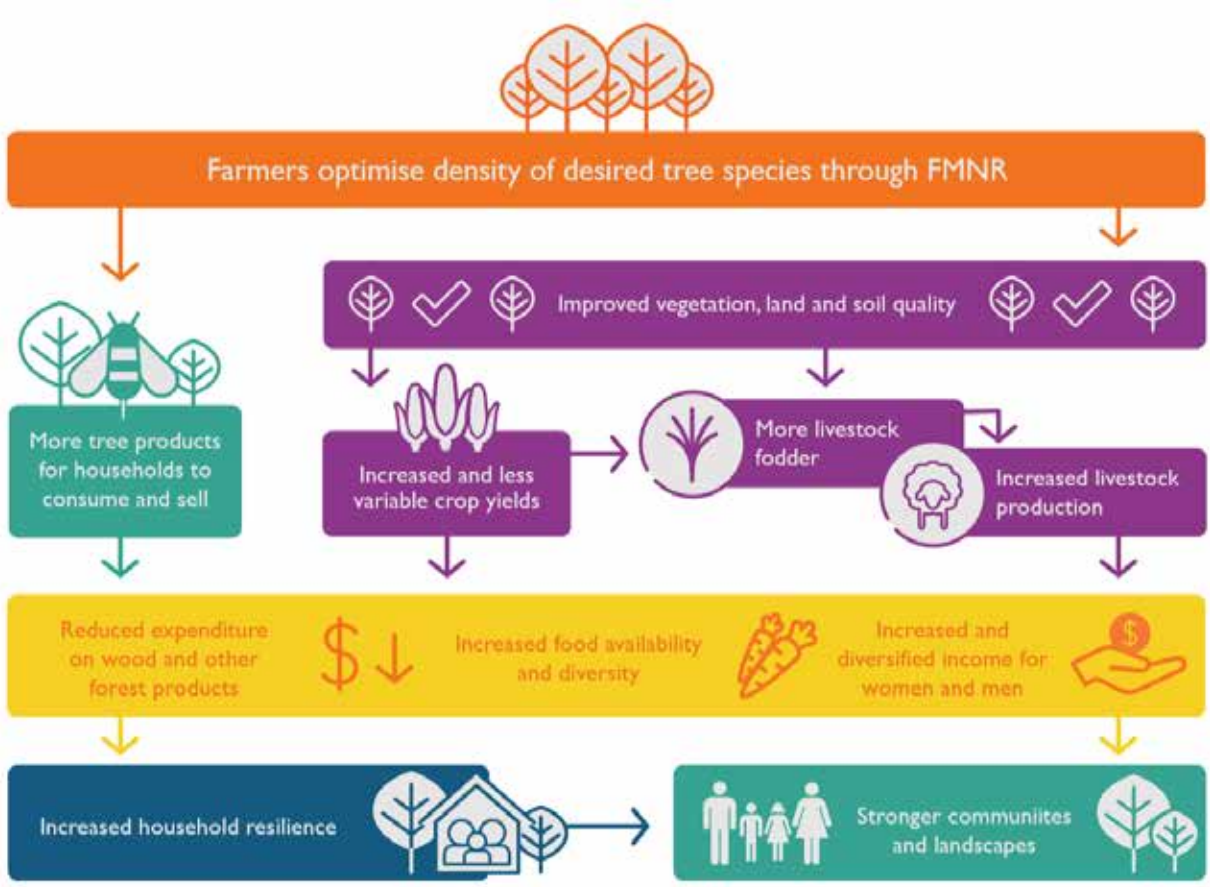


Figure 1: FMNR Theory of Change

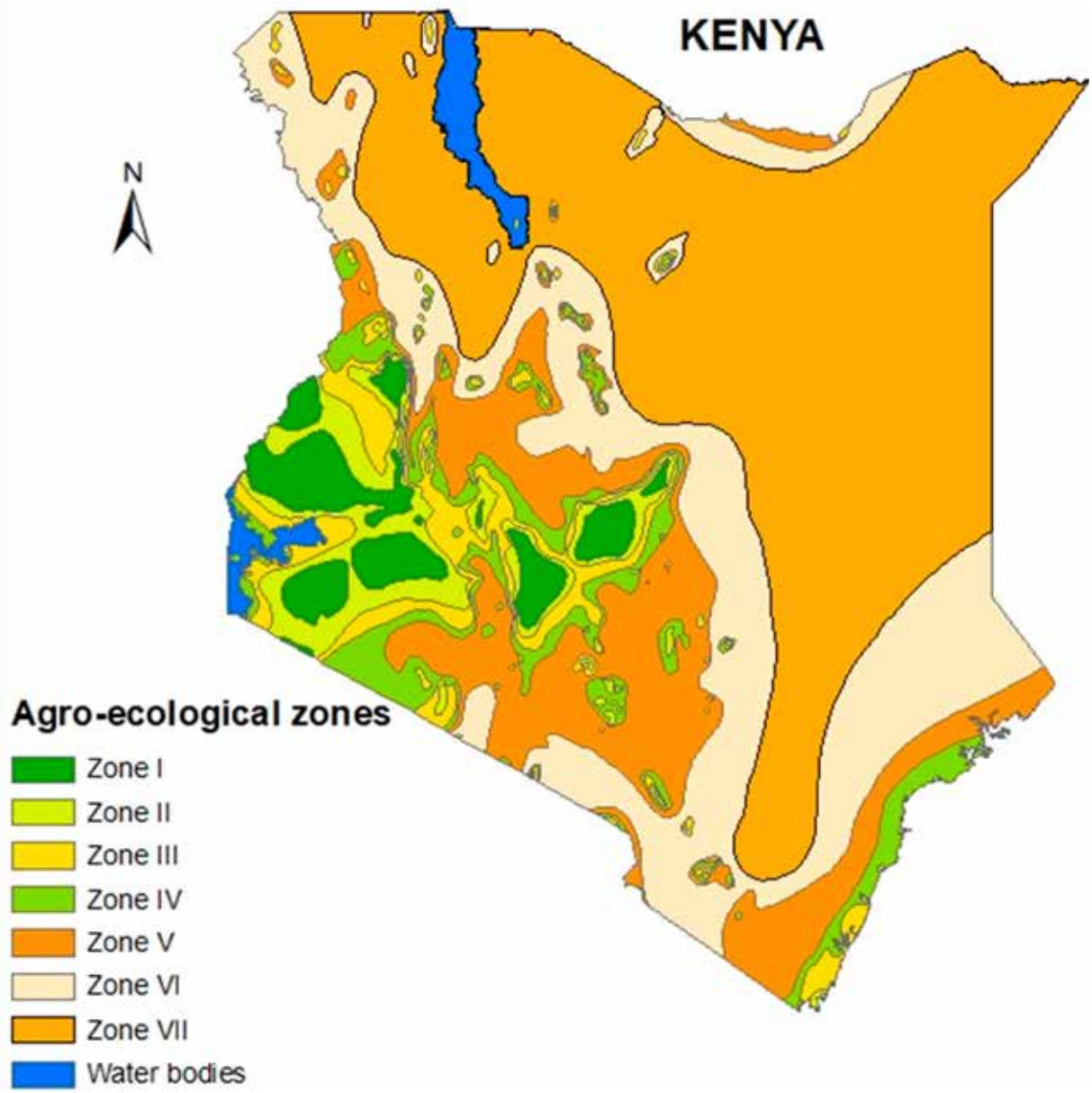


Figure 2: Agro-ecological Zones (AEZ) of Kenya *Source: Kenya Soil Survey*

CHAPTER 1

BACKGROUND INFORMATION ON KENYA'S AGRO-ECOLOGY

1.1 Agro-ecological Zones (AEZs) of Kenya

An Agro-ecological Zone (AEZ) is a land resource mapping unit, defined in terms of climate, landform and soils, and/or land cover. An AEZ has a specific range of potentials and constraints for land use[R13] essentially defined by the crop-growing period, temperature regime and soil type. Agro-ecological Zoning is a general guide that enables agriculture and forestry experts to plan on the best land use options, crop and livestock types for their respective duty zones and to use these blueprints to guide local communities in planning land use[R56]. However, these biophysical guides should be informed by socio-economic factors such as land tenure, population density, access to markets, level of education, infrastructure and support services, farming practices, culture and traditions. Existing government policies and regulations that guide and control land utilization by landholders also have a significant impact on decisions on land use.

Kenya's agro-ecological zoning has been mainly based on altitude, rainfall and potential productivity of crops and livestock. Broadly speaking, the country is divided into high, medium and low potential areas for agricultural productivity; this gives a general indication of what land use might be practiced in the specific areas. Seven distinct AEZs are defined for Kenya (Figure 2; Table 1). AEZs I and II correspond to the high potential area, AEZs III and IV represent the medium potential area while AEZs V, VI and VII lie within the low potential area. The low potential AEZs are defined by arid and semi-arid conditions and occupy about 84% of the country's total land mass. These zones can only support distinct vegetation types (Table 1) and a limited variety of land use practices.

All agroecological zones face unique challenges including land degradation, mainly orchestrated by deforestation and erosion of soil by wind and water. The arid and semi-arid lands (ASALs) face severe shortages of water, food and pasture for animals which is exacerbated by lack of sustainable natural resource management and overgrazing. The landscapes are fast losing their productivity and resilience potential, leaving poor farmers more vulnerable to climate shocks.

Each AEZ faces unique challenges including land degradation, mainly orchestrated by deforestation and erosion of soil by wind and water. The arid and semi-arid lands (ASALs) face severe shortages of water, food and pasture for animals which is exacerbated by lack of sustainable natural resource management and overgrazing. The landscapes are fast losing their productivity and resilience potential, leaving poor farmers more vulnerable to climate shocks.

Tree species suitability for each of the seven agro-ecological zones has been established through potential natural vegetation mapping[R26&6]. Indigenous tree and shrub species easily regenerate naturally in their ecological niches while tree establishment by planting, especially of fast-growing exotic species, is particularly successful in high potential AEZs. In Table 1, the most appropriate approach to tree establishment is elaborated for each AEZ, while common agroforestry practices in farming systems under each AEZ are outlined in Annex 4.

Table 1: Brief description of the Agro-ecological Zones (AEZ) of Kenya[3]

AEZ	Zone description related to agricultural production	Geographical Area	
i	Altitude over 2700m above sea level Minimum annual rainfall of 1500mm. Covers 25,400 Km^2 of total land mass i.e. 4.36% Immediate surroundings are very attractive for agriculture especially tea, coffee and dairy farming among others. Forested areas also serve as water towers but are also suitable for timber and pulp production.	Mountains such as Mt Kenya and Mt Elgon and immediate surrounding. Also covers the immediate surrounding of Mau and Aberdares ranges as well as other major water towers in the country including Kakamega Forest and other areas such as Kisii highlands.	
ii	Highlands between 1980 -2700 m Minimum annual rainfall of 1000mm. Covers 23,800 Km^2 i.e. 4.08% of total land mass Mainly occurs as forests or open grasslands up the mountains. Significant for rain-fed agriculture with some of the most suitable crops being wheat, maize, beans, Irish potatoes, tea and coffee. This zone is also significant for dairy farming.	Mt Kenya (parts of Meru, Embu, Kirinyaga and Nyeri) Parts of the Rift Valley around Mau and Aberdares ranges (e.g. around Kericho and Nyahururu respectively), The surrounding of Mt Elgon (e.g. around Kitale and Webuye), Kisii highlands and Kakamega forest.	
iii	Mainly at elevations between 900-1800 m Annual rainfall between 950 and 1500 mm. Covers 25,700 Km^2 i.e. 4.41% of total land mass Numerous tree species but somewhat of shorter stature than in Zone II and abundance of shrubs Most significant zone for agricultural cultivation in crop-livestock systems. Some of the most suitable crops include pulses, maize, wheat, cotton and cassava.	Vast parts of Nyanza, Western and Central regions, Most of Central Rift-Valley (Nandi, Nakuru, Bomet, Uasin Gishu, Trans Nzoia A small strip of the Coastal belt	
iv	Same elevation as AEZ III (900-1800 m) or at times lower. Annual rainfall of about 500-1000 mm. Covers 28,700 Km^2 i.e. 4.93% of total land mass A significant zone for nomadic pastoralism and can support some commercial ranching High potential to support irrigated agriculture especially with added technological input[4]. Most suitable crops for this zone include barley, cotton, maize, groundnut and sorghum.	Surroundings of Naivasha Some parts of Laikipia and Machakos counties Vast parts of the Coastal belt (Kilifi, Kwale and Lamu) A small strip along the shore of Lake Victoria Parts of Narok county to Tanzania's border	

[3]Main sources of information are: i) R56, and ii) http://www.infonet-biovision.org/EnvironmentalHealth/AEZs-Kenya-System
[4]Global Yield Gap Atlas. Link: *http://www.yieldgap.org/kenya*

Vegetation type and most appropriate Tree regeneration method
Vegetation type is classified as Afromontane rain forest (Fa) and Afromontane undifferentiated forest (Fb) [R26&6] Common indigenous tree species include *Adenocarpus mannii*, *Faurea saligna, Rapanea melanophloeos, Schefflera volkensii, Acacia abyssinica, Acacia lahai, Afrocarpus falcatus, Agauria salicifolia, Albizia gummifera, Allophylus africanus, Bersama abyssinica, Casearia battiscombei, Cassipourea malosana, Catha edulis, Celtis africana, Croton macrostachyus, Dombeya torrida, Ficus sur, Ficus thonningii, Hagenia abyssinica, Harungana madagascariensis, Ocotea kenyensis, Olea europaea, Polyscias fulva, Rapanea melanophloeos, Schefflera abyssinica, Schefflera volkensii, Shirakiopsis elliptica, Symphonia globulifera, Synsepalum brevipes, Syzygium cordatum, Vepris nobilis, Vitex fischeri, Zanthoxylum gilletii,* among others. Tree regeneration - natural regeneration and planting in lumber production forests.
Vegetation types - Afromontane undifferentiated forest (Fb) and Afromontane moist transitional forest (Fe),[R26&6] Common indigenous tree species include *Afrocarpus falcatus, Croton sylvaticus, Diospyros abyssinica, Ekebergia capensis, Juniperus procera, Milicia excels, Ocotea usambarensis, Olea capensis, Olea europea, Podocarpus latifolius, Prunus africana, Vepris nobilis, Markhamia lutea, Milicia excelsa, Ozoroa insignis, Syzygium guineense, Terminalia brownii, Terminalia mollis, Trichilia emetica, Warburgia ugandensis, Ziziphus mucronata*, among others. Tree regeneration - natural regeneration of indigenous species and planting for exotics, naturalized and indigenous species of high economic value.
Vegetation types - Combretum wooded grassland (Wc), Edaphic wooded grassland (Wd) and Coastal Mosaics (Cm)[R26&6] Common indigenous tree species *Acacia gerrardii, Acacia malacocephala, Acacia mellifera, Acacia nilotica, Acacia polyacantha, Acacia polyacantha, Acacia senegal, Acacia tortilis, Acacia xanthophloea, Balanites aegyptiaca, Combretum adenogonium, Commiphora schimperi, Dalbergia melanoxylon, Faidherbia albida, Lannea humilis, Sclerocarya birrea, Albizia zygia, Antiaris toxicaria, Bridelia micrantha, Cordia africana, Croton macrostachyus, Croton megalocarpus, Dombeya torrida, Ficus sur, Ficus thonningii, Hagenia abyssinica, Lepidotrichilia volkensii, Markhamia lutea, Milicia excelsa, Olea capensis, Polyscias fulva, Rhamnus prinoides, Spathodea campanulata,Trichilia emetica, Vepris nobilis, Warburgia ugandensis, Zanthoxylum gilletii* among others. Tree regeneration - natural regeneration of indigenous species and direct planting for exotic species and naturalized species of high economic value Tree regeneration - natural regeneration and planting in lumber production forests.
Vegetation type is classified as Evergreen and semi-evergreen bushland and thicket (Be), Edaphic wooded grassland (Wd) and Coastal Mosaics (Cm) [R26&6] Common indigenous tree species are mostly of Acacias species, *Combretum spp., Terchonanthus spp., Euphorbia spp and shrub species. Some of the species include Acacia drepanolobium, Acacia gerrardii, Acacia nilotica, Acacia polyacantha, Acacia senegal, Acacia seyal, Acacia tortilis, Adansonia digitata, Albizia coriaria, Annona senegalensis, Boscia salicifolia, Bridelia scleroneura, Commiphora habessinica, Cordia africana, Croton macrostachyus, Entada abyssinica, Erythrina abyssinica, Ficus glumosa, Grewia bicolor, Grewia mollis, Harrisonia abyssinica, Kigelia africana, Lannea schweinfurthii, Ozoroa insignis, Rhus natalensis, Syzygium guineense, Tamarindus indica, Terminalia mollis, Ziziphus abyssinica, Ziziphus mucronata,* among others. Tree regeneration - natural regeneration of indigenous species (most of the trees on land) and planting for suitable exotic and naturalized species.

AEZ	Zone description related to agricultural production	Geographical Area	
v	Usually lower elevations than Zone IV Annual rainfall is 300-600mm. Moisture index of 0.25-0.39 Covers 87,300 Km^2 i.e. 14.98% of total land mass High trees and shrub diversity Mainly significant for nomadic pastoralism and ranching. High potential for irrigated farming with beans pigeon peas, sweet-potatoes, sorghum and millet as some of the most suitable crops.	Parts of Rift Valley (West Pokot, Turkana, Baringo, Laikipia, Samburu, Kajiado and Narok Counties) Parts of eastern region (parts of Machakos, Kitui and Makueni counties) Parts of North Eastern region and Marsabit County Some parts of coastal Kenya (Tana River)	
vi	Zone is semi-desert and is the driest part of Kenya Annual rainfall is 200-400 mm and unreliable. Moisture index of 0.10-0.24 Covers 126,400 Km^2, i.e., 21.69% of total land mass. The zone is significant for ranching and wildlife conservation. Crop farming best under irrigation otherwise dryland varieties of maize, sorghum, millet and cowpeas can perform well	Parts of Marsabit, Turkana, Mandera, Garissa and Wajir counties Parts of Kajiado, Kitui, Makueni, Laikipia, Samburu, Baringo and West Pokot counties Small strip of the coastal region particularly Taita Taveta, Tana River and Kilifi counties	
vii	This zone covers very arid land mass of the country which are mainly rangelands. Annual rainfall is 150-300 mm and unreliable Moisture index of < 0.10 Covers 265,300 Km^2, i.e., 45.53% of total land mass. Some diversity of perennial tree and shrubs for livestock fodder Crop farming is possible under irrigation especially along major permanent water sources such as rivers and aquifers	It covers vast part of Marsabit, Garissa, Mandera, Tana River and Wajir counties It also covers eastern part of Isiolo and Turkana counties	

Vegetation type and most appropriate Tree regeneration method
Vegetation type is classified as Edaphic wooded grassland (Wd), Somalia-Masai Acacia-Commiphora deciduous bushland and thicket (Bd) and Acacia-Commiphora stunted bushland (Bds)[R26&6] Common indigenous tree species include *Acacia abyssinica, Acacia lahai, Catha edulis, Cornus volkensii, Croton macrostachyus, Cussonia spicata, Dombeya torrida, Dracaena steudneri, Erica arborea, Erythrina abyssinica, Euclea divinorum, Euphorbia tirucalli, Faurea saligna, Ficus ovata, Ficus sur, Ficus thonningii, Hagenia abyssinica, Lepidotrichilia volkensii, Margaritaria discoidea, Maytenus undata, Olea capensis, Pittosporum viridiflorum, Schefflera volkensii, Schrebera alata, Rhus natalensis, Senna didymobotrya, Syzygium guineense, Vangueria madagascariensis, Vernonia amygdalina, Zanthoxylum usambarense,* among others. Tree regeneration - mainly natural regeneration while planting only realistic with water harvesting interventions (see Chapter 2 for examples of these)
Vegetation type is classified as Somalia-Masai Acacia-Commiphora deciduous bushland and thicket (Bd) and Acacia-Commiphora stunted bushland (Bds)[R26&6] Common tree species include Acacia tree species such as *A. brevispica, A. drepanolobium, A. gerrardii, A. hockii, A. lahai, A. paolii, A. senegal, A. seyal; and Commiphora species like C. habessinica, C. myrrha and C. rostrata; Adansonia genera, Balanites eagyptica, Boscia coriacea, Salvadora persica, Boswellia microphylla, Euphorbia tirucalli, Faidherbia albida, Ozoroa insignis, Sclerocarya birrea, Rhus natalensis, Terminalia brownii, Ziziphus mauritiana, Ziziphus mucronata, among others. Also available are dwarf shrubs commonly of Indigofera, Sansevieria, Sericocomopsis and Duosperma genera.* Tree regeneration mainly through natural regeneration while planting only realistic in some areas with water harvesting interventions (see Chapter 2 for examples of these)
Vegetation type is classified as Acacia-Commiphora stunted bushlands (Bds)[R26&6] Some of the common species worth regenerating under FMNR for fodder, timber, woodfuel, honey production among other benefits include: Acacia species such as *A. brevispica, A. drepanolobium, A. gerrardii, A. hockii, A. lahai, A. senegal, and A. seyal; Balanites glabra, Berchemia discolor, Boswellia microphylla, Commiphora myrrha, Euphorbia tirucalli, Faidherbia albida, Grewia spp., Ozoroa insignis, Sclerocarya birrea, Rhus natalensis, Terminalia brownii, Ziziphus mauritiana, Ziziphus mucronata* among others Tree regeneration through natural regeneration while planting of high-value agroforestry fruit trees such as grafted Mangifera indica only realistic in some areas with water harvesting interventions (see Chapter 2 for examples of these) and around oases

1.2 Livelihood aspects of Kenya's Agro-ecological Zones and relevance of tree-based agriculture

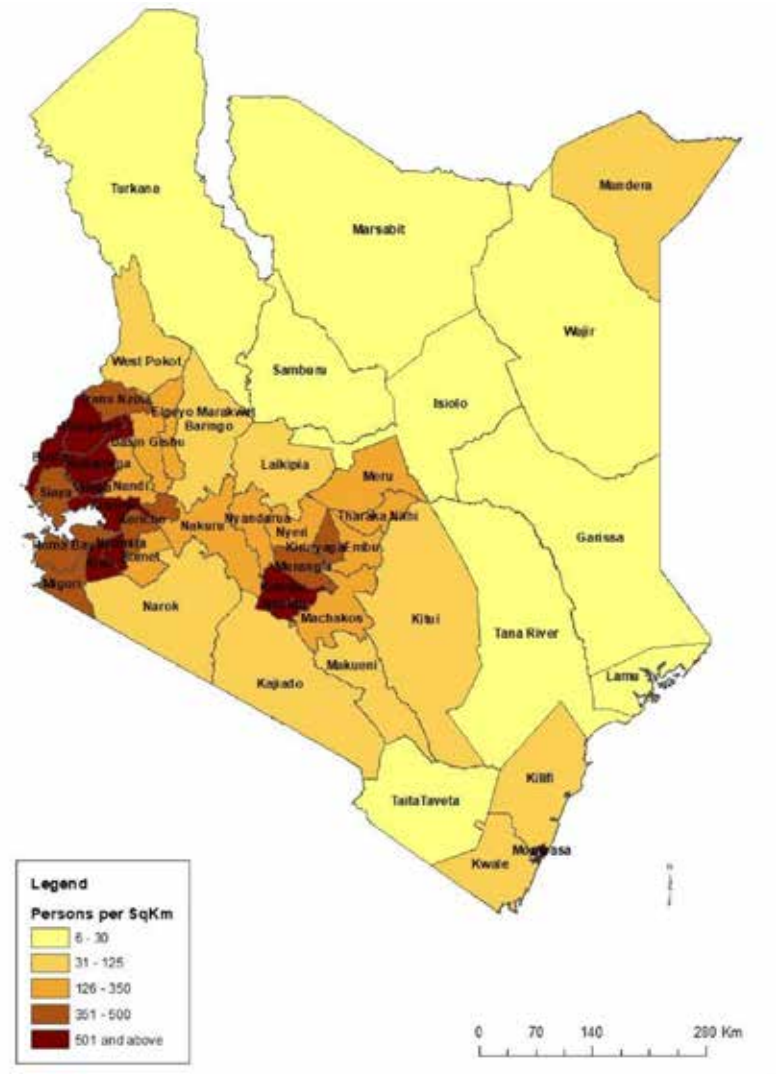


Figure 3: Kenya's population density (2019).
Source: Kenya National Bureau of Statistics[5] .

The agro-ecological context that could have an impact on the practice of FMNR, mainly in the ASALs, is elaborated in this section. A brief description of the biophysical characteristics of the landscapes as well as the socio-economic characteristics of households which significantly influence decision-making on which restoration practices to adopt is presented.

Population density in Kenya varies from one AEZ to another, with the highest density being in AEZ II and lowest density in AEZ VII (arid lands) (Figure 3). About 80% of the country's population is concentrated in AEZs II and III which occupy less than one-fifth of the country. ASALs cover 29 of 47 counties and host 36% of the country's total human population. There has however, been continued migration from humid to ASAL areas with the migrants attempting to carry out agricultural practices more suitable to humid areas in their new drier settlements. This includes planting trees that are not suitable to ASALs among other land management practices, which exacerbates land degradation as livelihood patterns change in response to new demographic context.

Given the high population density, the humid zones (AEZs II and III) are characterized by high agricultural

[5]Accessed from: *https://en.populationdata.net/maps/kenya-density-2019/*

intensification resulting **in low biological diversity in farmlands**. Farmers in these zones plant only a few tree species, mainly exotics, that give high economic returns particularly, *Grevillea robusta* and eucalypts. ASAL areas (AEZs IV to VII) are endowed with a good diversity of vegetation, which varies widely in terms of both area and season. For example, the lowland ASALs are dominated by grass and scrubland; slighter wetter semi-arid lands are dominated by woody savannah or woodlands, while higher altitude arid and semi-arid lands like Mt Marsabit, Mt Kulal and Huri Hills are covered by forest.

Agricultural production in the humid zones has hitherto relied on a few crop species usually planted as monocultures with high input of chemicals that easily degrade land when not applied judiciously. Farming practices are now changing in favour of an agro-ecological approach that leads to **multi-functional agricultural landscapes**[6], thus placing trees at the centre of production. Multi-functional landscapes have capacity to provide food and fibre to humans and animals, offer habitats for insects that deliver pollination and pest control services, soil organisms that influence soil structure, nutrient cycling, soils stabilization against erosion, carbon sequestration and storage, among several other environmental goods and services. The role of indigenous tree species in producing such landscapes cannot be overstated.

ASAL zones, on the other hand, are fragile and easily lose their capacity to provide ecosystem services compared to humid zones. Shallow soils, trampling by livestock, high wind speeds and other geological and climatic factors contribute to the fragile status. Maintaining key indigenous tree species that define specific vegetation types can thus provide a natural support system for maintaining a multi-functional landscape status in such zones *(Box 1).*

Arid and semi-arid lands are fragile, and easily lose their capacity to provide ecosystem services compared to humid zones. Shallow soils, trampling by livestock, high wind speeds and other geological and climatic factors contribute to the fragile status. Maintaining key indigenous tree species that define specific vegetation types can thus provide a natural support system for maintaining a multi-functional landscape status in such zones.

On average, three in 10 rural households face **food shortage** in Kenya. In terms of food quality, about 4 million people (12% of all households) have unacceptable food consumption relying on diets that mainly consists of a staple, flavoured with green vegetables and oil. The bigger share of the population with inadequate nutrition mainly lives in the ASALs. The prevalence of low dietary diversity in some counties such as Turkana (37%) and Marsabit (33%) is much higher than the rest of the country, with households consuming only four or fewer dietary groups[7]. Trees have the potential to improve this situation by providing additional nutrition, e.g., fruit trees, or diversifying household income sources which can then be used to meet their dietary needs.

Generally, two-fifths of Kenya's population lives below the poverty line, but the figure rises to over 60% in the rural ASAL areas. Eighteen of the 20 poorest constituencies are from the ASAL counties such as Turkana, Marsabit, Wajir and Mandera which have between 74% and 94% of their population living below the absolute poverty line. Livestock is the main livelihood support for the ASAL communities while co-existence with wildlife contributes greatly to wildlife-based ecotourism. Human wildlife conflicts reverse such gains, however. Inequalities abound in ASALs with the few rich owning either larger herds or more fertile lands. Women, especially those living in rural areas (whether in humid areas or ASALs), are most affected due to discriminatory practices that deny them access to productive assets[R63]. FMNR has the potential to diversify income and livelihood sources with opportunities at primary, secondary and tertiary production processes (See Figure 4). This can reduce inequalities between both gender and wealth categories.

[6]**A multi-functional agricultural landscape** is an agricultural landscape that has potential to provide multiple services for society in addition to the service of food and fibre production. That is, it has the ability to contribute to: (i) the viability of rural communities, providing employment and catalyzing economic activities such as supply and processing industries and service providing companies, (ii) landscape values, including supporting cultural-historical landscapes, natural habitats, openness, silence and darkness; and (iii) environmental health, including clean water and air, land conservation and the sustainable management of renewable resources.

[7]There are 12 dietary groups commonly used for dietary diversity measurements, i.e., cereals, roots and tubers, vegetables, fruits, meat/poultry/offal, eggs, fish and seafood, pulses/legumes/nuts, milk/milk products, oil/fats, sugar/honey and miscellanies

Box 1. Natural support system for maintaining multifunctional landscape status in ASALs

Farmers and pastoralists from the drylands of Kenya depend on the land's natural biological productivity (influenced by high diversity of indigenous vegetation). This natural capital generates products of economic value such as food, fibre, and other products as well as other ecosystem services[R33]. Amidst unfavourable climatic conditions, the people and their land have been able to acquire resilience[8] that enables regular recovery following droughts and other nature-induced shocks like floods and fires. For example, food production depends on land productivity, which is expressed in terms of primary plant productivity, (primary, since it is derived from nature's raw materials converted into organic matter by photosynthesis). FMNR ensures that natural productivity of the land is restored for the well-being of humans and other fauna and flora in the ecosystem. The various ecosystem services that result from increase of tree cover and diversity include[R33&13:]

1. ***Supporting services*** *- Trees recycle nutrients and fix nitrogen from the atmosphere, thus making them readily available for crop use. Other services include hosts to edible insects, habitats for pollinators, carbon capture/sequestration, shelter from wind and sun, modifying micro-climates, increased soil carbon, erosion control, refugia for biodiversity, record of climate history and better regulation of water, including groundwater recharge.*
2. ***Provisioning services*** *- Tree diversity generates a diverse suite of products of economic value such as fruit, nuts, oils, beverages, gums, resins, latex, flavours, leaves for food, livestock fodder, timber, fuel wood and biomass for energy production, and medicines, most of which can also be sustained during drought years. Farmers also earn income from sales of the tree products.*
3. ***Cultural services*** *- Trees, more than other plants, generate cultural services (sometimes as individuals but more often as their aggregation in groves, woodlots, etc.) especially when comprising islands of greenery in otherwise bleak landscapes. These cultural services have potential to be translated into recreation and tourism opportunities, which are also sustained during drought years. Trees have also been used as land boundary markers and to confer land use rights even if not full ownership of land.*

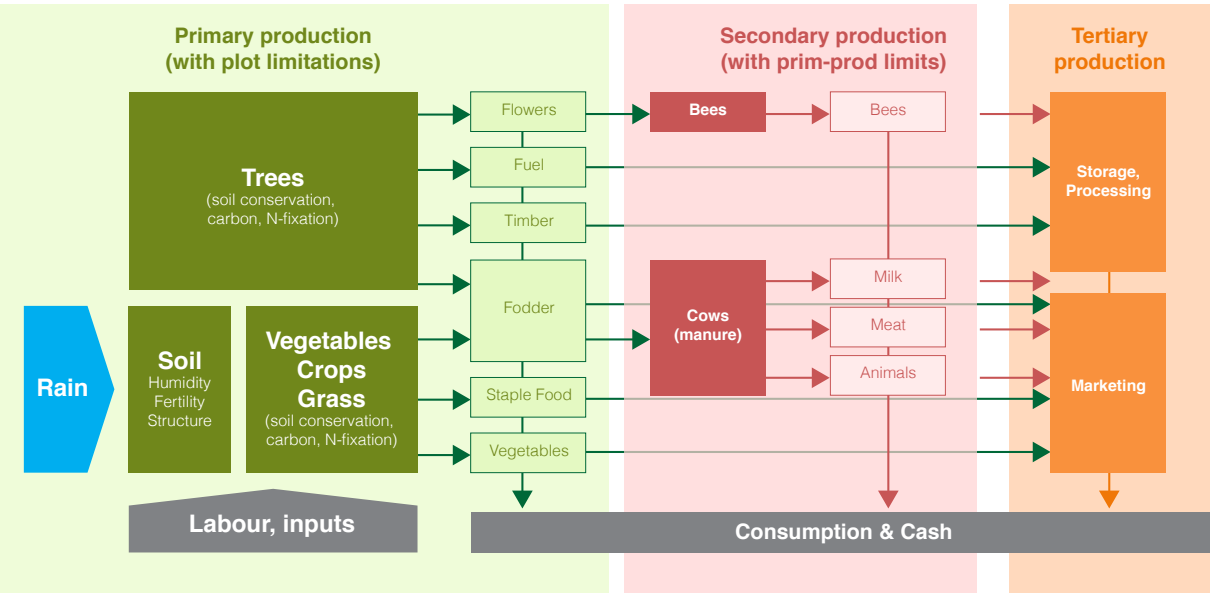


Figure 4: FMNR-based agricultural production system *(Adapted with permission from[R55])*

[8] *Resilience* is a desirable condition, often simply considered as the converse of vulnerability, where people have the means to protect themselves from, or survive hazards. Complete protection from drought, flood and other eco-physical factors is impossible (it either rains or it does not).

Land holdings per household increases with aridity in Kenya with households in ASALs holding, on average, bigger parcels than those in humid areas. In semi-arid lands, however, agro-pastoralists usually cultivate a small portion of their land, leaving the rest as fallow or bushland that is either not utilized or left for animals to graze. The uncultivated portions are usually not put into economically productive use and are prone to degradation. While FMNR is applicable and useful to both crop- and bushlands, it can significantly improve management of bushlands by bringing them to economic use, thus increasing farm and household resilience (more of this in Chapter 3).

In terms of **culture**, a rich ethnobotany exists among pastoralists as well as other rural communities, albeit that changing land use and culture is contributing to fast erosion of the knowledge. Pastoralists have good understanding of what tree species serve as dry season feeds and the associated conservation approaches. Many communities in the country are also amenable to trees, with a good tree planting and conservation culture that can be harnessed for promoting FMNR. Cultural bias however exists in several communities depriving women of opportunities to own land and/or limiting access and control of trees and their products, which to them and their children are important safety nets and 'insurance' at times of hardship and crop failure. Commercialization of some products such as charcoal also under-compensates primary producers resulting in degradation of values and commitment to resource conservation among poor communities. Promotion of FMNR with mindset change and value chain strengthening aims to reverse such cultural negatives.

Going by the foregoing challenges, ASAL areas require better planning, careful selection of farm enterprises, greater investment in infrastructure, improving productivity of agricultural landscape and rangelands by reversing degradation through approaches such as agroforestry, farmer-managed natural regeneration, holistic grazing management[9] and other sustainable soil and water management practices. Some of these are briefly considered in Chapter 2 as supportive practices to FMNR.

1.3 Assessment of Agro-ecological Zones for FMNR applicability

The presence of many plant species in an agricultural landscape increases biological diversity across landscapes which increases the population of pollinators and natural enemies of pests and diseases, among other benefits. Extension agents and other farmer advisory services should therefore encourage crop-land-based FMNR for such purposes (see Chapter 3) where conditions allow. Given that the humid zones have usually been under continuous cultivation for decades, it is possible that seeds of indigenous species may have been depleted from the soil while stumps are already destroyed. Restoration of such species may therefore call for deliberate planting of indigenous species in addition to ecologically-fit high-value exotic species while encouraging regeneration of those that are freshly cut.

A detailed description of the Agro-ecological Zones in 1.1 and 1.2 as well as the associated farming systems described in Annex 4 reveals that natural regeneration (see definition in Chapter 2) of trees is a more reliable approach for establishment of trees than planting in semi-arid and arid lands (ASALs) (AEZs IV-VII). Table 2 highlights some of the inherent characteristics of AEZs IV-VII (ASALs) and their implications on the role FMNR can play as part of an integrated development approach. The suitability of FMNR in the various AEZs is further elaborated in Chapter 3 (Table 4). It is important to note however, that while tree planting may be more preferable in humid areas so as to target high-value species, FMNR is also applicable in these zones as some level of indigenous tree species diversity needs to be incorporated in farms. These species enhance tree diversity and thus increase the stability of farm systems in the zones.

[9]Holistic grazing management is an important management tool for maintaining healthy ecosystems and improving rangelands productivity. Its effectiveness is dependent on timing and frequency of grazing, as well as the type of animal (R32).

Table 2: Characteristics of ASALs and their implication on development initiatives and FMNR

Characteristics	Challenges faced by the community groups	
Low rainfall defined by erratic distribution, sudden severe storms, and high day temperatures	High costs of livelihood sustenance, especially associated with food and fodder scarcity, need for investment in water management technologies and difficulty in establishing trees by planting	
High soil erodibility, high salinity, very low soil organic matter	High cost of soil management specially to maintain soil fertility and stability in situ	
Dominated by communal lands which are increasingly being converted to private lands. However, majority still don't have tenure security for their land.	Communal land ownership poses a great challenge to adoption of conservation practices such as FMNR in absence of strong community governance structures	
Insecurity caused by cattle rustling and conflict over resource use such as grazing areas and water. The issue of insecurity is compounded by protracted hosting of refugees in some of the ASALs (see more of this in Box 2)	Cases of insecurity are likely to cause displacement of persons and abandonment of ancestral lands temporarily. This can cause stalling of community development projects and protracted displacements in worst case scenarios	
Cultural practices like nomadism dominantly practiced by men in search of pasture and water for a better part of the year	Men might not be dependable in restoration projects since they move with animals to far places. And as pasture zones continue to shrink, possibility of involving men in land restoration initiatives grows thinner by the day	
Dominated by communities with generally high levels of poverty and vulnerability	Limited capital to invest in livelihood activities and contribute to development initiatives	
Livestock production is the main source of livelihood for the communities	Nutritional insecurity and lack of diversified income sources for households	
Wealth of natural resources including vegetation, wild animals, water resources (both surface and in underground aquifers) that supports livestock production but susceptible to degradation due to overstocking and overgrazing among other factors	Persistent conflict over these natural resources causes insecurity, displacement of residents, and increases vulnerability of women and children who are heavily dependent on sustainable ecosystems for their survival	

Opportunities through FMNR
FMNR can lead to quick establishment of trees that could provide forage for animals and food for humans (fruit trees), which are key in building resilience of the populations. FMNR enhances tree protection and regeneration, thereby improving soil moisture availability and landscape level hydrological functions
FMNR can improve soil properties both physical and chemical due to improved biological functions around regenerated trees
FMNR scaling can take advantage of a strong communal leadership structures which is common among pastoral communities and realize much success where appropriate benefit sharing arrangements are in place. Strengthening leadership structures where weak is a necessary entry point for success.
FMNR projects can support conflict resolution because, as trees grow and enhance pasture availability, more natural resources become available thus reducing competition for scarce resources. Also, the practice of FMNR involves community participation, consultation and agreement around how to best manage natural resources to everybody's benefit. This may reduce incidences of conflict, thus strengthening cohesion
Experience has shown that women are the most appropriate target participants for sustainability of FMNR initiatives in largely pastoral communities. FMNR presents opportunities to empower women but there is need to target men as well. Men whose mindsets have been transformed towards sustainable land management are likely to practice land restoration, even in areas where they migrate to in search of pasture and water
Low-cost initiatives such as FMNR can support asset accumulation and rekindle livelihood hopes
FMNR can support sustainability of livestock value chains and diversify incomes through tree-based value chains (e.g., gums and resins, honey, fodder, timber and poles, fuelwood, etc.) as well as enhance crop productivity
Strong community institutions can support FMNR practice and thus restoration of rangelands and livelihoods. FMNR also has potential to boost the much-needed resources that are main causes of conflict especially through conservation of forage and of water resources. Community groups especially of women who are most vulnerable in times of conflict are likely to motivated to adopt FMNR

Box 2. A note about refugees and tree resources in Kenya's ASALs

Since the early 1990s, Kenya has been hosting about half a million refugees in two camp complexes; Dadaab in Garissa County, and Kakuma in Turkana County, both in the fragile arid region. In both camps, firewood and charcoal are the primary sources of cooking and heating energy, although majority of refugees use firewood because it is cheap and relatively available[R58]. Demand is high, and the capacity of the surrounding environment to provide it sustainably has been eroded over the years[R48]. The increased demand has accelerated unsustainable harvesting of trees for firewood as well as charcoal production and the ensuing scarcity causes competition between refugees and local communities, often resulting in tension and even conflict[R24]. Moreover, scarcity of firewood has resulted in refugees selling their food rations to access energy for cooking, as distance to collection areas increases and trips become insecure to undertake, especially for women. There does not seem to be an end in sight for this problem given that efforts to repatriate refugees to their countries are frustrated by protracted instability back home. Some refugees have been in the camps for about three decades and increasingly identify with the camps as their homes. The extractable resources will continue to dwindle with increasing land degradation and escalate conflicts between refugees and the local communities, if efforts to reverse the situation are not enhanced. The legal framework governing refugees in Kenya is under revision with a bill already drafted that gives provisions for promoting self-reliance and entrepreneurship for both refugees and local communities. The bill grants refugees the right to be included in development plans thus enabling work and use of land for livelihood support. These developments provide opportunities to organize refugees and host communities, through their grassroots institutions, to undertake restoration of the degraded lands near the camps in order to alleviate this problem. FMNR is a low-cost approach that can help achieve this aspiration in the near term.

Picture of houses in a section of Kakuma refugee camp – Turkana County – note the spread of settlement and lack of vegetation (Photo: World Vision Kenya)

CHAPTER 2

FMNR DEFINITIONS AND PRINCIPLES

2.1 Defining Farmer-managed natural regeneration (FMNR)

2.1.1 Foundational basis of farmer-managed natural regeneration

Farmer-managed natural regeneration is an agroforestry practice that does not rely on tree planting. Instead, it depends on active management of bushlands, tree stumps and/or seeds that have self-germinated from the soil, allowing them to grow into productive or useful trees. It is important to note that FMNR is often used interchangeably to describe both the physical tree management practices, such as pruning, and a broader community development approach that uses FMNR alongside community advocacy and economic development initiatives to regenerate a community's environment and provide sustainable laws and value chains. The process of tree establishment is a form of natural regeneration, which can take different approaches in different contexts as outlined below.

Spontaneous natural regeneration	Natural regeneration is the process by which forests, woodlands, rangelands and farmlands are regenerated or restocked from seeds that fall and germinate in situ, or vegetative means without any human involvement[R53]. There is minimal external input or management, other than possibly fencing or excluding threats from the site to be regenerated.
Assisted natural regeneration (ANR)	ANR is a way of enhancing the establishment of secondary forests from degraded grassland and shrub vegetation by protecting and nurturing mother trees and their wildlings inherently present in the area. ANR aims to remove or reduce barriers to natural forest regeneration, such as soil degradation, competition with weedy species and recurring disturbances, which include fire, grazing and wood harvesting. In addition to protection efforts, enrichment planting ensures new trees are planted as needed or desired. ANR is used to regenerate secondary forests and does not include the pruning of existing trees, only protection of mother trees and wildlings or seedlings.
Farmer-managed regeneration	Farmer-managed regeneration refers to the regeneration of introduced species that remain un-naturalized in a specific landscape. The same practices of pruning and management are used as those of FMNR explained later in this chapter. However, farmers may select species for specific uses, such as the regeneration of eucalypts in forest plantations either in Kenya government forests, private forests such as tea or tobacco zones for wood.

Adapted from Global FMNR Manual[R49].

Natural regeneration of native trees as well as naturalized exotic species is an age-old practice in Kenya and the rest of the world. It has received scanty attention in past land management initiatives, especially in its role as an agroforestry regeneration practice. World Vision and World Agroforestry (ICRAF) have embraced FMNR in particular, and are promoting it globally while contextualizing its definitions and scope. It is therefore necessary to understand the evolution of of agroforestry in order to frame FMNR definitions and application in the Kenya's agroforestry context.

Agroforestry is an old practice, but was only formally defined four decades ago. During this time, its definition has evolved as the context becomes better understood. The practice was initially defined as:

> **Agroforestry is a collective name for land-use systems and technologies where woody perennials (trees, shrubs, palms, bamboos, etc.) are deliberately used on the same land management unit as agricultural crops and/or animals, in some form of spatial arrangement or temporal sequence. In agroforestry systems, there are both ecological and economic interactions between the different components.**

The early definition was very focused on the practice at the farmers' level of land management. However, the current focus now includes landscape level outcomes as well as policy levers. A broader definition is currently applied:

> **Agroforestry, a combination of agriculture and forestry, is land use that combines aspects of both, including the agricultural use of trees[R45].**

Agroforestry has now become widely accepted as a sustainable land management approach due to the many benefits trees confer on lives, livelihoods and landscapes. However, the practice has been historically based on conventional forestry practices, and has thus emphasized tree establishment through direct planting. This approach has fronted tree nurseries as the genesis of tree establishment through provision of good quality seedlings.

Tree planting is limited in some places by various factors such as harsh environments, poor access to tree seeds and seedlings, especially of native species, livestock damage and others. Farmer-managed natural regeneration provides the potential solution for tree establishment in such contexts, as long as it meets the farmers' needs and production objectives.

World Vision defines FMNR as the systematic regrowth and management of trees and shrubs from felled tree stumps, sprouting root systems or seeds, or in woody thickets.

World Vision defines FMNR as the systematic regrowth and management of trees and shrubs from felled tree stumps, sprouting root systems or seeds, or in woody thickets.

FMNR leads to quick restoration of tree-less landscapes, especially those with many living stumps. FMNR can be practiced by men, women and children, and could minimize cultural hindrances to tree establishment associated with tree planting in some cultures[10].

World Vision has promoted FMNR as a sustainable livelihood approach and has a repository of resources at the FMNR Hub to support development practitioners in scaling the approach. A manual was published by the Hub to guide FMNR practices globally[R15], from which contextualized guidelines can be drawn to enhance scaling up in specific country contexts. The vision is to catapult a global land restoration movement based on FMNR and support achievement of land restoration targets (see Annex 5). This primer is an offshoot of the same.

Broadly, FMNR is the practice of actively restoring, managing and protecting non-planted trees and shrubs in agricultural landscapes, communal lands and rangelands to combat poverty and hunger by increasing food, fodder and wood production as wells as resilience to climate extremes.

[10]For example, it is a taboo among the Luo for women to plant trees when their husbands are still alive, since it is believed that such action can lead to the death of their husbands or cause barrenness in women [R47]

2.1.2 Origin and evolution of FMNR

FMNR is not a new technique, but rather a term that brings to the fore the centuries-old practice of "**coppicing** and **pollarding** of trees" (see section 2.1.3 for details).

The practice gained wide international attention after communities in the Maradi region of Niger, West Africa, began implementing it around 1983. The actual innovation is however, said to have begun following the severe drought of the mid-1980s. A few innovative farmers in Maradi region, working with Tony Rinaudo under the missionary organization, Serving in Mission (SIM)[11], developed specific techniques for regenerating trees from existing stumps – combined with low-cost soil and micro-catchment water harvesting techniques. Given that Niger was a focal area for the development and scaling up of FMNR, most of the current literature on FMNR covers Niger and neighbouring countries like Burkina Faso.

Plate 1. Tony Rinaudo demonstrating tree pruning in an FMNR site in Elgeyo Marakwet County

A number of projects that utilize approaches similar to FMNR have been implemented in other parts of Africa. During the late 1980s and 1990s, a long-term government-supported programme was implemented in Tanzania's Shinyanga region. The project aimed to reverse land degradation by reviving traditional dry-season pasture and woodlot protection, an initiative that gained momentum and spread to more than 800 villages (Box 3).

[11]The global FMNR manual gives Tony Rinaudo's story in his own words. A worthy reading for inspiration.

Box 3. The Shinyanga Soil Conservation Programme

Better known by its Swahili acronym HASHI (Hifadhi Ardhi Shinyanga), the programme ran from 1986 to 2004, with the aim of restoring the degraded Shinyanga region of northwest Tanzania. The region's Miombo woodlands had been decimated by decades of forest clearing (partly for tsetse fly eradication) and forced resettlement under Tanzania's "villagization" programme. HASHI brought together an array of government and international partners, but put local communities at the forefront of reforestation efforts. A traditional system of enclosures dubbed *Ngitili*, was reintroduced and Sukuma agro-pastoralists were given responsibility for conserving forest plots. Participatory rural appraisal methods helped villagers to identify local natural resource problems and agree on solutions. Farmers and villagers received training on how to best manage their Ngitili. Technicians provided advice on which indigenous species were best suited to enrich farms soils or create dense boundary plantings. In most villages, HASHI field officers used residual natural seed and root stock to restore *Ngitili* enclosures. In others, active tree planting (first of exotic species, later of the indigenous tree species preferred by local people) was carried out, especially around homesteads. The result was that by 2004, at least 350,000 hectares of *Ngitili* had been either restored or created in 833 villages across the region.

Briefed from: ***https://www.equatorinitiative.org/wp-content/uploads/2017/05/case_1348161099.pdf***

Community resource conservation has faced many challenges with time, as livestock numbers and human population increases while land use change and partitioning is becoming the norm.

In Kenya, land management approaches bordering on FMNR have been practiced in many areas where farmers allow selected tree regeneration on crop land through protection and management of sprouting stumps and wildings. Pastoralist communities have also traditionally closed some portions of community land to allow for regeneration of trees and restoration of degraded resources. In areas where the practice has been prevalent, traditional institutions play a very important role in ensuring success. Some areas were reserved for dry season grazing and were protected by the community. The dry season grazing areas were set aside, both to cushion pastoralists during drought and to give the normal grazing areas time to recover.

Community resource conservation has faced many challenges with time, however, as livestock numbers and human population increases while land use change and partitioning is becoming the norm.

While these trends have exacerbated land degradation, a new approach to restoration through community conservancies is being pioneered by Northern Rangelands Trust and (variants of the same by) other organizations. The conservancies are autonomous institutions representing communities that legally or traditionally own or use a defined area of community land who come together under a well-structured corporate body with an aim of improving social wellbeing, land and resource management and environmental conservation (see example in Box 4). Income from the eco-tourism industry is giving the needed incentives for resource conservation in this model.

Box 4. The NRT Community Conservancy Model of Resource Conservation[R28]

Community conservancies bring together people living on, and using a given piece of land under a well-structured corporate body with an aim of improving social wellbeing, land and resource management and environmental conservation. As an organized platform and voice for people to manage their common resources, the institutions develop programmes for peace, livelihoods, conservation and business development and provide a formal structure for partner engagement.

Conservancy establishment begins with engaging community leaders (traditional and formal) as well as prominent individuals who are natural leaders in their community to create awareness. In communities where traditional institutions (for governing resources) are strong and intact, conservancies recognize them as the highest decision-making body and either, formally or informally, integrate them into the conservancy institution. This streamlines community governance structures and ensures formal, administrative or customary institutions are represented on Conservancy Boards as well as integration of both customary and formal approaches to conservation in the particular model. Examples:

- **Ndera Community Conservancy in Tana River County:** The traditional council of elders for the Pokomo Community is known as *Gaza*. The Chairman of *Gaza* is co-opted into the Conservancy Board to ensure that any decisions made by the Board are also communicated and approved by the traditional group.

- **Shurr Conservancy in Marsabit County:** The Gabbra community has five Councils of Elders or *'Yaas'*. During the formation of Shurr Conservancy the *Yaa* were informed and closely involved; they are consulted prior to election of the Board and continue to play a significant role in conservancy management. The Chairman and several other Board members are also members of the *Yaa.*

Conservancies can represent a single ethnic group, especially those among the first to be established (Il Ngwesi - 1995, Lekurruki - 1999, Sera - 2001 and Kalama - 2002), or can be multi-ethnic conservancies whose members came together as one 'conservancy community' with a common goal. Examples:

- **Ruko Community Conservancy (2006)** – Pokot & Ilchamus communities in Komolion and Rugus locations of Baringo County

- **Nakuprat-Gotu Community Conservancy (2010)** – Borana & Turkana communities in Ngare Mara and Gotu locations of Isiolo County

- **Nasuulu Community Conservancy (2011)** – Borana, Somali, Turkana & Samburu communities in Isiolo West location of Isiolo County

Creation of multi-ethnic conservancies has significantly reduced conflict among resident communities in cases where there was historical conflict between the different tribes living in areas now encompassed by the conservancy.

2.1.3 Practical Aspects of Tree Establishment and Management with FMNR

Unlike tree planting, FMNR is applicable wherever there are living tree stumps with the ability to coppice [re-sprout] or wherever there are living seeds in the soil that can germinate.

In dry areas, native species adapt to stress conditions by producing many seeds that retain viability for long since good seed production seasons (referred to as *'seed years'* in forestry) may be few and far apart. The seeds produced also usually have 'dormancy' to ensure germination is delayed and only happens when there is sufficient soil moisture to boost survival of the germinants. Production of many seeds with long-term viability and dormancy ensures that the soil has a wealthy stock of seeds of various plant species, usually referred to as the 'soil seedbank'. Germination usually happens at the onset of rains, more so during the long rain season. However, the seedlings may either be weeded out or destroyed by livestock and/or other agents. FMNR farmers nonetheless, nurture newly germinated seedlings (also known as wildlings) of preferred species to maturity by protecting them from animal browsing and trampling.

Tree stumps mask an entire root infrastructure that has developed over the entire tree lifetime and remains robust for a long time after the above-ground tree is cut down. The stumps have a stock of nutrients and other support systems to enable quick re-establishment of the tree above ground which has the capacity to grow faster than a newly established seedling. FMNR makes use of these existing root systems and tree stumps to re-establish trees on landscapes.

Shoots produced at the base of the tree (stump) establish and grow as fast as young seedlings since the base of a tree always retains juvenile characteristics (Figure 5). That is why cuttings established from tree stump sprouts establish faster in nurseries than those from the tree branches (which are used for grafting and usually dwarf the tree). Shoots sprouting from the stump can therefore grow faster than germinated tree seedlings since they benefit from a well-established root system (underground tree).

In practice, FMNR involves three steps. These have been listed below[R49].

1. Selection of species and stumps
2. Pruning and management of regenerating trees
3. Maintenance and utilization of trees

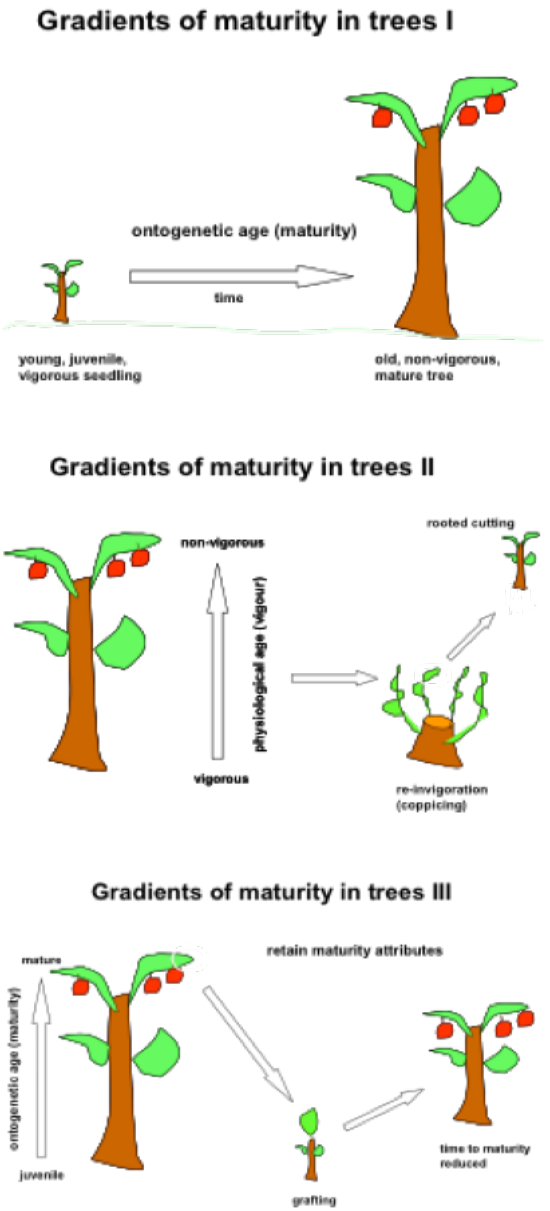


Figure 5: Gradients of maturity in trees showing that a tree stem base always exhibits juvenile characteristics *(Adapted from [R23])*

1. Selection of species and stumps

Tree species involves identification of tree species that farmers want to have on their land based on the farmers' objectives. Farmers usually keep species that are valuable to them, whether on their farmlands or community-managed lands, except in specific projects where biodiversity is a major objective or is tied to another benefit such as receiving carbon credits for rehabilitation projects.

Tree species selection depends on:

1. natural occurrence of species,
2. coppicing ability of each species,
3. local beliefs and values ascribed to each species,
4. uses of each species, and
5. characteristics such as thorniness, competitiveness with crops, and growth rate among other factors.

The Africa Tree Finder app developed by ICRAF as well as the guidance questionnaire in the global FMNR manual can help in the development of a list of possible indigenous tree species within a locality in a participatory manner. Other materials that can aid tree species selection include manuals such as the FAO Community Forestry Manual[R60]. Information provided by the tools can augment local knowledge in widening the portfolio of species to regenerate through FMNR in a locality.

The following steps are useful in selection of species and stumps:

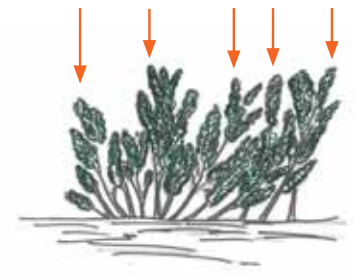
1. Generate a preferred species list with the community based on required uses of regenerated trees, local species' availability and possible restrictions, to inform tree species selection.
2. When regenerating from living tree stumps, roots and seeds, base your selection on individual and community goals. For each stump identified, choose and protect a number of the most robust (tallest and straightest) stems to leave.
3. Where there is bush encroachment, select the desired trees and species to be managed and cut out the rest. When dealing with dense thickets, you may need to make decisions as you go, because many trees will not be accessible until you have removed some of the unwanted ones.

2. Pruning and management of regenerating trees

1. Remove unwanted or weak stems (coppices) and side branches, leaving only those with potential for robust growth (see Figure 6).
2. Train the selected stems to grow into new trunks, usually by tying them together.
3. Protect the remaining branches from livestock, fire and competing vegetation or weeds.
4. Periodically return to the trees and cull emerging new stems and prune side branches from time to time.

The Africa Tree Finder app developed by ICRAF as well as the guidance questionnaire in the global FMNR manual can help in the development of a list of possible indigenous tree species within a locality in a participatory manner. Other materials that can aid tree species selection include manuals such as the FAO Community Forestry Manual[R60]. Information provided by the tools can augment local knowledge in widening the portfolio of species to regenerate through FMNR in a locality.

1. Select species and stumps of trees



Step 1. Survey land for sprouting stumps or seedlings and identify what species of tree are present

Step 2. Select the species and stumps to be regenerated

2. Prune and manage

Step 3. For each stump, select tjhree to five stems to keep and prune away the unwanted stems

Step 4. For each remaining stem, prune off side branches up to halfway up the trunk

Step 5. Protect the stems while they are growing

3. Maintain and utilise

Step 6. Prune unwanted emerging shoots every two to six months as needed

Step 7. Utilise tree for planned purposes; harvesting branches, portions of wood or the whole tree as necessary

Figure 6: Seven-step demonstration of initial selection and pruning of shoots identified for establishment. *Source: Global FMNR Manual*[R49]

3. Maintenance and utilization of established trees

The practices described below are used in both establishment of trees (coppicing, thinning, pruning and propping) as listed in 2 above, as well as managing established trees. Therefore, they have been explained below together with those mainly used for management and harvesting of tree products such as pollarding.

a. **Coppicing** - involves strategically cutting off tree stems near the ground to encourage regrowth. The regrowth often sprouts as multiple stems (referred to as coppices) that vary in form and size (Figure 7). The weak sprouts are removed leaving about 3-5 strong ones to form the new tree. They may later be reduced to leave one or two strong stems to grow into big trees.

Figure 7: Stages in coppicing trees – a) before coppicing; b) tree cut close to base; c) rapid shooting of coppices; and d) mature tree regenerated from coppices. *Source: Greenpop*[12]

[12] *https://greenpop.org/farmer-managed-natural-regeneration-fmnr/*

b. **Thinning** - wildlings (seedlings that germinate naturally from the soil seedbank) usually germinate as many seedlings very close to each other with some being smaller, less healthy or of less desirable species. The poorly formed trees should be removed to allow space for robust growth by those that remain and minimize chances of inbreeding where many seedlings of the same species germinate. This is called thinning.

Whether the regeneration is from stump coppices (for which few are retained per stump) or from seeds (after which thinning is done) ensure a density of about 100 trees per hectare is maintained for robust growth and to open up space for other companion plants such as pasture and crops.

c. **Pruning** - Pruning is removal of undesirable branches starting from the lowest part of the tree crown to enhance better growth and yield. Pruning of trees is carried out to:

   i. reduce competition for light between trees and crops;

   ii. stimulate rapid growth for taller, straighter and more useful tree trunks;

   iii. provide early harvest of branch-wood for fuel or other use; and

   iv. enhance yields from trees because of more access to light.

When pruning, branches should always be cut upwards and as close to the stem as possible (as shown in Figure 8), while watching out not to injure the stem to avoid creating ports of entry for pathogens (disease-carrying organisms).

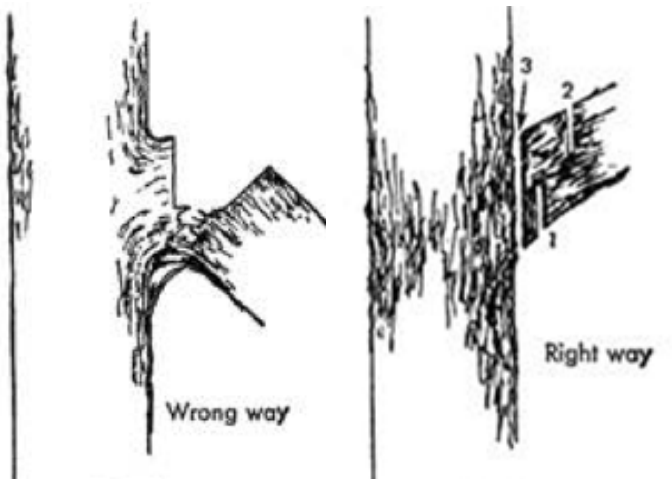


Figure 8: Tree pruning – wrong way of pruning – cutting from the top (L); and, right way of pruning – cutting from the bottom (R) *(Source: ICRAF [R56])*

The frequency and extent of pruning is dependent on the desired end use of the trees. For instance, if firewood provision is the objective, it is desirable to retain more branches for periodic harvesting, hence such trees are pruned less frequently than those grown for timber.

d. **Pollarding** - involves cutting all branches (for some species the whole tree crown) at a height of 2-3 m above ground level to prevent animals from browsing the fresh shoots when they sprout. Pollarding is undertaken as a way of regularly harvesting wood from the trees and/or to open up space for light to reach the crops or pasture underneath the trees. The practice encourages the growth of many shoots or branches but, as a management practice, is only applicable for tree species that are tolerant to frequent cutting. Pollarding should be undertaken when trees are in the dormant state (such as during the dry season) rather than during times of active growth. Although sometimes farmers cut all the branches to the top (a practice called *Topping*), if conducted too frequently, this practice could kill the tree. It is advisable to leave a few branches on the tree to support minimum physiological processes.

Plate 2: Justin, FMNR farmer in Mogotio, Baringo County pruning trees correctly (L); and, Pollarded Acacia polyacantha in a field under FMNR in Baringo (R)

e. **Propping** - means supporting thin and weak stems or young trees from falling by either tying the stem to a strong adjacent tree or by use of props (firm poles or stakes used as temporary support to keep the weak trees in position). Propping protects the growing trees or saplings from wind damage and helps them to grow into straight trunks. The practice is especially necessary after a thinning exercise has been done, to enable remaining saplings or stems gain the sturdiness necessary for fast establishment.

Plate 3. Scholastica, FMNR farmer in Mogotio, Baringo County propping a sapling (L); and, a farmer tying together stems of a coppiced acacia with a rope in an FMNR plot (R)

2.1.4 When is FMNR appropriate?

The practice of FMNR is more appealing and is likely to scale easily in communities where:

1. **Community members recognize that their environment is deteriorating** especially with the disappearance of trees, and are yearning to restore land productivity. Such landscapes are characterized by shortage of fuelwood, building materials, forage for animals (including bees), and other products from high-value indigenous tree species. Decline in productivity of agricultural lands in various forms is also a concern.
2. **Community members and community groups have a vested interest and stand to directly benefit from improved agro-ecological conditions** that they create over many years. These include women, the youth and marginalized groups who often suffer most in situations of severe food, water and firewood shortage. Women bear the heaviest burden of searching for fuel wood, cooking food and gathering wild fruits, so they stand to benefit significantly from restoration of forest and tree resources, as will their families.
3. **Community leaders have an interest in conserving and managing natural resources for community survival**. The leaders play an important role as a voice of influence in the community and can serve as initial grassroot partners for FMNR scaling. Riding on the respect and authority that the leaders command can gain FMNR acceptability and momentum, and propel its spread and sustainability in the community. FMNR is more likely to succeed where community leadership is more interested in protecting community quality and sustainability rather than seeking to exploit local resources (both the natural resource base and community members). **Local (County) government officials at village, ward and sub-county levels as well as national government institutions** such as Water Resources Authority (WRA), Kenya Forest Service (KFS) and others who have interest in restoring degraded lands with trees, should be engaged right from the beginning. They hold key roles in information sharing, training and implementing progressive policy reforms. Other leaders of interest include schoolteachers, religious leaders and leaders of CBOs who have an interest in creating knowledge on resilience among their constituent members.

2.1.5 What are the main advantages of FMNR?

1. Promoted as an asset-based community development approach (ABCD; see Box 5). FMNR starts with what many farmers/herders already possess, such as land with trees that have known value and uses. Therefore, it respects and builds on **local knowledge**.
2. It is not expensive to implement, as it relies on tools farmers already possess, although some form of protection of trees is very important depending on what factors cause degradation. For example, free-range livestock grazing destroys tree saplings and an FMNR site needs to be “fenced off” from livestock, at least for a while. Local (enforceable) by-laws are usually more effective in keeping off livestock and less costly than physical fencing. Additionally, “social fencing” is more immediately available to communities and does not create dependence on external investment and expertise.
3. In a favourable policy environment and secure land tenure arrangements, FMNR has great potential for spreading from farmer to farmer over large areas. This is mainly because, once established, the process attracts wider attention and spreads using local resources and initiatives.

Box 5. Asset-based community development (ABCD)[R7]

ABCD is an approach that encourages community members to drive their own development process rather than depending on help from outsiders. It builds on assets that are already present in the community rather than focus on the needs that the community has. Support institutions step back and play a supporting role of identifying the skills, giftings (talents) and physical assets present among community members, which can be harnessed to achieve the aspirations of the community. Five key assets are identified in ABCD: individuals (community residents with their skills and giftings), associations (groups of people coming together voluntarily as a result of shared interests), institutions (paid professionals within organizations that can help in mobilization), physical assets (land, trees, buildings, funds) and connections (exchanges and sharing of assets by people). Although present institutions are important in ABCD, they are steered towards supporting people's aspirations rather than directing or planning for them.

2.2 Principles underpinning FMNR

2.2.1 Value-based principle for land use

FMNR should be community-led with land users appreciating the accruing benefits and perceiving them to exceed any cost or risk involved. Promotion of FMNR should start with community engagement that discusses how they value natural resources and how that determines decisions on land use. Although the resultant restoration contributes to national, regional and global goals, it should first meet the needs and goals of farm families involved in the practice. Farmers have many different objectives when they engage in land management practices such as FMNR. These objectives may include benefits from trees listed in Box 1. Ultimately, the farmer's mix of objectives, and condition of the land, is what determines the type of FMNR practiced and, by extension, its acceptability among community members.

2.2.2 Process-based principle for community development

Community development is a process of rural reconstruction, founded on development of local capacity (including leadership), to determine community futures through exploitation of local resources in a sustainable manner. It is a continuous multi-agency process that does not stop, even where some piloted projects have failed the sustainability test. External agents are meant to be facilitators of this process to enhance community visioning, planning, implementation and evaluation while incorporating learning.

FMNR should be promoted as part of an integrated (community/individual) development model aimed at increasing assets through sustainable land use. This should be distinguished from objective-based promotion which seeks to achieve a certain goal within a set time (as a project should be). Not all communities are similar and different aspirations define different communities. This implies that a formal or informal community needs (and assets) assessment is necessary. It is also important to understand the process underpinning development of the particular community, which might differ from another seemingly similar one.

Community assessment techniques need to be a combination of both formal and informal approaches and tuned to the particular target community. For instance, a community that has been introduced to FMNR before, differs from one that has not, while the value of trees by the two communities might also be different. While trees confer multiple benefits, they are not a panacea to every land use constraint. A community that is close to an oasis may be more receptive to FMNR at first, than one that has serious water supply constraints. The former may be very receptive to regeneration of trees since less labour and time is used to collect water, while firewood may be getting scarcer. The latter community may not embrace trees at first but might become more receptive after water-sourcing constraints have been addressed.

2.2.3 Asset-based – use of what is available

FMNR is 'local asset-based' (see Box 5). Documentation of existing tree species and their importance within the local culture is foundational and can favourably dispose towards FMNR. Primarily, these include indigenous and naturalized species, but there may well be a niche for exotics, particularly fruit and timber trees. The process proceeds as follows:

1. **Raising awareness, changing behaviour and mindset of the community** on where they need to be and how to use what they have to get there. This will encourage appreciation of the need to restore land as well as manage trees on their land.
2. **Encouraging the community to allow trees to grow from wildlings and existing stumps on their land** and following the steps in 2.1.3 to manage the trees. The trees then anchor biodiversity and other natural processes that improve soil health. Farmers can give this 'underground forest' a chance to grow in a number of ways:

    a. Minimize land tillage practices that destroy biodiversity (regenerating seedlings, underground seed banks) especially on areas best suitable for conservation (see Chapter 6 of global FMNR manual for guidance on 'managing fire and other potential problems').

    b. Minimize weeding of regrowth from tree stumps and roots, as well as the wildlings that sprout from seeds stored in the soil.

    c. Control livestock grazing in the targeted land parcel. This way, seeds and saplings can grow to a point that grazing livestock won't harm them anymore.

3. **Active individual and whole community engagement.** While individual practice confers private benefits, working with the whole community enhances synergy and empowerment. Working together enhances negotiation on land ownership and tree user rights. Farmers can use their skills, knowledge and resources when benefit-sharing processes are clear, and risk distribution is well structured. Farmer-to-farmer extension is also enhanced, thus enabling FMNR techniques to spread easily across farmer communities, with minimal government or NGO intervention.

FMNR should primarily benefit the land user and therefore farmers have flexibility to modify the techniques to meet their own needs.

2.2.4 Farmer-based – flexibility of the farmer

FMNR should primarily benefit the land user and therefore farmers have flexibility to modify the techniques to meet their own needs. Farmers select the tree species to manage and the ones to remove. They choose the number of shoots to manage per stump (although about 3-5 shoots are optimal) and the number of trees to manage per hectare. They choose how long to let the trees grow and the frequency of pruning and/or thinning to apply depending on the products they hope for. Farmers can make these decisions based on their own knowledge and experience or as part of lessons gained from collaborative learning as a group. Working together as a farmer/pastoral field school, farmers can co-learn and innovate around FMNR practices to obtain best results in their context. External agents such as researchers, NGO and government advisors, among others, can support the learning through building the knowledge base and capacity of farmers to make informed decisions. This especially works best where the facilitators are part of the collaborative learning processes.

2.3 FMNR and associated land management practices

Although FMNR's primary pillar is regeneration of trees in the landscape, the success of the practice is interdependent on other sustainable land management practices. The approach should be seen as a holistic suite of practices that achieves regeneration of landscapes and livelihoods and consequently, the resilience and economic status of households and communities. Being process-based, FMNR is most successful when undertaken as part of a portfolio of land management practices, and connected to lucrative value chains. The value chain connection is outlined in Chapter 5, while other practices that are often implemented as part of, or in conjunction with FMNR are discussed below.

2.3.1 Enrichment planting

Enrichment planting is the introduction of new valuable species in degraded forests without elimination of other valuable trees which already exist at the site[R40]. Enrichment planting requires planning for tree seedling acquisition including tree seed collection and nursery management, as well as early seedling care to increase field survival rates. Although the principles of conventional tree planting are applied, extra attention is required where trees are planted in areas frequently used by free grazing livestock. Useful manuals that could guide these processes include:

1. Nursery management, tree propagation and marketing manual[R42]
2. Tree seeds for farmers toolkit[R27]
3. Agroforestry tree domestication: A primer[R9]
4. Agroforestry extension manual for Kenya[R56]

Enrichment planting is an important technique used in forest rehabilitation. It is added onto FMNR in order to:

1. Increase tree cover where natural regeneration does not work
2. Increase tree diversity in FMNR fields mainly to include high-value tree species that farmers desire to have in their farmlands, thus enabling them to access critical services or participate in lucrative value chains.

2.3.2 Site enclosure/livestock management

Site enclosure (also referred to as exclosure in some areas) is fencing off a field set aside for restoration from any human activities that could reverse restoration gains especially grazing of livestock. The enclosure accelerates natural regeneration of grass, herbaceous plants and trees. Sometimes, farmers cut grass from the enclosed area and carry it to feed tethered livestock in order to minimize encroachment of the enclosures as restoration continues. This practice has worked in many areas, although it faces challenges in cases where land holdings are generally small, and farmers have no alternative grazing areas or where the community has conflicting or competing interests. Enclosures can involve physical barriers (fences) but usually is achieved through community by-laws or social fencing.

2.3.3 Rehabilitation of denuded lands

Denuded[13] lands are depleted of any vegetation cover and the surfaces are hardened by elements. Some lands are so eroded that they have developed rills and/or gullies. Denuded areas are often abandoned by farmers because there is little hope of recovery through natural processes. Table 3 lists common soil and water-related challenges that define denudation across different AEZs, and thus call for soil and water conservation structures.

Table 3: Common characteristics of denuded lands

Soil/water related challenges	Characteristics
Hardpan[14]	• Impervious soil impairing drainage and plant growth • Low soil moisture • Interlocked nutrients • Water loss through surface run-off • Cause of waterlogging in ASALs[R43]
Denudation	• Bare land, i.e., no vegetation cover • Barren, i.e., nutrient deficient • Gully and rill erosion
Steep slopes	• Prone to soil erosion through surface run-off

The following rehabilitation methods have been used successfully to restore denuded lands and can facilitate quick success of FMNR in such fields.

Grass re-seeding/improving ground cover: This involves sowing grass seeds on the denuded lands at the beginning of the long rain season. Given that the denuded land's surface is often hard, hand hoes or ox-drawn ploughs are often needed to loosen the soil before re-seeding. A new technique called *'Seed balling'* has also been tested and works well with some grass and even tree species (Box 6).

Plate 4: FMNR farmer in Kapkuikui location, Baringo County showing unproductive rocky land that was converted to productive state through grass reseeding (L); and, Unproductive rocky landscape in Baringo (R). Photo: ICRAF

[13]According to the Merriam-Webster dictionary, denudation is the act or process of removing surface layers (as of skin) or an outer covering, in this case land.
[14]A hard pan is a dense layer of compacted soil just below the plough zone. It is mainly caused by continued use of conventional tillage tools such as the moldboard plough.

Box 6. Seedballing

Seedballing is a recent innovation introduced in Kenya by a social enterprise dubbed 'Seedballs Kenya'. They use briquetting equipment to produce biochar seedballs for aerial reforestation and pasture regeneration. The seedballs are a special blend of charcoal dust, nutrients and binders sourced from long dead acacia trees. The seedballs contain seeds that have not been pre-treated in any way and are still in their natural state. Once the field to be restored is identified and the right tree species selected, the seedballs are thrown into the field, preferably using catapults in order to cover large areas. Larger operations also use drones to shoot seedballs in large areas. The biochar coating of the ball helps protect the seed within from predators such as rodents and insects, dehydration and temperature extremes. When wet, the seedball will help retain and prolong a moist environment around the seed to encourage germination. At this time the char (charcoal powder) and other components of the seedball will offer an initial nutritious boost. This enables the seedling to establish more robustly than would have happened normally in the absence of the coating. Seed balling has been tested in land restoration initiatives in Machakos and the results were amazing.

Adapted from: *http://chardust.com/seedballs/4593306541* with permission from Seedballs Kenya

Digging trenches: Trenches are shallow excavations dug at intervals across a slope to reduce soil erosion by surface run-off. They promote infiltration of water in denuded lands, moistening the soil and accelerating growth of grass, herbs and shrubs that provide ground cover.

Mulching: Mulching is the practice of covering bare soil surface with organic matter from plants such as plant leaves, branches, grass and cut herbaceous plants, among others. The purpose of mulching is to increase soil organic matter, control splash erosion, conserve soil moisture and improve the general condition of the denuded lands so as to accelerate colonization of the area by new plants such as those introduced through grass re-seeding.

For more explanation on soil and water conservation practices, refer to technical manuals such as: (i) Sustainable Land Management in Practice: Guidelines and Best Practices for Sub-Saharan Africa by FAO[R34], (ii) Sustainable Agriculture Land Management by We Effect[R61], (iii) Sustainable Agriculture Land Management by Vi Agroforestry, etc.

Gully treatment: Gullies can be small or large. Their treatment can be accomplished using physical structures (such as gabions, check dams or sandbags placed across the gully) to prevent further spread and instituting by-laws (such as stock exclusion) to protect stream beds. ***Gabions*** are wire woven baskets filled with stones and placed across the gullies. ***Sandbags*** involve bags or sacks filled with soil or pebbles, hence are cheaper and easier to construct than gabions but are equally effective in controlling gullies. Additionally, biological measures such as planting fast-growing trees or vigorous grasses (such as vetiver grass) in riparian areas and stream banks are incorporated to slow the velocity of water, trap silt and prevent further erosion.

Use of micro-catchment water harvesting techniques: Micro-catchments are common water harvesting techniques used in agriculture and agroforestry to trap surface run-off, make soil and water settle down and feed the plant at a microsite. They are often dug in enclosures of plants or around high-value agroforestry tree species. They include half-moons or semi-circular stone bunds, micro-basins, V-shaped bunds and zai pits, among others. These structures are usually made by hand albeit that their construction requires considerable amounts of labour.

Plate 5: Water accumulates in the pit on the lowest part of the micro basin. (T);Micro-site water harvesting strictures: half-moons (L); and micro-basins (R). *Sources (respectively): ALI et al. (2009), FAO [R54] and ICRAF*

Contour stone lines/bunds: Contour stone lines are small lines of stones placed along the contour, whereas stone bunds are built up to a height of 25 cm and about 35-40 cm width. Bunds are permeable, allowing water to flow through them but with run-off speed totally reduced. They are very effective for cropland and rangeland rehabilitation.

Retention ditches: These are trenches dug at the highest boundary of the land parcel to collect run-off coming from outside the field, including from roads. The trenches check run-off before it initiates erosion that is problematic to halt further in the field. The ditches are usually about 50 cm deep and 50 cm wide, and constructed along the contour. The excavated soil is either thrown uphill to form an enlarged *fanya juu* terrace, or downhill as a cut-off drain. The base of the ditch is usually level but may be graded to allow water to flow from one end to the other. The ditches are often used for banana-growing because sufficient water and fertile soil collects there. A spillway should be constructed so that excess water can escape without causing damage.

Retention basins: Retention basins collect the run-off from roads, footpaths, sharp hills or transient streams. They differ from retention ditches in that they are not continuous trenches, but may be rectangular or square, surrounded by small earth bunds. They are usually located adjacent to bananas or trees. Small basins may be used for individual trees or range reseeding, while larger basins are used for annual crops or small woodlots. The main purpose is to recharge the land with water, enhance percolation and accumulated soil moisture which enhances vegetation growth.

For more explanation on soil and water conservation practices, refer to technical manuals such as: (i) Sustainable Land Management in Practice: Guidelines and Best Practices for Sub-Saharan Africa by FAO[R34], (ii) Sustainable Agriculture Land Management by We Effect[R61], (iii) Sustainable Agriculture Land Management by Vi Agroforestry, etc.

Photo: Danyell Odhiambo/ICRAF

CHAPTER 3

THE KENYAN CONTEXT OF FMNR

The previous two chapters have outlined the general agro-ecological context in Kenya and introduced the concept of FMNR. This chapter seeks to provide details on how the practice can be undertaken in the context of Kenyan agriculture and land management. The state of land ownership and use have a huge bearing on how FMNR can be practiced in the country. This section frames FMNR from that background and presents the approach that fits various identified contexts.

3.1 Important considerations for FMNR in Kenya

3.1.1 Kenya Agro-ecological Zone suitability for FMNR

Land suitability is defined as "the fitness of a given type of land for a defined use".[R12] The land may be considered fit-for-purpose in its present condition or after improvements. The process of land suitability classification is the appraisal and grouping of specific areas of land in terms of their suitability for defined uses including rain-fed agriculture, irrigated agriculture, pastoralism, rangeland management and wildlife conservation, recreation and forestry.

FMNR is both a land use and an approach for restoring land so that it regains suitability for other land uses. The practice quickly restores the production capacity of land to sustain an agroforestry-based production system, which is preferred in Kenya's agricultural strategies. Table 4 therefore builds on the information provided in Table 1 and Annex 4 to guide in deciding whether to invest in FMNR or tree planting, and maximize returns on investment depending on the AEZ targeted. An area can be classified as highly suitable for FMNR, where the cost of restoration through FMNR is much lower, realistic and faster compared to tree planting. Moreover, Figure 9 presents areas where FMNR has so far been successfully introduced in Kenya and from which we can draw lessons to accelerate scaling up into other suitable AEZs in the country.

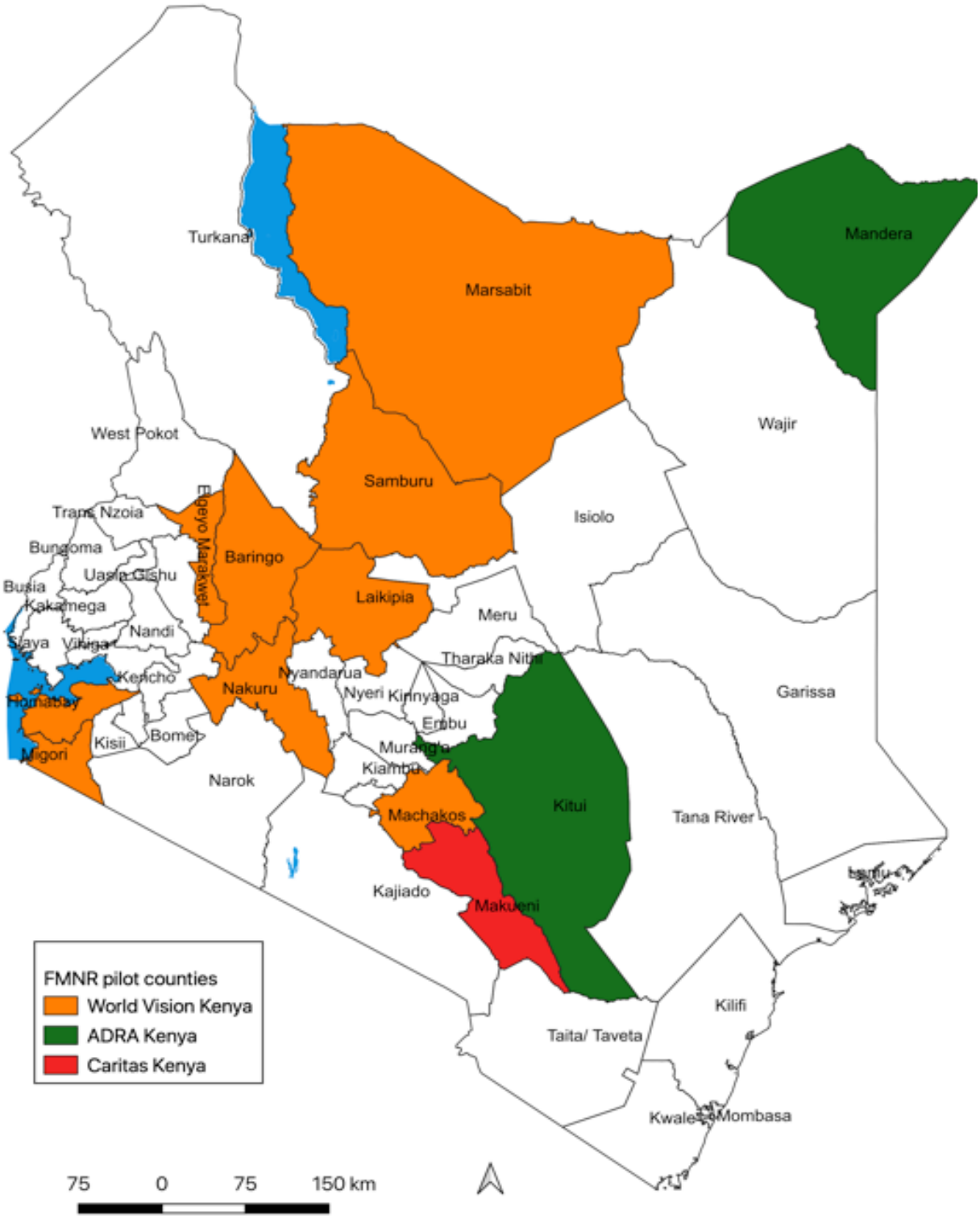


Figure 9: Counties where World Vision and partners have introduced FMNR in Kenya

Table 4: Suitability of FMNR across Kenya's AEZs

AEZ	Description	FMNR Suitability	Remarks
I	Humid	Marginally suitable	Tree planting largely performs better in this zone due to high survival rates and quicker establishment of high value tree species. FMNR may not be a priority approach in this zone but can target specific contexts such as hills, degraded natural forests (gazette; ANR in this case), riverine areas, lands where biodiversity and wildlife could benefit from FMNR hence boosting conservation and ecotourism opportunities, areas where fuelwood is scarce or certain wild fruit tree species are in high demand, or other useful tree species that can be regenerated from living root stumps and seeds, and more.
II	Sub-humid	Marginally suitable	Same as in AEZ I; ditto.
III	Semi-humid	Moderately suitable	The cost of tree establishment varies and could be high or low depending on the season, availability of seedlings of desirable species and farmers' economic status, among other factors. Given the low-cost factor, FMNR would be more acceptable among the less endowed households.
IV	Semi-humid to semi-arid	Highly suitable	Same as in AEZ III; ditto.
V	Semi-arid	Highly suitable	Tree planting is constrained by low soil moisture, poor access to seedlings and high cost of field establishment. FMNR is likely highly acceptable given the low costs. Large land holdings that accommodate fallow seasons can incentivize farmers to enclose an area of land for a period with minimal constraints. Communal lands can also be regenerated as long as appropriate institutional arrangements for access and benefit sharing are in place, or are strengthened where found to be weak.
VI	Semi-arid to arid	Highly suitable	Tree planting is very difficult due to unreliable rainfall, poor access of seedlings, high cost of establishment and free grazing. FMNR[15] involving enclosures is highly acceptable, building on traditional pasture management systems. Large tracts of land under communal management can easily accommodate enclosures. Community-based land management approaches are needed to embed FMNR.
VII	Arid to very arid	Suitable	Very low moisture inhibits tree establishment through planting except along, or around water sources such as rivers, oases, etc. Livestock movement is a further challenge to seedling survival. FMNR/PMNR (see footnote) involving enclosures and building on traditional pasture management systems is highly recommended. FMNR can also be embedded into other community-based land management approaches where they exist or are jointly introduced with such approaches.

[15]When practiced in the context or rangelands where pastoralism is practiced with little or no crop husbandry, FMNR is usually referred to as PMNR (pastoralist managed natural regeneration) in order to internalize the local context

3.1.2 Aligning FMNR to land use policy, regulation and guidelines

Promotion and practice of FMNR is likely to receive wide support when aligned to appropriate policies at both national and local government levels. The Government of Kenya has developed a raft of policies, legislations and regulations to govern land use in the country. The legal instruments emphasize sustainable land management which is the key principle of FMNR. Annex 5 presents some of the instruments upon which FMNR can be anchored. Additionally, there are regional and global priorities and commitments that target sustainable development and land use that Kenya has ratified, and whose aspirations and targets are in line with FMNR. Aligning FMNR practice to the policies and commitments is also likely to attract investments by government to be used in scaling up the successes.

Where supportive policies do not yet exist, FMNR projects can include activities that support communities to advocate for better policies, in particular, those related to tree and land ownership and access.

3.1.3 Land use planning and catchment approach

Land use by individual farmers or farmer groups mainly involves crop production, livestock husbandry, settlements (housing/market centres), tree production (either as woodlots or incorporated in croplands and/or pasturelands) and other publicly used infrastructure such as roads, schools, health centres, religious institutions and urban centres. All these land uses are integrated in a landscape and several landscape-based planning approaches have been developed to ensure that all stakeholder interests are met, as much as possible.

Proper land use planning is essential for efficient and sustainable utilization of land and land-based resources. Such planning approaches include spatial plans (at county/district or other governmental levels), rangeland management plans and catchment plans, among others. The National Environment Management Authority (NEMA) has also prepared guidelines on land use planning and utilization at community level[R44]. The guidelines focus on how to manage main land cover types such as agricultural land, forests, rangelands and wetlands, among others.

Rational land users seek to maximize private benefits from investment but costs go beyond the individual parcel. Equally, failure by some land owners to undertake good land management practices results in effects that flow to other land parcels, such as gullies, even when the latter are better managed. Land use planning and collective action ensures fair accrual of benefits and minimizes problems such as land use conflicts, environmental degradation, and poor utilization of marginal lands and riparian areas, among others. This is the basis of the catchment approach to land and water management (Box 7).

At a minimum, FMNR should be anchored as a key restoration approach in catchment management strategies such as sub-catchment management plans. Where such strategies have not been developed, a participatory plan development process should first commence to decide which restoration/FMNR approaches should be adopted considering ownership, land use and position in the catchment. This is particularly useful in managing soil erosion, water harvesting and weed control (including management of invasive species); working down from the top of the catchment to the bottom, or prioritizing hotspots for maximum effectiveness.

Box 7. Catchment approach to natural resource management

A catchment is an area of land which drains into a particular body of water such as a river, stream or lake and is used as a physico-biological and socio-economic unit for planning and managing natural resources. All stakeholders in a catchment (whether upstream, downstream or in-between) have an interest in how catchments are managed whether for drinking water, irrigation water, recreation, biodiversity and/or other ecosystem services. Land use associated with agriculture has a high likelihood of causing disturbance to the land surface, thus dislodging sediment that is carried away by agents of erosion such as wind and water. In a catchment, all eroded sediment lands in the water body, thereby raising the interest of various stakeholders such as water users, ecotourism stakeholders (biodiversity interests), and others. A catchment conservation committee usually oversees activities that aim at maintaining catchment integrity, guided by a plan that has been developed in a participatory manner. Given the importance of water in a catchment, and the upstream-downstream dynamics, all land users are expected to participate in catchment conservation activities as members of Water Resources Users' Associations (WRUAs). WRUAs also collaborate in water allocation processes, assist in water monitoring and information gathering, as well as conflict resolution on resource use within the catchment. WRUAs, with support from the Water Resources Authority (WRA), are supposed to develop Sub-catchment Management Plans (SCMPs) to ensure catchment integrity. The flow diagram on the right presents the chapters of an SCMP, and details of the identified catchment problems, management approaches, conservation as well as institutional coordination approaches. The FMNR approach described in this primer can be mainstreamed in the SCMP, especially embedded in the chapters on catchment and riparian conservation.

Chapter flow diagram source: R22

3.1.4 Land use decision-making processes and gender inclusion

Decision-making on land use is often influenced by household dynamics (gender, age, education) and nested levels of governance. Such dynamics, including role of gender, differ among communities especially between pastoral and agro-pastoral societies. In some communities, strong community leadership structures that determine allocation of grazing lands and conservation may exist to drive land use decisions, but not in others.

Generally, women are concerned with household consumption needs while men are inclined towards income generation. Men could therefore, prefer high value commodities and may not be very concerned about diversifying the production portfolio, while women might focus on a diversified portfolio that may appear low value but meets household nutrition requirementsR29. Depending on the society, women may have rights to harvest certain tree products but may not be allowed to plant trees. They could however, be allowed to apply FMNR for species that are not highly valued by men.

Promotion of FMNR should aim at livelihood improvement, especially for vulnerable groups and raising a responsible, land use conversant and prosperous community. Identification of opportunities to improve welfare of vulnerable

groups through FMNR should be prioritized and entrenched in policy, planning and promotion processes. This includes dialogues that increase participation by all community groups (women, men, youth and all disadvantaged groups) in land use decision-making processes and minimize vulnerability through prohibition of retrogressive land use practices and up-scaling knowledge on livelihood needs.

3.1.5 Climate change realities

Kenya is waking up to climate change with clear evidence in rising temperatures and increasing irregularity and unpredictability of rainfall. The impacts of these changing climatic patterns include:

- Increase in the area under arid and semi-arid conditions from the current 83% and eating into the sub-humid zone which calls for wider adoption of land use practices such as FMNR.
- Loss of species due to increasingly harsh conditions that threaten Kenya's rich biodiversity (flora and fauna) hence calling for microclimate regulation for habitat stabilization.
- Increase in the frequency and intensity of droughts accompanied by severe reduction in river flows and complete drying up of some seasonal rivers. For instance, crop failure in 2009 placed an estimated 10 million Kenyans (more than a quarter of the country's population) at risk of malnutrition, hunger and starvation.
- Population displacement and migration as a result of climate-related disasters such as flooding, with rural households in disaster-prone areas being the most affected.

The adverse impacts of climate change are compounded by local environmental degradation (such as illegal encroachments and settlements, logging and livestock grazing), which have among others, further aggravated people's vulnerability. Thus, a community's right to physical integrity is at the core of land use practices. Restoration of vegetation cover over land is imperative to sustain livelihoods. Agroforestry is accepted as a key approach to climate change adaptation and mitigation in Kenya and increasing aridity places FMNR at the centre of the requisite tree establishment.

3.2 Land ownership status in Kenya and implications on FMNR

There are three categories of land ownership in Kenya – public land, community land and private land. Tenure arrangements are not permanently sealed and may change for a particular parcel based on changing circumstances or aspirations of government, community and/or individuals or their families. Below is a brief description of the three types of tenure and how they apply to FMNR.

3.2.1 Public land

Public land includes among others, land situated on hill sides, hill tops, forests and mountains. The land is managed by the National Land Commission on behalf of the national and county governments. Another statute governing public land is the Environmental Management and Coordination Act (EMCA). Communities can apply through their registered associations to participate in the conservation and management of public land. FMNR can be applied where such application has been done and approved.

3.2.2 Community land

Ownership of community land parcels (also referred to as customary tenure) is vested on a specific community. Customary land tenure gives poor women and pastoralists the right to access land and utilize it either for crop farming or grazing. It however, involves complex management systems and is associated with lack of incentives for individual investments in resource conservation, thus exacerbating land degradation.

Community land is, as per the law, managed by a Community Land Management Committee (CLMC) which is selected by the community assembly. CLMCs are mandated to *'coordinate the development of community land use plans in collaboration with the relevant authorities'* among other roles. This land ownership arrangement is common in rangelands where pastoralism is the main economic activity and therefore management of grazing land is best handled at community level. Some crop production is also done in a few areas where conditions are favourable.

Management of community land through FMNR and restoration, where degraded, holds great potential when CLMCs are placed in the lead. Promotion of FMNR therefore requires strengthening of these grassroots institutions and development of clear access and benefit sharing norms to incentivize long-term investments by people working at different levels (farm, watershed, landscape).

Community is defined as 'a consciously distinct and organized group of users of community land who are citizens of Kenya and share any of the following attributes: common ancestry, similar culture or unique mode of livelihood; socioeconomic or other similar common interest; geographical space; ecological space; or ethnicity'.[R35]

Plate 6: Communal land in Baringo South with depleted vegetation (L); and, a communal woodland in the same county with perennial vegetation but no undergrowth (R). Both parcels hold great potential for FMNR. Photo: ICRAF

3.2.3 Private land

Ownership of private land (also referred to as individual tenure) is vested on individuals who may hold land on a more or less permanent basis, free from any adverse claims from others and absolutely answerable to no-one in the enjoyment of such property. Use of the land is however, subject to the various laws that govern agriculture, conservation of rivers and riparian strips, and the environment in general. This type of tenure is the most common in the country and various jurisdictions aspire to achieve it because of the investment advantages it confers.

Private land users primarily use land for crop and livestock production while some of the land is under private forestry and settlements. In the drylands, much of this land is not cultivated and is left as unmanaged bushland as explained in Chapter 1. FMNR is applicable in croplands, unmanaged bushlands, private lands with an absentee owner, as well as riparian areas (which according to law are not supposed to be tilled (see excerpt below).

> **Any person who, except with the written permission of an authorized officer, cultivates or destroys the soil, or cuts down any vegetation or depastures any livestock, on any land lying within 2 m of a watercourse, or, in the case of a watercourse more than 2 m wide, within a distance equal to the width of that watercourse to a maximum of 30 m, shall be guilty of an offence (Agriculture Act Cap 318 (Basic Land Usage Rules), 1965).**

Freehold land tenure is common in humid AEZs, but is also gaining momentum in ASALs. Land 'banking' by rich people has seen large swathes of ASALs purchased and fenced off with pastoralists at times losing their best dry season grazing lands to such land conversions. Often, the fenced lands are owned by absentee landlords and are usually not well managed. This can accelerate land degradation when accessed like common property (more of these under managing the commons below). Nevertheless, there is an opportunity to reach out to, and sensitize such landlords with the FMNR message who can then hire trained FMNR agents or work with FMNR community groups to manage the 'banked' land and enhance its productivity, depending on short- or long-term interests of the owner.

Overall, despite the challenges of conflict over land resources and degradation due to overgrazing, FMNR has a lot of potential in freehold land when individual farmers understand the benefits of the practice.

3.3 Getting FMNR in different land categories

Given its direct contribution to land productivity, FMNR is practiced in agricultural fields (both croplands and pastures) where land can sometimes be left fallow or as meadows, depending on the size of landholding. Three main contexts in which FMNR can be practiced in Kenya can therefore be derived as croplands, unmanaged bushlands and the commons. These contexts map to the ownership status described above as presented in Table 5.

The rest of this section provides guidance on the practice of FMNR in each of these three contexts, taking cognizance of the sub-catchment concept explained in 3.1.3.

Table 5: Matching land management context to ownership status

Land context/ ownership	Public	Communal	Private
Croplands		x	x x
Bushland and denuded lands	x	x x	x x
The Commons	x	x x	x

[16]Definition according to Natural Resources Conservation Service (NRCS) of the United States Department of Agriculture (USDA). Link *https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/landuse/crops/*

3.3.1 FMNR in croplands

Cropland is the area on a farm that is used to produce crops on a continuous basis, and comprises both land under cultivation and that which is usually left fallow for some time[16]. In humid areas, cropland occupies most of the farm, while in semi-arid areas it is usually a portion that could even be smaller than half of the landholding. Farmers usually remove trees from croplands in order to minimize competition between trees and crops for light, moisture and nutrients. Removal of trees consequently exposes the land to soil erosion by wind and water, as well as decline in fertility and ultimately, low productivity. Adoption of FMNR could however, reverse this condition by letting a reasonable number of compatible trees and shrubs regrow on the land, thus restoring soil structure and fertility while reducing erosion and soil moisture evaporation.

3.3.1.1 Establishment of trees in cropland with FMNR

a) Enhancing natural regeneration

A forest of living stumps and dormant seeds remains buried under cropland unless continuous cutting back of stumps has happened for several decades during cultivation. With favourable conditions, the trees will begin to regrow into a community of new tree species.

These favourable conditions are enhanced by:

1. Not burning trash on the land, whether crop residue or other cut vegetation, including pruned or cut trees
2. Not uprooting tree stumps
3. Allowing sprouts to grow from stumps
4. Minimizing soil disturbance to allow tree seedlings to germinate from the soil seed bank
5. Being careful during weeding operations to spot tree seedlings and let them grow

b) Species selection

Once a number of trees and shrub species begin to appear on the cropland through natural regeneration, the farmer needs to decide which species to grow because some species have adverse effects on adjacent crops. Some farmers regenerate a wide variety of tree species while others allow only a few based on their goals. It is however, advisable to maintain as many tree species as possible, but minimize the number of individuals of the undesirable varieties (in many cases to just one). It could be that a species has no apparent direct economic benefit, but it may be critical for provision of ecosystem services such as habitat for beneficial insects.

Below is a two-step guide to help farmers make decisions on which species or stems to keep in croplands.

i) Identify primary uses of regenerated trees based on the following simple questions:

- What products and services (to the farmer and to the environment) can be provided by the tree species that have regenerated?
- What characteristics do trees need to have to provide these needs, and optimize the current farming system? Table 6 gives a summary of characteristics to look out for.

Table 6: Primary tree uses and characteristics of appropriate trees for croplands

Primary use of tree and shrub species	Common characteristics of useful trees and shrubs on croplands
Intercropping with food crops	• Deep-rooted to avoid competition with crops at the root zone (this aspect can also be managed by root pruning but that increases farm labour load) • Relatively open canopy that minimizes shading of crops (can also be managed through pruning and lopping) • Nitrogen-rich leaves for mulch and/or nitrogen-fixing ability for enhancing soil fertility • Does not suppress growth of other plants around them (i.e., no allelopathic characteristics) • Root structure provides 'hydraulic lift' characteristics – pulling water from deep in the soil profile to the top/sub-soil and making it available for other parts of the tree, and other plants
Timber & firewood	• Strong wood/high energy content • Withstands pruning of branches and stems • Advantageous if long straight stem (bole)
Honey	• Flowers preferred by bees • Flowers for a reasonably long period in a year, particularly when herbal bee forage is not available
Fodder	• Leaves and/or pods are palatable and nutritious for livestock • Sprouts readily after cutting • Can withstand regular pruning/browsing
Fruit & non-timber tree products	• Produces fruits or other known non-wood products (medicines, gums, resins, fibre, etc.) that are useful at home, or can be sold in the market • Storage, transportation or other value-addition services for products available • Good form for tree seed collection to qualify as superior quality 'mother' trees where tree seed and seedling business is established.

Adapted from Global FMNR Manual[R49]

ii) Develop a local tree species list and a preferred species list for FMNR

This exercise is best done by farmers and their facilitators (from government or community extension volunteers such as lead farmers) in a group. Using local ethnobotanical knowledge, farmers can generate a draft list of tree species that are useful in the area and those which can be established in croplands.

A list of preferred FMNR species can then be developed by screening the draft list with the characteristics of uses listed in Table 6 above, i.e.,

c) Marking selected species

Farmer can individually or collectively use the generated list of FMNR species to select the most appropriate stumps and wildlings from the species mix regenerating in their fields. Selected wildlings and stumps are then marked either

with coloured fabric, ribbon or tape as a sign that these species are being managed. The trees can be managed to good form and utility by:

1. Protecting the new sprouts, seedlings and saplings from livestock browsing and other damaging agents such as fire
2. Mulching[17] around the seedlings and saplings for water capture
3. Propping
4. Pruning
5. Establishment of water harvesting structures[18] such as half-moons around the trees (has proven very beneficial in ASALs).

The number of trees managed in croplands may vary from farm to farm based on individual farmers' judgement as influenced by the need for wood and other products, optimal environmental protection and the desired effect on crops. Ideally, spacing between individual trees based should be at least 10m apart for large canopy species and less than 10 m apart for small canopy trees and shrubs. However, spacing will differ depending on the species, hence learning together in the local context can help farmers determine the most appropriate density and management practices (listed in Chapter 2) for specific species.

3.3.1.2 Enrichment planting

Sometimes there may be no living stumps remaining on cropland or existing stumps may be barely sufficient to meet the practitioner's needs and goals. In other cases, the diversity of species and density on cropland is low or the farmer does not value the available species. In such cases, introduction of high-value tree species through planting is encouraged. Farmers can also transplant or directly sow seeds of more of the species regenerating naturally on the cropland to increase their density and quality, if necessary.

3.3.1.3 Selective cutting/thinning and pruning

The objective of thinning trees in croplands is to maintain sufficient tree cover all year round, at a density that is not detrimental to crop growth, in order to harness the ecological benefits conferred. Thinning helps concentrate growth on well-formed trees in the farm and to encourage robust crop growth underneath. The thinned out trees can be used by the household as firewood or poles or sold.

Regular pruning of trees established in croplands is encouraged primarily to minimize shading of crops and to improve tree growth. Pruned branches can be utilized as fuelwood or other uses as deemed appropriate by the household while the leaf biomass is used as mulch or fodder.

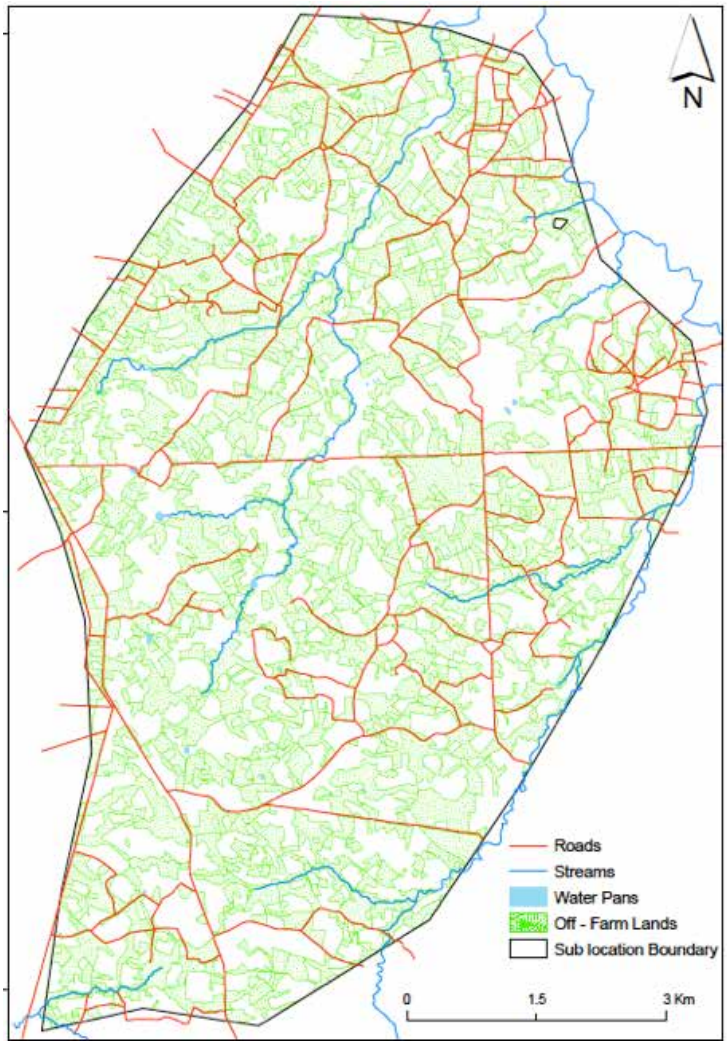
Plate 7: Indigenous tree species established in cropland and casting some shade on crops. Pruning such trees improves crop productivity and provides fuelwood and poles for the farm household to use

[17]While mulching and establishing water harvesting structures are excellent interventions supporting regenerating trees, few farmers are prepared to invest their time in these activities. Hence, while these activities can certainly be promoted as 'best practice', they should not be considered as a requirement for successful FMNR

3.3.1.4 Establishment of soil and water conservation structures

A sustainably producing cropland is defined by its ability to harness and recycle most of the moisture and nutrients in the field. Soil and water management is therefore critical for optimum crop productivity. Traditionally, in Kenya, agroforestry practices in cropland have been linked to soil and water management approaches. Building on this knowledge, a consideration of soil and water management status of any parcel where FMNR is practiced in cropland is critical. Trees help water to infiltrate and percolate into the soil, while captured water helps trees to establish faster. Soil and water conservation structures maintain or enhance the productive capacity of land in areas affected by, or prone to soil erosion and low or erratic rainfall.

FMNR facilitators should closely work with farmers to identify soil and water conservation challenges in crop fields where FMNR is practiced. Soil management experts and/or trained local artisans can then design the most appropriate soil and water conservation structures that will ensure more trees can be managed productively in the farm (see list of these in Chapter 2).



3.3.2 FMNR in unmanaged bushlands

Bushland is uncultivated or fallowed land that is covered with trees, shrubs or other natural vegetation[18] (Figure 10). They are either privately or communally owned lands characterized by lack of meaningful productive use of the vegetation therein. They may have been under cultivation in past years, but were colonized by other vegetation, mainly thickets, after cultivation ceased. Usually, they are not securely fenced and are used for grazing and as source of fuelwood and other tree products.

Poor management of these parcels of land leads to degradation, and in some cases denudation. Unmanaged bushes, and in extreme cases invasive species such as *Lantana camara*, make it difficult for pasture to regenerate, rendering the areas of little economic use. They can also harbor pests, rodents, birds and other animals that pose a danger to crops, livestock and people.

If placed under sustainable management, this land resource can be converted to productive management and provide rich forage for livestock, fuel wood and construction materials, fruits and herbal medicine, among other benefits.

Figure 10: Map of Ikatini Sub-location in Machakos County showing agricultural land use (all green shaded area is uncultivated and mainly comprises unmanaged bushland)

[18]Definition of bushland according to Collins (English) Dictionary.

Plate 8: Unmanaged bushland in Baringo County

3.3.2.1 Bringing bushlands under FMNR

The following practices are recommended for sustainable and productive management of bushlands in Kenya.

1. Species selection

Maintaining a reasonable diversity of plant species is advisable for bushlands to be both economically and ecologically productive. Individual land owners or communities are advised to:

i. Fence off using locally available materials such as thorns or keeping livestock away from the bushland to minimize destruction. For communally-owned bushland, social fencing may apply if the community respects local institutions.

ii. Select and mark the species to retain on the land, keeping in mind that indigenous species play some role in creating and maintaining healthy and functioning ecosystems.

iii. Remove unmarked trees and shrubs which are deemed less desirable to the farmer/community and could be hampering growth of grass or other desirable species.

2. Selective cutting and pruning

The main purpose of selective cutting and pruning on bushland is to:

i. Maintain the right density of retained tree species under FMNR. Being a woodland, density can be higher than that of cropland depending on whether or not pasture grows underneath (in which case 5-7m for large canopy trees) and the size of the average tree canopy

ii. Concentrate growth on well-formed trees on the land

iii. Encourage undergrowth of useful herbaceous plants and pasture for livestock.

Selective cutting can be spread across the calendar year to provide products to the household as required while encouraging new sprouts to grow from the cut stems.

3. Enrichment planting and grass re-seeding

Grass re-seeding hastens restoration of pasture which can be cut and fed to livestock off-site or sold to other livestock keepers. Enrichment planting of high value tree species is encouraged as a way of improving the tree species mix (diversity) and density if less than desirable.

Plate 9: A bushland brought under management with FMNR in Homa Bay County. (The farmer may want to reduce the density of the dominant *Acacia polyacantha* in order to allow other species to grow through natural regeneration and/or enrichment planting)

4. Soil conservation structures

Extension agents or trained community artisans should take land owners or the community through a process of identifying key soil conservation concerns and come up with realistic approaches to address them as guided under croplands.

3.3.3 FMNR in the commons

This category deals with lands whose interest goes beyond a single household and for which community governance structures are instrumental in bringing them to sustainable management. Given that community members may have to provide labour to manage the land without expecting any direct benefit from it (in fact, the degraded state of the land adversely affects them, e.g., they become a source for gulleys, etc.) community by-laws need to be in place to ensure access and benefit sharing modalities and incentivize FMNR. Such benefits can be anchored in value chains as pasture harvesting, honey production, fuelwood, gums and resins, medicinal and aromatic products, and other opportunities in cottage industry. Chapter 5 covers these value chains in detail. The lands are usually referred to as the Commons and may include community grazing lands (especially in the rangelands), riparian areas, public lands that are accessible for community use and vast tracts of lands under private tenure but with absentee owners, among others.

Riparian land is the area adjacent (on both sides) to rivers or streams and can range from 6m to 30m from the middle of the river/stream, depending on the size of the river. Agricultural land management guidelines discourage tilled farming or any land use that could accelerate erosion in riparian areas. Riparian lands are often registered under individual titles, but the Water Act 2012 encourages WRUAs to peg them and bring them under sustainable management through SCMPs. The community therefore, has interest in, and can influence FMNR practices on riparian land even when it is under individual title.

Private land that is owned by absentee owners presents the greatest challenge in this category of commons. Usually, erosion that emanates from, or builds momentum through these lands contributes to challenges of conservation in adjacent lands, especially downslope. The absent owners are not available to undertake conservation and may not even be members of the community organizations spearheading land management. With effective community governance structures however, appropriate measures can be put in place for negotiation with such land owners to bring this land under community conservation.

Other **community land** types include land set aside during land use planning and adjudication for public utilities such as livestock health management structures (e.g., crushes, dips, etc.), future schools and health facilities, places of worship, etc. Added to this category are other public lands such as hills and woodlands. Usually, these lands are used by the community for grazing and other livelihood benefits (including cultivation) with little or no management and suffer from what is referred to as the "Tragedy of the Commons"[R16]. They are degraded and bare and are often abandoned to denudation.

All these land categories are characterized by degradation in form of loss of vegetation as well as soil erosion and depletion. They suffer nutrient deficiency, high bulk density and may have hardpans, among other challenges. These lands, just like unmanaged bushlands, are unproductive in their unmanaged state, but can be restored to productivity through FMNR enhanced with soil management practices. Strong grassroot institutions such as environment committees, WRUAs, CLMCs, CFAs and others that may be established by county governments are necessary for success.

Necessary practices include:

i. Fencing off the land targeted for restoration from human and livestock interference either by physical or social fencing, or both[19]

ii. Encouraging natural regeneration: nurture every vegetation springing up from the land including grasses, herbs, shrubs and tree species, especially those with known uses. A wide plant variety should be allowed to provide soil organic carbon, soil fauna and other necessary outcomes that improve soil productivity

iii. Thinning of overcrowded trees and undesirable shrub saplings, where applicable

iv. Pruning of trees to minimize shading of useful undergrowth vegetation and to enable management practices to be undertaken under tree species such as Acacias which have spikes

v. Enrichment planting to increase the diversity of high value tree species including use of seed-balling techniques. Micro-catchment water structures such as half-moons and trapezoidal bunds can increase establishment rates. Use of seedballs could can also enhance tree establishment
(see Ndivuni case study in Box 8)

vi. Grass reseeding. Usually the ground may be too hard for any vegetation to grow. Scarifying (digging shallow trenches to open up the hard surface) the land helps increase success of reseeding with suitable fast colonizing grass species

vii. Constructing soil conservation structures such as gabions, terraces, trenches and grass strips across slopes to minimize soil erosion

viii. Look out for invasive species and get rid of them (a list provided as Annex 6)

ix. Planting of species such as aloes and installation of structures such as beehives that support income generation, etc.

[19]Physical fencing (which doesn't have to be expensive) works best with privately-owned land but may be unattainable for communally-owned land due to the cost of fencing a large parcel of land. For communal land, 'social fencing' is advisable. Social fencing implies closing an area through community solidarity and governance structure where members police themselves. They set by-laws and stick to them, and those who infringe on the by-laws are punished in various agreed ways

Plate 10: Honey production in a managed bushland in Baringo County

Box 8. Restoration of Ndivuni, a denuded public land in Matuu Sub-county with FMNR and Seedballing

Matuu Sub-county in Machakos County has been experiencing extended and recurrent droughts, making it very difficult to raise trees. Survival rates of transplanted seedlings were very low, resulting in expansion of denuded lands in the area. Some of the major challenges include the costs associated with purchase of seedlings, labour for digging tree planting holes, application of manure and watering of the young seedlings until they fully establish. Availability of water in this semi-arid area has also been a major constraint to tree-planting, hampering both tree nursery establishment success as well as survival of planted seedlings. The DryDev Programme partnered with the Ndivuni community, Ministry of Agriculture, Kenya Forest Service (KFS) and Seedballs Kenya to pilot seed-balling as an alternative to planting trees. The focus was on a tree species mix comprising nitrogen-fixing fodder trees *(Sesbania sesban)* and indigenous acacia trees due to their resistance to drought and pests, as well as their social and ecological benefits. The restoration was conducted in a public plot (former cattle dip site) of about 2 acres which had 90% bare land; the community had long ceased to graze their livestock in the plot due to lack of pasture. One year after Seedball technology was applied, the land was totally covered with vegetation, with pasture grass reaching an average height of 2 feet and sesbania trees already at a height of 2 metres. This created microsites for other tree species and at least 10 other species were observable at various stages of growth. The plot has become a restoration model site for farmers as well as a source of pasture grass for their stall fed cattle.

CHAPTER 4

SCALING UP FMNR WITH COMMUNITIES

FMNR has been piloted by various projects in Kenya and has shown great promise. Pilot projects have revealed strong farmer uptake in Baringo, Elgeyo Marakwet, Homa Bay, Kitui, Machakos, Makueni, Marsabit, Mandera, Migori and Nakuru counties, among others (Figure 9). FMNR can therefore be taken to scale nationally by adopting appropriate scaling up approaches.

This chapter delves into possible approaches to support the scaling up of FMNR in more areas so as to be adopted by many more farmers in different locations. Scaling up means "deliberate efforts to increase the impact of successfully tested interventions so as to benefit more people and to foster policy and programme development on a lasting basis[20]. Promotion of FMNR should take community members through analysis of their different landscape and household challenges and lead them to appreciate the potential of FMNR within their context (including issues of community land management and approaches for ASALs).

The section presents the process of scaling up by outlining: i) how to take stock with the community; ii) the process of assessing community assets in order to embed FMNR within local natural resource management processes; iii) elements of community mobilization; and, iv) scaling approaches that can be utilized to enhance uptake of FMNR by many farmers in a community.

4.1 Taking stock with the community

Stock taking is a process that gives the community an opportunity to jointly reflect on their current challenges, changes that have occurred on their landscape and livelihoods over time and their causes, their current and future needs, their goals and visions, and understand the contributions that FMNR can make towards meeting their set goals and visions. This is therefore a first step towards '*scaling up FMNR with the community, for the community and by the community'.*

The community here implies any group that will potentially be involved in the FMNR initiative, including but not limited to farmers, pastoralists, local leaders (clan leaders/elders, religious leaders, chiefs/assistant chiefs, village headmen), county government officers and committees (environment officers, representatives from county department of agriculture, livestock and water; village/sub-location/location/sub-county environment committee representatives), national government officers (KFS, KEFRI, NDMA, etc.), traders such as those who sell firewood and charcoal, youth and women groups, and advocacy groups at the community level.

Key topical areas the stock taking process should cover include: (1) Current situation and goals of the community; (2) Land category (croplands, unmanaged bushlands and the commons) and ownership status (community, private or public land); (3) Land use; (4) Climate and disaster risks; (5) Plants and animals; and (6) Social and cultural characteristics of the community. These topical areas have been explained in the global FMNR Manual[R15]. They set the stage for the community to start a discourse to assess their current and future needs, and set visions and action plans through a shared community visioning and action planning process (see sub-section 4.2).

[20]Definition adopted from *https://expandnet.net/scaling-up-definition/*

It is important to highlight that such stock taking should:

i. Look at the goals of the community with regard to land productivity, household food and income security, climate and biodiversity (both trees and animals) of the area, how these are used and most importantly, how they have changed over time.

ii. Help the community see how they could benefit from sustainable land management by helping to address pressing problems and build enthusiasm and commitment towards the practice.

iii. Encourage the community to reflect and understand how the land and their lives have changed over time and the role that loss of trees could have played in creating their current situation.

iv. Ensure that information gathered from this assessment is used to shape the design of an FMNR initiative and to ensure that it will best meet the community and environmental needs of an area.

v. Ensure that all stakeholders are involved and able to contribute to the stocktaking activities. This will increase likelihood of community support and buy-in.

As part of stock taking, it is necessary to conduct a community assessment in order to understand where the community is at the start of the FMNR initiative. Communities are not homogenous, and each is defined by differences in sub-groups within it, as well as differences between itself and other communities. The scaling elements listed in section 4.2 are applicable in different ways across communities, given these differences. Community assessment is therefore important even if the development facilitator is already actively involved in the community because it can reveal additional strengths and opportunities that one may have missed. Assessment should involve a variety of stakeholders while taking care to manage expectations. There are many ways to conduct community assessments but for the sake of FMNR, this primer will focus on two aspects: i) community characterization; and ii) inventory of community assets including ethnobotany.

4.1.1 Community characterization

Community characterization helps to understand how the community is organized in order to tell how easy FMNR messages will gain acceptance, as well as the windows that exist to plug FMNR into the socio-economic nexus. The development facilitator can develop a matrix to collect information about the community using qualitative and/or quantitative approaches[21]. However, the tools need to be simple enough to enable a quick analysis and decision-making. Annex 1 of the Global FMNR manual provides a comprehensive list of questions that could guide the process of taking stock with the community. Annex 9 in this primer also provides a prototype community assessment checklist (adapted from [R8]) that facilitators can adapt to their specific interest.

4.1.2 Inventory of community assets and capacities

Community assets are defined as individuals *(community residents with their giftings and skills)*, associations *(groups of people coming together voluntarily as a result of shared interest)*, institutions *(paid professionals within organizations that can help in mobilization)*, physical assets *(land, trees, buildings, funds)* and connections *(exchanges and sharing of people of assets)*. It is necessary to produce an inventory of what exists in the community that can be utilized to facilitate dissemination of FMNR. This inventory focuses on untapped potential and how it can be connected to opportunities, thereby creating incentives for practicing FMNR.

Within the assets' inventory, a needs assessment can be done but from an appreciative inquiry approach (elaborated in Annex 3). This approach ensures that the discourse focuses on community strengths and opportunities rather than problems. Needs are therefore discussed as asset gaps and barriers to success that can be plugged to enhance momentum. Needs assessment helps to prioritize the gaps that warrant the attention and resources of the community when engaging in an FMNR initiative.

The checklist in Box 9 can be adapted to conduct an asset inventory using approaches such as focus groups discussions, community meetings, key informant interviews and transect walks.

[21]Approaches include focus groups discussions, community meetings, key informant interviews, transect walks and use of questionnaires, among others.

Box 9. Suggested community asset inventory questions

- What is special about the community?
- What events take place in the community?
- What is the community's greatest source of pride?
- When and where do people gather, and what do they do together? Include religious, social services, sporting, entertainment, and other types of gatherings.
- Who do they know? What skills do they have? What do they own?
- What knowledge might they share with others (on land use, use of trees etc.)?
- What topics or issues interest a significant number of community members?
- Who do people listen to?
- How does information spread in the community?
- What skills or knowledge in the community should be passed down to the next generation?
- Who are the formal and informal leaders of the community?
- Which institutions exist in the community, both private and public?
- What utilities and services are available in the community or institution?
- What payment or financing systems are in place to pay for goods and services?
- What natural resources are found in the community? Which areas have open space?
- What are some of the gifts and talents of the people in the community?
- Is there an enterprising spirit in the community, either in business or civic/cultural activities?
- What businesses exist in the community?
- What products are made in the community?
- What services are provided in the community? Who provides them?
- What volunteer activities exist in the community, both formal and informal?
- How do community members demonstrate that they care for and trust their neighbors?
- Does a governing body help manage services, create and enforce rules, and perform other critical functions?

Adapted from [R50]

In some cases, it might be necessary to draw a Community Asset Map in order to better visualize the assets portfolio. This is a physical depiction of the geographical area that the community considers as their sphere of control. It shows places of interest to community livelihoods, where they carry out their day-to-day activities. Such places include markets, religious centres, schools, community centres, parks, businesses, fields, water sources, government offices, health clinics, police stations and recreational areas (Figure 11). A well-drawn asset map is very useful in the community visioning process as it can help depict where the community would like to move to from what is currently depicted visually.

Community asset maps should be drawn by community members with careful consideration given to how members interpret it in the context of land and tree resources as well as information flow, relationships and service delivery. As much as possible, the facilitator should seek to understand the meanings ascribed by the community with minimal assumptions. For instance, a church building can be a gathering place for a religious group that is negatively perceived by the community and several members might not be comfortable attending a meeting there, while an outsider could easily assume it is a social asset where meetings can be held.

Asset maps can be sketched by community members or over-laid on previously developed maps. Such maps can be developed from GIS tools such as Google Earth or sketched using GPS gadgets. Depending on the scope of the foreseen FMNR promotion initiative, several maps can be developed in order to show patterns (both desirable and

undesirable) or to emphasize various community services or subsets of the community. The scope of resources at the facilitator's disposal or depth of information required will determine the depth of differentiation or sophistication to go into.

It is imperative to have a deeper discussion during the community asset mapping process on the role of trees in the community since trees are the foundation of FMNR. This includes the products and services trees provide in the community, as well as the community approach to management of tree resources. The view of the community on the abundance of some species taken as priority can be collated in order to determine how the trees might feature in the FMNR initiative. The plans may have to include having tree nurseries in place to support enrichment planting in case natural regeneration is not the only feasible pathway. As an example, Annex 2 provides a list of tree species identified as priority species in Nakuru and Baringo counties in a pilot FMNR project[R25] that can be considered in those areas. Annexes 8 and 9 are reproduced and adapted from the global FMNR manual as tools used to collate information about tree resources.

The discussion on the role of trees should also include some problems and misconceptions that could be barriers to adoption of FMNR and tree-based restoration approaches in general (see Chapter 6 of the Global FMNR manual for details).

Figure 11: A generic community asset map
(Source: https://abcdinaction.org/community/forum/new_posts/1200/feedback-stories-abcd-updated-asset-map-storytelling-infographic)

4.2 Community mobilization – the elements

Individual farmers, herders or pastoralists can practice FMNR on their own at farm scale. However, FMNR is most successful when promoted collectively and when everyone in the community who uses or has interest in the land and trees is involved[R49]. This is because some benefits accrue beyond the individual practitioner even when all activities are conducted in individual land parcels as explained under the catchment approach. The whole community needs to be supported to develop and agree upon a community action plan, including a set of by-laws to control the management of land and tree resources.

Key elements for successful community mobilization are listed in Box 10.

Box 10. Elements of community mobilization

1. Encourage all community involvement
2. Build community agreement and ownership
3. Build relationship and trust
4. Shared community visioning and action planning
5. Shared capacity building activities on FMNR practice
6. Develop community by-laws that guide the community on FMNR
7. Manage conflicts emerging within the community that might slow down adoption of FMNR
8. Advocacy on the importance of FMNR practices to the community and households

Plate 11: Community engagement meeting with community representatives

a. ***Encourage all community involvement*** – There is need to involve all community groups with interest in land use when making decisions on conservation initiatives. Having interested stakeholders from all backgrounds share their experience and collaborate to conserve their environment, improves the chances of success.

In order to ensure effective community involvement:

- Involve local leaders right from the village to the county government level
- Organize sensitization meetings on FMNR at village level involving all key local stakeholders such as traditional community leaders, key opinion leaders, county departments of Agriculture, Livestock, Environment and Natural Resources, national government agencies such as (where present), Kenya Forest Service (KFS), Kenya Forestry Research Institute (KEFRI), and the National Drought Management Authority (NDMA), among others.
- Identify and register interested community groups including women and men, the elderly and the youth, children, people with disabilities, those who may not directly work the land and any minority groups in the community. Also involve other important stakeholders such as herders, community-based leadership (clan elders, local administration, faith leaders, political leadership and technical staff in various sectors) among many other interest groups.

b. Build community agreement and ownership – Many interventions have failed to go to scale because communities did not associate the initiatives with their felt needs and processes. It is therefore important that FMNR gains community ownership for sustainability, raising the likelihood of FMNR sites being protected from damage by competing land uses (e.g., grazing) and conflicts over use of resources. In addition to involving all community groups in decision-making, land users need to agree more broadly, on how to manage the land and the regenerating trees. They also need to accept that their past (and current) practices led the landscape down the path of degradation and agree on the changes in attitudes and practices necessary for land restoration with FMNR. Such changes may include moving from free grazing to grass cut-and-carry approaches or zoned grazing, among others.

The community should also be involved in project activities such as data collection (with simplified tools or training of local youth to undertake more complicated tasks) and providing performance feedback. A local management institution (such as project management committee) with good demographic representation (gender, vulnerable groups, etc.) needs to be put in place. Use of community assets in implementation of agreed activities should be encouraged as much as possible.

c. Build relationships and trust – Trust is the expectation that arises within a community of regular, honest, and cooperative behaviour, based on commonly shared norms, on the part of other members of that community[R15]. The benefits of FMNR to the broader landscape are accentuated when community members trust each other and work together to realize their shared goals. Trust is a major ingredient of social capital[22] and lowers the transaction costs of relationship-building and collective action. It helps in social networking, both with a community group (bonding), with other groups whose relationships are necessary in meeting aspirations (bridging), and with external support organizations (linking). This implies that community members must trust each other and also trust the FMNR agent[23] a trust that is largely informed by the fact that the community jointly selected the FMNR agent whom they believe will effectively promote change, current relationships as well as past experiences.

Ideally, building relationships and trust can begin by organizing a series of FMNR workshops, trainings, and capacity building events that aim to facilitate a learning journey. Box 11 has some valuable ideas that could help build trust during such workshops. The journey should help people associate their livelihood challenges with land degradation (including loss of trees), and see land restoration as anchoring their aspirations. This culminates in the development of a shared vision for the future.

[22]Social capital is a capability that arises from the prevalence of trust in a society or in certain parts of it. It can be embodied in any social group from the smallest and most basic, the family, largest of all groups, the nation, and in all others in between. … it is usually created and transmitted through cultural mechanisms like religion, tradition, or historical habit [(R15)].

[23]It is important to note that even the process of identifying key FMNR agents is always participatory, ensuring that community members identify persons they trust and believe can be effective in promoting the approach.

Box 11. Nuggets to keep in mind when engaging with the community to build agreement and trust

i. Be inclusive of everyone, regardless of their role, gender, economic status, tribe and age.

ii. Respect and encourage thoughtful, civil debate including on regrettable past incidents that might make it tougher for people to trust now.

iii. Discuss every person's concerns and work together to find solutions that help everyone. There is nearly always a locally appropriate solution! Give people the opportunity to suggest it.

iv. Always start with the assumption that the other person has positive intentions and respond to misunderstandings and mistakes gently.

v. Whenever possible, invite people who are already practicing FMNR to share their experiences and knowledge with your community.

vi. Listen and learn. By listening you will develop the knowledge necessary to support the community to introduce FMNR. Listening will help you become aware of threats to success and it will win you many allies. Ask questions with genuine curiosity.

vii. Exhibit humility and vulnerability to admit when you don't know the answers. Share what you know and acknowledge what you don't know. Acknowledge that everyone knows something unique and useful about the community.

viii. Talk about values. Don't lecture or preach, just share your values, listen to others, and walk your talk. Then, when you make suggestions, connect them to shared values.

ix. Make sure that everyone knows they can try FMNR in their own way, on as much or as little land as they are comfortable using. Keep your word. If you promise things you can't do, people might like you, but they won't trust you.

Adapted from [R49]

d. Shared community visioning and action planning – The target community needs to take responsibility for the degraded status of their land resources by being facilitated to ask themselves these questions: "How did the land end up being degraded and without vegetation cover? How have livelihoods been affected by the degradation over time?" This information and more can be obtained through a joint community stock-taking process. The background helps the community or producer groups to come up with a vision of how they would like their land or livelihoods to look like in future, an aspiration that can be achieved through FMNR. A community vision can be in form of a short statement (e.g., reversed land degradation and sustained increase in food production and water availability), or can be conceptualized as a drawing or a map of their area, showing how they would like their landscape to look in the future. Community action planning processes can be put in place to come up with a shared community vision and action plans to realize this vision (Box 12).

Box 12. Elements of a community action plan

- Local organization in place to coordinate activities and monitor progress of the plan
- Land use plan for farms and watersheds in place
- Local training on how to keep up the assessment of land use change, land degradation and productivity status, as well as associated risks such as climate change (including Information and Communication Technology (ICT) use)
- Selected technical solutions proposed for land management and commodity production
- If proposed technical solutions need further testing, a plan for local mechanisms to validate them (such as planned comparisons) should be put in place
- Plan for technical assistance and credit so that proven solutions (such as water harvesting, apiculture, sustainable fuelwood production etc.) can be adopted
- Leadership training to strengthen collective action and local leaders
- Advocacy plan to gain support of important policies and external stakeholders
- Financial plan to support anchor value chains (including tree-based value chains, village savings and loan options)
- Procedures and responsibilities assigned for monitoring and evaluation of the plan
- Alignment to the Sub-catchment Management Plan, if one exists (see case study in Box 13)

Adapted from [R3]

Box 13. Aligning CAPs with SCMPs for holistic NRM approaches by DryDev Programme in Machakos

Commencement of the Drydev Programme within the sub-catchment areas injected new life into WRUAs in Mwala Sub-county, Machakos County. The first step was to come up with community action plans which involved all community members within the sub-catchments coming together to identify their future-rich picture. The community action plans became the guiding document for all NRM activities undertaken by the programme and the community at large. The programme also harmonized the CAPs and SCMPs. The DryDev Programme in partnership with the WRA went further to conduct an in-depth capacity assessment on the WRUAs in order to identify gaps which needed to be addressed. The gaps included poor management of projects, understanding sub-catchment management approaches and policies guiding the same, financial management, mobilization of communities and resource acquisition. Training on institutional development and group dynamics by DryDev in partnership with WRA rejuvenated the holistic understanding of NRM by WRUAs. The WRUAs started becoming active as they developed a better understanding of their roles in sub-catchment management. They took charge of water flows and initiated projects in partnership with other stakeholders. Formulation of by-laws and creation of awareness on existing laws governing sub-catchment management bore fruit as the communities have gained skills on approaches to resource management. Riparian areas were pegged and restoration practices hinged on FMNR put in place.

e. ***Capacity building*** – This is a common terminology that comes with several meanings. Verity (2007[R59]) lists some of the definitions that have been used for the term including:

> Community capacity building is the continuous process required to foster the pride and appropriate local leadership that allows communities, through their members, to take responsibility for their own development[R19]; and, capacity building should enable people to move from the status of objects manipulated by external forces and victims of social processes, to the status of subjects and active agents of change[R2].

Going by these definitions, capacity building is important in FMNR promotion in that:

i. It seeks to equip people with the knowledge and skills to, not only successfully practice FMNR, but also to work together to do it, observe and experiment, and share their experiences with others.

ii. It aims to help communities develop the skills and structures needed to organize and manage FMNR fields, communicate about what they are doing and deal with problems.

iii. It enables and empowers community members to take full ownership of, and responsibility for their FMNR practices and outcomes.

In order to ensure that capacity building efforts are responsive to specific needs of the individuals, farmer groups or community and identify the best methods to address such capacity needs, the first step in community capacity development is a capacity needs assessment. Capacity needs in FMNR could include:

i. Technical aspects of FMNR (tree selection, pruning, protection, maintenance) as well as collaborative learning and monitoring. The FMNR Online Training Academy has courses available to cover these technical aspects. FMNR facilitators are encouraged to enroll for these courses. More details on the online courses can be accessed at *https://fmnrhub.com.au/fmnr-online-training/*

ii. Soft skills that support the spreading of technical aspects of FMNR such as facilitation and training of trainers.

iii. Leadership, governance and advocacy skills needed in order to scale up FMNR such as skills on

- How to create and use *by-laws*
- How to advocate for greater support for FMNR with local leaders and other government officials. World Vision's Citizen Voice and Action is a powerful advocacy tool available for use by communities as it enables communities learn how to voice their concerns and engage governments. More details on the tool can be accessed at *https://www.wvi.org/socialaccountability*
- Finding and improving markets for FMNR products (wood, fodder, wild foods, traditional medicines, dyes, seed, etc.) to increase and diversify incomes, thereby making FMNR more amenable for adoption.

f. ***Develop community by-laws*** – By-laws are rules or laws established by a community or group of people, to regulate itself. By-laws are essential to the success of FMNR. The most effective by-laws are those developed through community-wide consultation, so that everyone who uses the land understands how the changes required for FMNR will affect them and they are willing to abide. Any concerns by minority members of the community should be acknowledged and managed by those who are facilitating the process.

Copies of the by-laws should be shared with government officials, including those in the justice system, key local government leaders such as chiefs and assistant chiefs, among others, to help increase their legitimacy. Development facilitators, working with local government leaders such as chiefs, should also support community members to update by-laws to reflect current laws. In many cases, specialized training may be needed beyond FMNR technical training so that the community understand how to advocate for laws and their enforcement.

g. ***Advocate for policy change and/or awareness*** – FMNR is most successful when government policies that give land managers ownership or user-rights to their natural resources, including trees, are put in place and domesticated into relevant county government policies, strategies and county integrated development plans (CIDP). FMNR also benefits from policies that allow for organizational structures such as cooperatives and development groups to exist and the use of defined set of by-laws created and agreed by all stakeholders. In areas where the right policies exist but community members do not know their rights, awareness raising on enabling policies is necessary. It is also essential to empower the community leadership to enforce by-laws that have been consultatively developed.

4.3 Common scaling approaches

Having given the elements embedding community mobilization the next step is to select the approaches to use in scaling FMNR in the target communities. The approaches will be informed by the results of the community assessment and stock taking. The most common approaches are outlined below; they are rarely used singly in any community. The best scaling mix utilizes a combination of many approaches in any given context.

4.3.1 Farmer organizations' approach

Farmer organizations or grassroot community organizations are member-based collectives in the rural and agricultural space which manage relationships among members and with external actors. Farmer organization is multi-level and can range from small informal groups to formal organizations at micro, meso and macro levels. Individual farmers can belong to several farmer organizations depending on varying interests. Farmer organizations enhance learning, innovation, advocacy and general evolution of the community space by drawing on collective energy to facilitate change in the specific focus area. Kenya is synonymous with the spirit of *"harambee"* which essentially implies "pooling efforts together towards a common goal"; this is anchored in the spirit of collective action.

Working as a group is likely to have greater influence on scaling FMNR and tackling challenges that go beyond individual farms up to the catchment level. Group approach provides mutual support, shared learning, collective action when necessary, and a united front to approach external support agencies such as government entities, NGOs and donors.

Common organizations that are useful vehicles for promoting FMNR among Kenyan communities include:

i. Women groups

ii. Youth groups or clubs

iii. Agricultural producers' (farmers') groups

iv. Community-based organizations (CBOs – anchor organization for primary producer groups)

v. Cooperatives

vi. Savings groups (referred to using different terminologies such as Village Savings and Loan Associations – VSLAs; Savings for Transformation – S4Ts; Savings and Internal Lending Communities – SILCs, etc., depending on the support agencies involved)

vii. Common interest groups established for natural resource management, tree nursery establishment, etc.

viii. Any other groups existing for the purposes of mutual support and collective action, which have an interest in FMNR.

Community groups are ubiquitous in Kenya and have been a useful vehicle for delivery of most community development initiatives. Usually a key entry point is to identify existing groups, conduct capacity assessment exercises and sensitization on FMNR. In cases where the community has no existing groups that can undertake

FMNR, committees and groups can be formed with promotion of FMNR as the main objective. However, the principles of value and process-based approaches discussed in Chapter 2 should be taken into consideration.

It is imperative to support the community or farmer groups (new and/or existing) through the FMNR engagement process to:

i. Understand the purpose of forming or being in the group

ii. Develop a business mentality, and the will to commit time and energy in making the group perform

iii. Understand the benefits of cooperation

iv. Make a comparison on the benefits and the costs of joining the group

v. Understand what the group will and will not provide to members, and;

vi. Understand that successful groups are founded on trust, honesty, gender equity, shared social support and responsibility

Groups that are formally registered with the government and have a constitution as well as democratic processes in leadership election and transition are easier to work with, especially when it comes to linking with external agents such as NGOs, private sector actors and other actors where legal agreements are necessary.

Plate 12: A women's group learning session in Kambu, Makueni County

4.3.2 FMNR change agents (champions/lead practitioners)

FMNR change agents are women and men who have adopted and are successfully practicing FMNR. They are passionate advocates for the practice and are usually referred to as "FMNR champions" or "lead practitioners". They have great skills for managing land and trees, as well as adapting FMNR to make it more effective in their context. They also have a heart for people, and skills to work with, support and teach others to adopt FMNR.

The change agents play an important role in FMNR initiatives and the spread of the FMNR movement at the community level due to the position of trust and influence they hold. Unlike government extension agents, most FMNR change agents live in the community where they practice FMNR and are not necessarily driven by monetary interests, hence they have enormous credibility. An extension worker from government or a development organization can also become an excellent FMNR change agent as long as they are passionate and dedicated to training and supporting communities to practice FMNR.

FMNR change agents are outstanding in their community due to their ability to:

- Share their knowledge and experience
- Teach others
- Encourage and advise other practitioners
- Help monitor practices and troubleshoot problems
- Work with their community to resolve conflicts, change policies, and advocate with leaders and the government.

Identification of FMNR change agents

An FMNR practitioner can become an FMNR change agent if s/he has charisma and other necessary people skills to influence others. They should also be passionate about change and demonstrate a natural communication ability. Community members usually know who these people are and can help point them out through a participatory process. The following qualities can guide when selecting FMNR change agents:

i. **Excellent FMNR practitioners**, who monitor their progress and experiment to solve problems with their land and trees.

ii. **Good citizens** who have earned trust and respect in the community because of their behaviour and moral standards.

iii. **Passionate about spreading FMNR**, and about seeing people succeed. When they are practicing FMNR or teaching others, they are energized especially by what they are doing with little show of weariness.

iv. **Natural teachers**, who communicate patiently and clearly, are willing to guide those who may not be practicing in the right way, encourage learners when they struggle, and celebrate with them when they succeed.

v. **Willing and able to regularly visit with community practitioners** and participate in meetings and discussions about practicing FMNR.

vi. **Able to inspire others.** Some are extroverted and comfortable leading a crowd, while others, in their own quiet way inspire the ones and twos – both are effective, they just work differently.

vii. **Patient and persistent.** They understand that people may take time to adopt a new idea and are willing to continue the dialogue without getting discouraged or weary.

viii. **Forgiving and tough-skinned,** when they are the object of jokes and derision, sometimes even subjected to abuse, as they practice and promote what may seem unusual to some, at first.

ix. **Leaders who take initiative.** Not waiting for others to tell them what to do, but testing out new ideas and making use of opportunities.

A study in East Africa (Kenya, Uganda, Tanzania)[R30] revealed that change agents are motivated by a combination of intrinsic and extrinsic factors which may change over time, but gaining knowledge and altruism were the most motivating factors. Access to more income as a result of adopting the practice they promote, as well as being able to offer specialized services that the practice may yield is a further motivation. It is therefore important that, ideally, FMNR change agents should not be paid for their work, but should be reimbursed any costs they may incur while sensitizing and training community members. Taking them through a specialized training such as 'train the trainer' or 'facilitation' is also useful if they are playing significant roles within the FMNR roll-out. During such trainings, specialized skills on good agronomic practices (GAP) and financing approaches such as village saving and loaning association (VSLA) can be imparted to enable them become key community resource persons.

4.3.3 Primary and secondary school programmes

Schools and ministries or departments of education play an important role in influencing FMNR uptake by communities. Schools tend to be central locations for community members to meet as well as places where people are accustomed to learning and accepting new ideas. They are also a reflection of the future that communities seek to build for their children. While adults may be ambivalent to change, children often find it exhilarating and can be passionate activists who inspire adults to test new concepts. Working with schools is beneficial to FMNR uptake because:

- Children exposed to benefits of FMNR take the knowledge and skills into adulthood where many will be in positions of influence.
- Children are also powerful advocates of FMNR to parents and adults in general, hence school projects on FMNR can help shape the whole community.
- Children will grow up to be practitioners of FMNR.
- Environment clubs or FMNR lessons can increase opportunities for children and youth to learn, and to use their knowledge to improve their lives.
- Schools may have open space available that can benefit from FMNR and related projects and can provide space for community discussions or even act as FMNR demonstration sites.
- Ministries or departments of education can adopt FMNR into science, environment, and life-skills curricula, thus increasing knowledge of FMNR across their geographical scale.

4.3.4 Demonstration/model sites and innovation hubs

An FMNR demonstration site (also known as a model site) is a field that carries the aspiration of farmers and the community on the positive change they desire. An FMNR model site should exhibit sound management in terms of appropriate tree density, right tree diversity, sound FMNR practices (such as pruning, coppice management especially for stump regrowth, enrichment planting where necessary, etc.) and below-canopy vegetation (grass, annual crops, etc.) performance. As such, model sites can be seen as innovation hubs where a wide range of FMNR practices, both on farmlands and rangelands, are tested, and where the community members can learn about FMNR and replicate the same on their land.

An Innovation Hub is a place which provides facilities to nurture new ideas for faster land restoration and integrates ideas to accelerate scaling at landscape scale.

An Innovation Hub is a place which provides facilities to nurture new ideas for faster land restoration and integrates ideas to accelerate scaling at landscape scale.

Model sites as well as innovation hubs should ideally be set up at the lowest community level (village) so as to accelerate skills development and knowledge sharing among community members with the least travel costs. Innovation hubs should essentially be managed by grassroot institutions in the target area. The technologies demonstrated should be fit-to-local-context hence no one-size-fits-all. Some guiding notes on establishing model sites and innovation hubs are given below (adapted from [R10]):

1. **Conduct feasibility study:** diagnose the information and training needs of the community.
2. **Raise awareness** amongst farmers and identify 'champions' to promote FMNR, i.e., individuals or organizations already involved in some farmer training or extension activities.
3. **Train lead agents** on technical aspects of FMNR and also on adult learning and communication.
4. **Create demonstration plots and training approach based on identified needs** – you could include a tree nursery where enrichment planting is necessary.
5. **Organize demonstrations, training, field visits, etc**. for interested farmer groups; and update and refine extension knowledge to remain relevant.
6. **Establish links and partnerships** with other institutions to increase the scope of intervention.

Plate 13: FMNR demonstration site in Baringo

4.3.5 Exchange visits

Exchange visits (or study tours) involve organizing a meeting between a 'visitor' community group (not necessarily one that works together; it could be an amalgamation of representatives of several producer groups) with another 'host' group. The aim is to have the two groups exchange experiences and discover new viewpoints and approaches depending on expectations of the visiting group. The visit could happen in the same community, area or county, or could be a different geographical area. The term 'exchange visit' connotes an expectation that the host group will in return visit the visitors' home area at a later date, although in many cases the return visit doesn't happen.

Study tours are one of the most important components of a scale up strategy. Farmers listen most keenly to, and are more likely to believe their peers. When farmers see fellow farmers successfully practicing FMNR, they perceive real benefits. The 'practical demonstration' makes it easier to understand the concept and stimulates action. The visitors also become more aware of their own skills and capacities, which contributes to attitude change and ultimately adoption.

FMNR adoption by communities working with the DryDev Programme in south eastern Kenya (Machakos, Kitui and Makueni) was greatly enhanced by a visit to Central Rift where World Vision had piloted the approach. After interacting with their peers, the farmers from SE Kenya appreciated the wasted resources they had in the name of unmanaged bushlands and quickly selected FMNR farmer trainers who helped groups to introduce the approach. The practice quickly transformed bushlands into useful plots that are sources of fodder and wood products.

Photo: Danyell Odhiambo/ICRAF

CHAPTER 5

FMNR VALUE CHAIN DEVELOPMENT

The socio-economic perspective of FMNR embeds sustainability of land restoration interventions in different agro-ecological contexts. Majority of households in the rural set-up, especially those in the ASALs, struggle to make ends meet and often get involved in practices that accelerate land degradation when the full benefits of conservation are not immediate. In order to attract more farmers or communities to adopt FMNR and to sustain the practice for generations, an important early step is to identify and prioritize potential value chains for development. Mapping, selecting and analyzing priority FMNR value chain for development should be embedded within the community visioning and action planning process described in Chapter Four. To address delays in accessing benefits, it is also recommendable to run parallel local value chain development (LVCD) with selected farmers in food and income generating value chains (Box 14).

Box 14. FMNR champions and entrepreneurship in Kiambogoko World Vision Area Programme, Nakuru

This shop belongs to FMNR champions in Kiambogoko Area Programme in Nakuru County who benefitted from an FMNR pilot project in 2017. Through the project, they were supported to procure printing services as an income generating activity; one farmer later expanded the business to include household goods. He reported that participating in the FMNR project enabled him to expand the business group and portfolio. The shop is his individual enterprise, but the printing services section is managed by the group. They attribute all the success and accrued benefits to business knowledge acquired through the project.

5.1 Understanding the value chain development concept

FMNR value chain development is a concept that pays special attention to how FMNR-supported local production systems are linked to processing, trade (markets) and final consumption. It also describes the flow of inputs and services in production of a FMNR-based product. In further understanding the concept of value chain development, it is important to respond to the following questions:

1. What is a value chain?
2. Who is a value chain actor?
3. Why develop FMNR-based value chains?
4. What is the importance of gender-inclusive FMNR-based value chain development?
5. What are the benefits of developing FMNR-based value chains?

5.1.1 What is a value chain?

A value chain refers to the entire system of production, processing and marketing of a product, from inception through to the finished product to waste disposal[R51]. A value chain consists of a series of chain actors, linked together by flows of products, finance, information and services. FMNR value chain promotion aims to foster economic growth by making sure that the additional income generated from streamlining value chain processes associated with products generated through FMNR benefits low-income groups, while also ensuring sustainability of the practice.

5.1.2 Who is a value chain actor?

Value chain actors are the personalities[24] who are actually involved in FMNR-based value chain activities, from production to utilization. They are also known as stakeholders or market actors. They are often – but not necessarily – associated with particular value chain activities. Value chain actors include companies or organizations, individual farmers (or land owners/producers) and government entities that act either as input and service providers (e.g., transport or processing, extension service providers and NGOs involved in capacity building), producers, traders or as consumers. What most value chain actors have in common is that they become owners of the (raw, semi-processed or finished) product at one stage in the value chain. Value chain actors should be identified once FMNR value chain activities have been mapped for successful value chain development.

5.1.3 Why develop FMNR-based value chains?

Rural populations often fail to sustainably manage trees on farms or community land because of lack of real or perceived benefits in the short term. The purpose of developing FMNR-based value chains is to enable community-based producers gain value from managing their land and tree resources both from socio-economic and land restoration perspectives. The institutional arrangements involved in FMNR VCD (including improving financing options) aim to improve the asset base of smallholders (both as individuals and as their organizations) which reduces their vulnerability and improves their confidence and competitiveness.

Value chain development (VCD) focuses on deliberate efforts to create and strengthen win-win relationships between two or more chain actors aiming to result in win-win outcomes that can sustain the relationships over time. In addition, at the heart of VCD, are efforts to strengthen mutually beneficial linkages among value chain actors so that they work together to take advantage of market opportunities. FMNR VCD should be pro-poor and emphasize arrangements that improve quality and volumes of products by the smallholders and their linked enterprises which allows buyers to buy at better prices and reduce the pressure to degrade their natural resources.

Success in FMNR-based value chain development, can be achieved by:

i. Improving market access or creating new markets for FMNR products in order to sustain profitability

ii. Making services (financial, technical and business) more accessible to FMNR practitioners

iii. Building the capacity of farmers and pastoralists to profitably match their FMNR product(s) to the prevailing market requirements

Incorporating gender aspects into decision-making on which FMNR-based value chain to develop is important. Essentially, FMNR-based value chain development should help the youth, men and women generate a more sustainable income besides gaining economic empowerment. At the very least, any VCD should promote gender equity in terms of participation and sharing of benefits associated with FMNR-based value chain[25] This gives every community member a sense of belonging, value and respect, and thus promotes diffusion of FMNR in the community, an important requisite for scaling and sustainability. Any FMNR-based VCD programme ought to promote gender inclusiveness right from scoping, product selection and prioritization, value chain analysis, capacity building, market linkages and to the project monitoring and evaluation.

[24]In the legal sense of the term which implies capability of having **legal** rights and duties within a certain **legal** system, such as to enter into contracts, sue, and be sued. This therefore includes individuals, organizations, enterprises etc.

[25]For more information about gender inclusiveness in value chain development, refer to [R51].

5.1.4 What are the benefits of developing FMNR-based value chains?

Some of the benefits of implementing the asset-based approach in FMNR VCD include the following:

i. It helps identify constraints and common solutions for the challenges.

ii. The relationships developed by the value chain actors are more rewarding to all because the transaction costs of doing business are substantially reduced.

iii. It provides opportunities for innovation within the value chain.

iv. The feedback received from value chain actors reduces the time spent on responding to changing customer demand, as a result of better communication with chain partners.

v. It gives farmer organizations taking up FMNR a competitive edge when the value chain's products and processes are difficult to duplicate.

vi. It provides a unique way to manage risk because the buyers are assured of product quality, supply and safety through integrated systems from production to retail. Suppliers are more assured of a market and the benefits of economies of scale.

vii. It improves access to markets because every actor is sure of the next step and the channel of product flow.

viii. It minimizes focus on community needs as asset gaps are addressed in the VCD innovation platforms

5.2 Three key stages of value chain development

This section looks at how to help farmers with visioning the potential for food/income/resource generation as a direct result of their FMNR activities by presenting the three stages of local value chain development as listed below (adapted from [R51]).

Stage 1: Participatory product scoping, selection and analysis

Stage 2: Mobilize and build the capacity of producer groups

Stage 3: Facilitate market change and scale

Stage 1. Participatory product scoping, selection and analysis

This stage involves five major processes.

i) Scoping potential products and markets

Agroforestry can provide farmers with a wide range of marketable tree products and/or enhance production of other marketable agricultural products. These products may have varying market potential based on the local context. It is therefore incentivizing if FMNR promotion agents work closely with target community members to identify products that will attract better market rewards for development and scaling. The aim of scoping FMNR-based products is to

1. Select FMNR-based products with the highest production and market potential.
2. Establish and/or strengthen relationships between FMNR practitioners and specialized producer groups at community level.
3. Map key actors who may influence the products' value chains.
4. Identify market gaps for the potential product(s) selected through a participatory process.

5. Understand the (i) socio-economic and political drivers in the area; (ii) demographic and cultural features of the area; (iii) capacity and FMNR production practices by the target community; (iv) gender-related constraints, opportunities, norms, roles and responsibilities, among others.

6. Produce a situation analysis report with key findings to guide FMNR-based value chain development:

ii) Product selection

Selection of priority FMNR-based value chain(s) involves working with farmers or communities and other local actors[26] to identify high-value products/enterprises which could potentially contribute to, and spur FMNR scaling because they yield the best returns. Product selection should also include identification of the associated tree species and/or practices to which community members can invest in profitably. Some possible FMNR-based value chains for selection and prioritization are highlighted in Box 15. Further details are provided in Box 19.

Box 15. Potential FMNR-based products for selection

1. Woodfuel – firewood and charcoal
2. Honey
3. Medicinal and aromatic products
4. Gums, resins, dyes and tannins
5. Fodder and pasture
6. Fruits and nuts
7. Timber and poles

Selection of a value chain should be conducted during the community action planning stages through prioritization of a short-list of products in any particular area. This should involve weighting and ranking the list of products scoped under step 1 (above), against the selection criteria suggested in Table 7. The best scoring product/practice is selected for value chain analysis and development. The scoring criteria is further elaborated in Box 16.

Table 7: Evaluation and selection of priority FMNR-based value chains in Kenya

Product	Criteria	Score	Reason
e.g. Fodder/pasture	Public sector support		
	Growth potential (demand, etc.)		
	Gender factors		
	Sustainability		
	Impact on youth & women		
	Partnership opportunities available		

Scale: 1=very high 2= high 3=moderate 4= low 5= very low

Note: for each score include a brief explanation

The facilitator should use consensus as much as possible, during scoring for each product/practice. Where there are differing viewpoints and consensus does not come easy, the facilitator should actively recognize that there is

[26]These include local leaders such as chiefs and politicians, value chain actors from government institutions, non-governmental organizations, private sectors and microfinance sector and should be totally inclusive

strength in differing viewpoints rather than audibly placing viewpoints in value order. In such cases, participants can then be guided to vote for the products whose ranking is disputed, from most preferred to least preferred. In case of voting, each person has only one vote to put against his/her preferred product under each criterion provided.

Once the final selection is completed, a situation analysis report is then written, capturing the process of scoping and product selection.

Box 16. Criteria for FMNR/agroforestry-based value chain prioritization

Public sector support: The ability of the value chain to be supported by either the national or county government, or both. It includes the existing sectoral strategy frameworks, policies, regulations and legislations at both levels of governance, including county integrated development plans.

Growth potential: Involves the product's market demand, level of interest it attracts locally and beyond, at present and in future forecasts, foreseeable profit margin and return on investment, replicability, input availability and accessibility, and ability to address household needs, among other growth factors worthy of consideration. Pay attention to issues such as transportability and distance to market as some products such as firewood might be too bulky and costly to truck to distant markets.

Gender factors: Ensures gender equality[27] and 'empowerment'[28] are conceptualized in the analysis and selection to ensure that value chain interventions:

- Internalize awareness (and monitoring) of the different impacts they may have on men and women.
- Seek to increase the gains of female actors in the chain or at least to ensure that no harm is produced.
- Address gender inequality at the level of household, institutions and value chain governance, or attempt to help women achieve a better functional position along a value chain.

Sustainability: Imperatives for more sustainable production systems feature with multiple stakeholders in consumption, retail, and county and national regulations including taxes or cess, standards, voluntary incentives and related instruments. Sustainability offers FMNR-based chains a potential source of competitive advantage.

Impact on youth and women: Prioritization of FMNR-based value chains should include evaluation of the level of economic attractiveness along the chain to both. To survive, many unemployed youth and women engage in practices that provide short-term income at the cost of the environment. Therefore, the selected value chain should be able to significantly address the economic needs of youth and women.

Partnership opportunities: This evaluates the value chain's attractiveness to private sector investments at different levels, microfinance and other credit facilities, as well as other stakeholders' willingness to invest or provide incentives to farmers.

[27]Gender equality means that the different behavior, aspirations and needs of women and men are considered, valued and favoured equally. It does not mean that women and men have to become the same, but that their rights, responsibilities and opportunities will not depend on whether they are born male or female.
[28]Empowerment can be defined as 'a process by which those who have been denied the ability to make strategic life choices acquire the ability to do so'. Empowerment is about changing *gender* relations in order to enhance *women's* ability to shape their lives.

iii) Participatory value chain analysis of the selected products

Value chain analysis (VCA) is a process where a firm identifies its primary and support activities that add value to its final product and then analyze these activities to reduce costs or increase differentiation. A complete value chain analysis is conducted for each selected product to:

i. Understand the product flow from inputs to end markets, and the overall market environment

ii. Identify the product's value chain actors

iii. Develop a shared understanding among VC actors of the product's prevailing situation

iv. Identify constraints and opportunities for developing the product's value chain

v. Find market or information gaps that require further research on the product's value chain.

iv) Value chain mapping

Drawing from the concept of a chain as a metaphor for connectedness, a value chain map is an illustration that shows how a product flows from one actor in the value chain to the next and how activities and actors are linked across the chain[R51]. Figure 12 provides a simplified diagram of a typical value chain map, displaying the basic flow from producers through marketing agents, and processors to the end consumer, as well as input and service supplies to the farmer.

A value chain map helps to:

i. Understand the flow of a product from the primary producer (farmer, pastoralist, broom maker, etc.) to the final consumer

ii. Identify and categorize key market value actors as well as organizations that are supporting the selected value chain

iii. Understand different market channels through which priority product(s) and services reach the final user (e.g., number of value chain actors, size of the market, potential markets, type of support services, who controls the value chains, etc.)

Mapping a value chain with its various components, linkages and actors can, among other things, facilitate a structured discussion about the opportunities and constraints that producers and other actors face, as well as what could be done to address them. Product flows in the value chain have potential to affect the prices at final consumption. Value chain mapping will guide FMNR extension agents to work with farmer groups or the community to map, select, analyze and identify loops for creating wins for themselves and other actors.

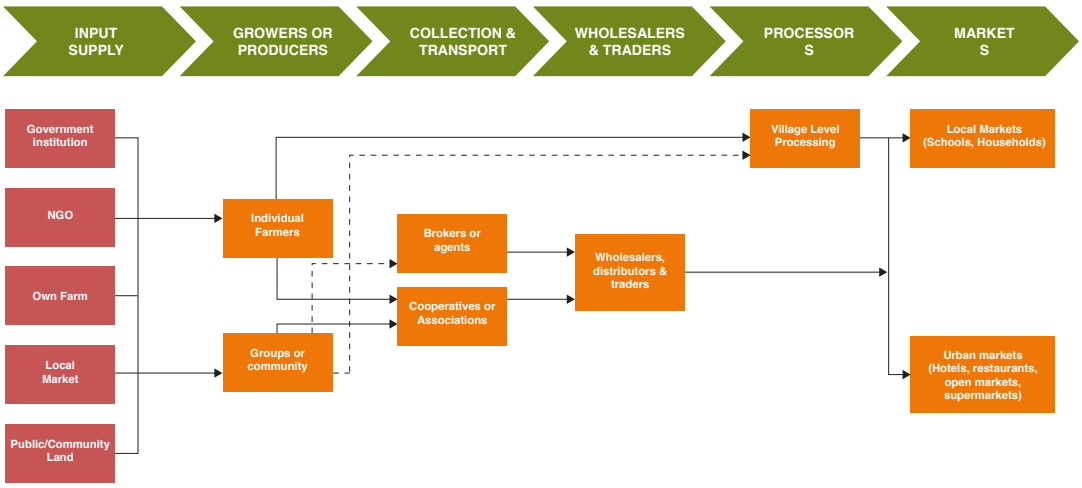


Figure 12: A prototype value chain map

Box 17. Value chain data collection and analysis

Key informant interviews: these interviews initially look at and develop a list of market actors identified through the value chain mapping, including supporting organizations and then snowballing is used to identify more actors.

Focus group discussions (FGDs): FGDs with a few groups of people (each of 7-10 with similar functions in the value chain) help explore concepts, develop ideas, identify different opinions and compare the data with that collected through other approaches.

Review of secondary materials: Literature, reports and data on areas of specific interest such as price trends, volumes traded, key market actors, etc. Sources include market actors, research institutions, donor reports, financial institutions, government and NGOs, among others.

Data analysis: Identify constraints and opportunities from the gathered data. Some of the most important analyses include market analysis, benefit-cost analysis and gender analysis.

Data analysis helps to identify market gaps, value chain strength, areas that require more efforts, value chain(s) worth farmers' investment, and who to partner with (value chain actors) among other areas of interest for value chain development. Findings from the value chain analysis provide evidence to incentivize community members and their support organizations[29] to practice FMNR. FMNR farmers thereafter identify partners with whom they share aspirations and commitment or willingness to support the development of the value chain for the selected product.

Stage 2. Mobilize and build the capacity of the community or farmer groups

Collective action[30] at community level makes VCD within FMNR more successful because it is easier and more cost effective to reach farmers through their respective organizations (usually organized around the value chain) as compared to individual farmers. Hence, farmer capacity building on selected value chains should commence by:

i. Facilitating and supporting the establishment of new farmer groups where there is none, or

ii. Motivating existing farmer groups.

The groups could be formed based on a specific FMNR-based value chain or participate in more than one value chain where the instruments establishing them allow. Where the group deals with cross-cutting value chains, gender equity should be observed right from group membership (though membership is voluntary) to the leadership positions. The basic group formation prerequisites listed in Chapter 4 need to be observed.

FMNR-based value chain development is a process and each selected value chain requires a specific action plan which is context-specific. An action plan for developing wood fuel value chains may not be similar to that for developing a honey value chain. In the action planning process with stakeholders, it is important to:

i. Discuss and prioritize critical points in the market chain from production to marketing.

ii. Address the constraints and opportunities identified in the analysis of the selected value chain

iii. Identify the types of interventions that could increase chain competitiveness

iv. Identify priority interventions and classify them as short-, medium- and long-term activities

v. Examine the roles of the actors associated with each intervention

vi. Determine the groups savings and/or financial resources to invest in different activities

[29]Such organizations may include local microfinance, banks, private businesses that sell grass seeds or beehives to farmers, government extension workers, local veterinarians, regional or national research institutes or universities and many more.
[30]Collective action is an action taken by a group (either directly or on its behalf through an organization) in pursuit of members' shared interests.

vii. Identify the potential of each stakeholder within the selected value chain

viii. Consider forming a stakeholder network that will spur development of the selected value chain in the area[31]

• **FMNR-based value chain network**

Forming a network of stakeholders will play a significant role in increasing the gains of FMNR at the community level and beyond. This is because of the influence of networks in the development of the selected value chain, contribution to the local policy or regulatory reforms, and enabling farmers to access new markets that were once inaccessible. Inclusion of leaders of farmer organizations in the network builds local capacity and adds value to existing strengths, while building on where energy already exists in the community. Livelihoods improve as community members begin to recognize the value of FMNR, develop their own natural resource management skills and sustainably manage the natural tree resources.

• **Training of FMNR farmer groups**

Training is geared towards building the capacity of FMNR groups on various aspects of the value chain as highlighted in Box 18. Men, women and youth should be equitably involved in the training activities by identifying each of them directly other than through proxies who might undermine the principle of inclusivity.

Box 18. Five key skill sets required by producer groups

1. Group management skills
2. Financial and internal savings and lending skills
3. Basic market skills
4. Innovation and experimentation skills
5. Sustainable production and FMNR skills

Adapted from [R51]

Stage 3. Facilitate market change and scale

Market change is a common phenomenon and is influenced by forces which affect prices and behaviours of producers and consumers. These forces (also known as drivers) create fluctuation of supply and demand for a given product or service among other market forces that result in price movement. Community groups involved in FMNR can be prepared to cope with such dynamics by enhancing their capacity to produce as well as engage with and strengthen their relationships with service providers (finance, insurance etc.).

Community training is necessary for market change and should be done by training providers who are knowledgeable about the market dynamics, likely causes and appropriate interventions to minimize adverse effects along the value chain. The trainer can be home-grown[32] or externally sourced. Target FMNR groups should be involved in identification of the provider as far as possible. In influencing the market change for the selected FMNR-based value chain, it is important to undertake the following:

1. **Build relationships with financial service providers**. This will help improve access to capital for investment in the selected value chain especially where substantial capital is required and cannot therefore be accessed through savings groups or local village lenders. FMNR farmer groups need adequate skills to recognize the different savings and credit options available to them, their implications, real comparative interest rates, application process for loans, and reputation of their potential lenders.

[31]Stakeholder networks bring together producers with other value chain actors such as input providers (if any necessary), traders, buyers, middlemen etc., to improve communication and trust in the value chain. The networks can address larger, chain-wide interventions that may benefit a larger number of producers or the community, thus spurring socio-economic development and sustainability of the FMNR practice.
[32]A member of the FMNR farmer group trained and coached to facilitate market change.

2. **Build relationships with value chain actors.** By building good relationships between main actors, i.e., producers and upstream value chain actors and fostering a constructive discussion aimed at improving the conditions for their business relationship, the market is likely to remain stable and profitable for farmers. Farmer groups gain confidence to negotiate with other actors on pricing and value creation arrangements that will benefit them.

3. **Reflection meetings.** It is important for FMNR groups to regularly organize reflection meetings to encourage sharing and innovation in a changing market system. The meetings help to:

    - Analyze own behaviour and contribution to changes in production or market engagement.
    - Enable learning and sharing among FMNR farmers (or producers)
    - Share promising practices and common challenges
    - Provide a platform for interacting with external agents such as government and NGO technical officers with experience on particular value chain or other upstream value chain actors.

4. **Scale up and learning**. Valuable lessons can be drawn throughout the VCD process leading to new approaches to improving the selected value chains. Such approaches may include (i) intensive training of participating FMNR farmer groups on market dynamics; (ii) forming associations of context-specific FMNR farmer groups to consolidate, market and enjoy economies of scale, improve access to resources and services as well as access better support from the government (county or national government), large buyers and/or suppliers.

5.3 How can FMNR practices sustain the resource base for particular value chains?

The FMNR-associated value chains listed in box 15 are not very lucrative when pursued exclusively and would barely sustain a community that solely relies on either one or two of them. They are therefore better off undertaken as part of agricultural enterprises portfolio with a view to boosting household income and resilience based on diversification. Value chain development is therefore necessary to improve the resultant income. As a practice, FMNR supports increased volumes and quality of products while sustaining the resource base. The rest of this sub-section discusses how to apply FMNR to improve and sustain production in some of the products listed in Box 15.

1. Fuelwood

Fuelwood comes in the form of firewood and charcoal and has been a major cause of degradation of forest and tree resources. Some species of high calorific value are completely destroyed, leaving land bare or having trees of only weak species. Governments at national and county levels have attempted to proscribe charcoal trade with little success because at least four in every five households in Kenya use this form of energy. The concern is how to sustainably produce and trade in charcoal rather than banning it. FMNR can help by regenerating the felled trees from stumps and ensuring selective cutting of branches, pruning and coppicing of trees with careful monitoring of tree resources at different levels. FMNR groups can select coppices from stumps to ensure of the two or three stems that are raised, selective cutting is practiced such that at least one stem is always standing on a regenerating stump.

Plate 14: Firewood (L); and charcoal (R) in Baringo County

Kenya Forest Service has put in place an institutional framework consisting of Charcoal Producer Groups amalgamating into Charcoal Producer Associations (CPAs). The capacity of CPAs to undertake FMNR practices and wood resource monitoring can be developed to sustainably produce charcoal and fuelwood and trade on a sustainable basis. From a value chain perspective, building the capacity of these groups to invest in alternative fuel enterprises such as briquettes will also sustain the resources and ensure that the value chain is more environmentally-friendly. Other value addition opportunities exist in dendro-power (electricity generation from wood) as has been tested in some countries such as Sri Lanka with species such as *Gliricidia sepium*.

2. Honey

Honey is a value chain that supports community conservation initiatives by giving value to biodiversity. FMNR enhances regeneration of diverse plant species which provides bee forage in abundance. As a way of diversifying benefits from FMNR, farmers embrace honey production with beehives hanged under trees. Honey production can be both individually and/or communally managed. In the latter, an FMNR group can have the beehives in a group FMNR plot or in a public land where they have negotiated with authorities to practice FMNR. However, honey production is sensitive to colonization of bees in beehives which can be boosted by complementary practices as elaborated in Chapter 2.

Plate 15: Locally processed honey in Kapkuikui Location, Baringo County (L) Beehives hanged on trees under FMNR (R)

Successful honey production is dependent on providing bees with food, water and shelter. Unlike other insects that feed on leaves, bees feed on nectar which has less water than leaves, hence will easily colonize a beehive that is close to a water source. In the absence of a reliable water source, water harvesting (such as in ponds) might be necessary.

Not all, and not only trees are good for bee forage. FMNR farmers or groups should ensure sufficient quantity of honey plants (such as crop or pasture plants, weeds, shrubs, forest trees, roadside planting, etc.) are present within an economical flight range of the foragers. Enrichment planting is therefore advisable within FMNR plots to boost the abundance of bee forage trees. The more plant species at the site and the more staggered the flowering pattern can be within the year, the better. Shrubs and other thickets of little-known value at the site can be removed when starting. An elaborate list of honey plants has been compiled for the Upper Mara Basin[R20] that can be adapted for other parts of Kenya. Bee experts in the community (both technical experts and those with local knowledge) can help identify and list the species to target.

3. Medicinal products

Many communities in Kenya have traditionally relied on medicinal trees to manage human and animal health. Some of the remedies have even been commercialized. A lot of traditional medicinal knowledge has however, been lost as older generations pass on and medicinal trees are lost due to woodland and farmland degradation. FMNR provides an opportunity to restore some of these species, as well as document the associated knowledge, especially in the ASALs. Traditional healers are local repositories of this knowledge and can be consulted to help with the documentation.

Medicinal plant product value chains are not very developed in Kenya compared to regions such as Southern Africa and Asia. However, some improvement has been witnessed in recent times. The remedy and commercialization policy environment is improving but concerns about sustainable harvesting remain. These concerns are particularly alarming where the plant parts in demand are the ones that sustain the life of the tree, especially the roots and bark. There is need to monitor demand and supply patterns so that FMNR practices can be promoted in such a way that demand is satisfied sustainably. In addition to indigenous species regenerating naturally, enrichment planting can diversify the resultant medicinal plant gardens by introducing other species of high medicinal value (see Annex 2 for a list of some medicinal species valued by farmers and herbalists in Embu and Meru counties).

4. Gums, dyes, resins and tannins

Gums, dyes, resins and tannins are important products in the rangelands due to the global trade around them. Gums are mainly produced from *Acacia senegal* and *Acacia seyal* which could be easily established and managed through FMNR. Tree species serving as sources of dyes, resins and tannins include *Commiphora holtiziana*, *A. bussei, Lawsonia inermis, Commiphora campestris, Commiphora confusa, Commiphora candidula, Acacia zanzibarica, Boswellia neglecta* and others. These products are mainly extracted from the bark of the trees and, if not well monitored, could result in the death of trees.

Plate 16: Women producers from Laisamis community in Marsabit county with frankinsense a resin from Boswellia neglecta (Left) and (Right) Myrrh from Commiphora holtziana

Enclosures, as well as managed pasturelands, may be the best approaches to regenerate the species. FMNR groups need to monitor their regeneration especially in community lands and put in place institutional mechanisms to sustain them. FMNR promoters can connect groups with upstream value chain actors to build capacity on quality and standards, thereby improving income.

5. Fodder and pasture

Livestock products (mainly meat and milk) are major value chains that provide early income to FMNR practicing communities. Demand for livestock feed can however, impede FMNR, especially where free range grazing is practiced. The practice of free grazing easily degrades land and is only sustained through careful monitoring of stocks and resource-carrying capacity. FMNR provides an opportunity to improve fodder and pasture production by improving microsite conditions for palatable grass and fodder species. In unmanaged bushlands, farmers are advised to fence off the area, clear unwanted bushes and allow useful plant species to regenerate. Some of the regenerated trees are good forage for livestock, while pruning of the same allows growth of grass underneath. The farmer or herder therefore takes charge of managing the land rather than being managed by shrubby growth.

Reseeding of high value grass varieties might be necessary to accelerate ground cover. Some recommended grass species for pasture reseeding include *Cenchrus ciliaris, Chloris roxburghiana, Enteropogon macrostachyus* and *Eragrostis superba*. Farmers can earn an income from sale of pasture or stall feeding the grass when it is harvested from the FMNR field.

Plate 17: Cenchrus ciliaris (Local name: African foxtails grass) (L); and, hay made from African foxtails grass (R)

Enrichment planting with high value fodder tree species can also improve forage. Leaf material from the planted species can be included in the cut load for feeding livestock. High protein value fodder species include *Calliandra calothyrsus* (although does not do well in dry conditions), Leucaena species, *Morus alba* (mulberry), *Gliricidia sepium, Sesbania sesban* and others.

6. Fruits

Depending on the level of market development, fruit value chains can be very rewarding. The market for indigenous fruits is however, underdeveloped in Kenya, apart from a few species. Some of the indigenous fruit tree species that easily grow under FMNR, and have high nutrient value include *Balanites aegyptiaca* (desert date), *Dacryodes edulis, Tamarindus indica*, etc. These species help build a household fruit tree portfolio[33] (Figure 13), and improve nutrition at the household level, where markets are not well developed. Development of market standards for indigenous fruit trees takes long and requires germplasm development (domestication) and processing options which may slow income growth. Farmers should be encouraged to introduce high value exotic fruit trees such as mango through enrichment planting both for income and additional household nutrition.

The portfolio approach recommends the optimum number and combination of ecologically suitable tree species to provide for household food and nutrition gaps year round

English name	Species name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Pawpaw	*Carica papaya*												
Mango	*Mangifera indica*												
Waterberry	*Syzygium spp.*												
Custard apple	*Annona reticulata*												
Guava	*Psidium guajava*												
Lemon	*Citrus limon*												
Orange	*Citrus sinensis*												
Chocolate berry	*Vitex payos*												
Passionfruit	*Passiflora edulis*												
Desert date	*Balanites aegyptiaca*												

Figure 12: Fruit tree portfolio developed for Machakos County (Source: ICRAF)

[33]Fruit tree portfolios are location-specific combinations of indigenous and exotic fruit tree species that can provide year-round harvest of vitamin-rich fruits and, at the same time, fill 'hunger gaps' and specific 'nutrient gaps'.

7. Timber and poles

Timber is a lucrative value chain for producers. However, accessing quality timber through FMNR might be a challenge, especially where indigenous tree species are concerned. Enrichment planting is more desirable as it introduces high value timber species such as *Melia volkensii* in the FMNR species mix.

Farmers can easily produce poles from trees managed under FMNR. Some of the potential candidate species include *B. aegyptiaca, T. indica,* etc. The method of pole production follows the pattern of fuelwood production described above. The market for poles is also well developed at local community level and beyond. Plate 18 illustrates poles in a FMNR plot.

Plate 18: A FMNR farmer in Salabani Location, Baringo County managing his P. juliflora for timber (T); prosopis poles (BL) and, prosopis timber (BR) Photo: ICRAF & KEFRI, Baringo Sub-centre

CHAPTER 6

MONITORING, EVALUATION AND LEARNING

Monitoring, Evaluation and Learning (MEL) should be an integral part of any FMNR promotion initiative and provide approaches to assess the impact, appropriateness, effectiveness, efficiency and legacy of the initiative besides being a process to promote accountability (see Box 19).

Monitoring is defined as the set of actions that provide information on where an initiative is at any given time (and over time) relative to planned activities, inputs, outputs, targets and outcomes[R4]. It is a continuous function, involving methodical collection and analysis of information (data) to assist in timely decision-making, ensure accountability and provide the basis for evaluation and learning by management and key stakeholders of an initiative. It can also be used to describe the systematic tracking of the contexts within which initiatives are carried out to identify trends.

Evaluation is defined as the process of generating evidence on why and how well the outputs, targets and outcomes of an initiative are, or are not, being achieved. Evaluation assesses what has taken place in order to improve future outcomes. Through evaluation it is possible to interpret the changes that have been identified through monitoring. While monitoring tends to be descriptive, evaluation is analytical and reflective, and looks at causality.

Box 19. Why undertake monitoring and evaluation in FMNR initiatives?

The overall purpose of MEL is to accelerate the spread of FMNR at landscape level by:

- Tracking the spread of FMNR in communities and across counties.
- Identifying factors that influence the effectiveness of FMNR in different contexts and for different groups of people.
- Sharing evidence of outcomes and successes/impacts of FMNR on a large scale.
- Revealing the contribution of FMNR to household needs, as well as county and national targets.
- Identifying opportunities for improvement in the initiative.

Besides gauging the appropriateness of FMNR and other land restoration practices, M&E is also important in:

- Demonstrating the effectiveness of different methods of promoting FMNR.
- Assessing effectiveness of the organizations and staff doing the work.
- Documenting the success of FMNR in different contexts and conditions.
- Providing the necessary data for reporting to donors the outcomes of their investments (such as impacts on income, food security, water availability, and other critical outcomes) and for policy makers to make informed decisions.

6.1 What should monitoring and evaluation focus on in an FMNR initiative?

In an FMNR initiative there is need to monitor and evaluate immediate impacts, intermediate and some long-term impacts. The more immediate monitoring may focus on areas such as:

- **Activities;** e.g., awareness creation among farmers through activities such as cross-farm visits
- **Resources;** e.g., time and money used to raise farmers' awareness
- **Participation;** e.g., involvement of men and women and the marginalized in FMNR activities
- **Reactions;** e.g., farmers' views about their involvement in FMNR activities

The results of immediate effects monitored above can be used to determine the longer term and intermediate impacts of FMNR, such as:

- **Practices;** e.g., farmers' adoption and adaptation of the various agroforestry-based production techniques introduced through FMNR
- **Social, economic and environmental impacts;** e.g., income obtained from the sale of milk, pasture grass, fattened livestock, etc. whose production increased as a result of FMNR, and higher crop yields due to increased soil fertility from the fields in which FMNR is implemented. The social impact includes women acquiring ownership of land and access to productive resources, and reduced drudgery and associated distances when collecting firewood due to empowerment activities internalized in FMNR
- **Attitude, skills and knowledge;** e.g., farmers' knowledge about the tree species and production practices best suited for various agroforestry-based value chains (such as, woodlots, forage and napier grass integration); attitudes toward experimenting with the introduced species and skills in establishing and managing forage plots, woodlots, hedgerows and other practices associated with trees on farms or pasture lands; and, their urge to increase and expand practices into additional fields; among others

6.2 Procedure of conducting monitoring and evaluation in FMNR promotion initiatives

Throughout this primer there has been emphasis on building the capacity of the community targeted by the FMNR promotion initiative to undertake activities in order to meet household and community aspirations which then contribute to county and national targets of land restoration, among others. There is emphasis on inclusion of youth, women and other members of the community across the information-consultation-collaboration-empowerment continuum of participation. Emphasis is on external agents taking on a facilitation role as community members, including the marginalized, gaining influence and control over resources and development initiatives and any policies, instruments and decision processes that affect them.

The empowerment thinking is embedded in FMNR monitoring and evaluation, hereby referred to as participatory monitoring and evaluation (PM&E). The process facilitates all stakeholders at various levels of an initiative to engage in the M&E process, share control over content and results, as well as engage in identifying and taking corrective actions.

The steps for conducting a participatory monitoring and evaluation (PME) include:

1. Identifying and engaging stakeholders for the PM&E
2. Building stakeholders' capacity for PM&E
3. Defining and agreeing on what to monitor and evaluate: the objectives
4. Developing measurement indicators
5. Identifying methods of collecting information and analyzing the information
6. Reflection, sharing and using the results of PM&E
7. Learning and change

Step 1: Identifying and engaging stakeholders for the PM&E

In FMNR, stakeholders include all those who affect (e.g., project team, development partners and donors), and/or are affected by the policies, decisions and actions of the FMNR initiative (e.g., community, extension workers and relevant government offices – such as ministries of forestry, planning and agriculture). Involving all stakeholders is critical to developing successful PM&E systems. In addition, integrating different perspectives from those within the community, research and development systems and project participants, enables creation of ownership of the process.

A stakeholder analysis should be conducted at the onset of the FMNR programme (preferably during the community engagement process covered in Chapter 4) to identify stakeholders' interests, roles and responsibilities and the participation strategy necessary to involve them in the PM&E process. PM&E stakeholder analysis ensures that key stakeholders are not left out in the process; it is an important step in the sharing of roles and responsibilities for PM&E. This will enable all actors to understand the initiative from all perspectives, as well as enable learning and improvement of FMNR practices.

Which stakeholders should be involved in PM&E Process?

- Community members – for continuous improvement and adaptation of techniques
- FMNR change agents – for motivation and adaptation of methods
- Political leaders at grassroot level such as ward and sub-county administrators
- Project staff – for continuous improvement in design and delivery and for preparing reports for donors
- Organization management and leadership (for all partners involved) – as evidence and as an advocacy tool for scaling up FMNR adoption, and for reports to donors
- Researchers and research organizations – for refining techniques and approaches
- Relevant government (county and national) departments (e.g., Department/Ministry of Agriculture and Livestock, Water and Environment) and other policy and decision makers – for continuous improvement and adaptation of techniques, evidence building for increased adoption of FMNR, and to influence policy.
- Children – for insights and relevant contributions that might be overlooked

Step 2: Building stakeholders' capacity for PM&E

This process aims to develop a common understanding among all stakeholders identified during the PM&E. The stakeholders are trained on: the concepts and principles of participation in the process, approaches for selecting indicators (determining what to measure and how), variety of tools and methods to be used (including formal workshops, meeting minutes, observations and interviews).

Capacity development involves:

- Developing a common understanding about the PM&E concepts and goals
- Identifying local vocabulary and local terms that are equivalent to technical terms (monitoring, evaluation, participation and indicators)
- Using of methods and tools that encourage participation of all individuals in the group, such as graphics, role-plays, graphics using scenes from the farmers' daily lives, or planting and cropping seasons and management
- Discussion on why PM&E is important to their lives and their project

Step 3: Defining and agreeing on what to monitor and evaluate: the objectives

Before implementing PM&E, all stakeholders must have a common vision on what is to be measured and evaluated. When FMNR is part of an integrated community development process, several activities contribute to an output, several outputs contribute to an outcome and several outcomes contribute to an impact. In this case, the stakeholders need to agree on the measurable results, approaches, strategies and methodologies that can be applied to achieve the results while the project is being implemented.

Visualization tools such as the community action plans, asset maps and force-field analysis are used to enable communities to develop shared goals and a common vision on what to monitor. In force-field analysis the community uses a diagram to think about and record their opportunities, and the constraining factors in reaching their goals.

Step 4: Developing measurement indicators

Indicators are variables that measure the viability of the practice. They help the programme team to understand where they are, which way they are going (is it the right way or not), and how far they are from where they want to be (the progress they have made, and what is remaining). Indicators are a means to track progress towards achievement of results. They help to measure if the community is benefitting from FMNR and communicate results to stakeholders in terms of quality, quantity and timelines. For each indicator selected, baseline data is necessary. In practice, the FMNR M&E plan needs to be re-visited several times as the project evolves and as participants become clearer about the core indicators to measure (such as those outlined in Table 8) and the feasibility of measuring them.

Selection of indicators should consider locally relevant factors, and those that can be applied more widely among other stakeholders that are involved. They should also capture intangible as well as tangible changes, particularly in enhancing the social development part of the community, for example, women's access to land. The concept of indicators for community-driven M&E is discussed using visual tools such as graphics and familiar stories from the farmers' lives.

Indicators for measuring community change are developed during a brainstorming session with farmers for each result or objective. Different community members have different perspectives on the indicators, depending on their level of involvement in the project, gender, wealth status or expectations from a particular activity. The project team will also have developed their own indicators apriori, which can be modified following consultations with the community. The indicators selected must however, be specific, measurable, achievable, realistic and time-bound (SMART). Table 8 shown describes the Core FMNR indicators and their respective data collection tools to be included in PM&E for FMNR.

In addition to the core indicators in Table 8, there are other additional indicators categorized into:

- Indicators of building FMNR capacity
- Indicators of improving the enabling environment for FMNR project impact indicators
- Indicators of improved vegetation, land and soil quality
- Crop yield indicators

- Fodder and livestock indicators
- Social and economic impact indicators

Other indicators are discussed in detail in the Global FMNR Manual[R49].

Table 8: Core FMNR indicators (disaggregated by sex), their sources of data collection tools

FMNR Core indicators		Source of data	Data collection tools
1	Number of people trained in FMNR (male, female, youth)	Project monitoring reports	Documents review, ICT tools
2	Number of individuals adopting FMNR (male, female, youth)	Project monitoring reports	Documents review, ICT tools
3	Number and proportion of households that have adopted FMNR in the target area	Project monitoring reports, baseline, midterm & end line evaluation survey	Documents review, Household data tools
4	Coverage of FMNR in the target area (in hectares)	Project monitoring reports	Documents review, remote sensing, ICT tools
5	Average tree density change in the target area (defined in per ha basis and differentiated between cultivated land, grazing land, forest land, other (specify))	1. Geospatial analysis of tree cover (remote sensing + ground truthing) 2. Project monitoring reports	Documents review GIS mapping
6	Number and proportion of households with year-round access to sufficient food	Project monitoring reports, Baseline, Midterm & End line Evaluation survey	Documents review, Household data tool
7	Number and proportion of households with access to forest products (firewood, timber, and non-timber forest products, including honey, fruit, nuts, livestock feed, etc.)	Project monitoring reports, Baseline, Midterm & End line Evaluation survey	Documents review, Household data tool
8	Proportion of women who have access to tree products	Project monitoring reports, Baseline, Midterm & End line Evaluation survey	Documents review, Household data tool
9	Average household income (from crops, livestock and FMNR-related products)	Baseline, Midterm & End line Evaluation survey	Household data tools
10	Value chains developed and participated in by community	Project monitoring reports	Documents review, key informant interviews, focus group discussions

Once the key M&E indicators have been selected and agreed upon by key stakeholders, the monitoring frequency can also be outlined for each. Some of those indicators can be monitored on a regular basis throughout the project while others can be assessed before and after project interventions. For example, land area (hectares) under FMNR and tree cover change over the period of the initiative (at least three years). This is influenced by the fact that significant changes in such indicators may be slow and takes a considerably long time to manifest.

Step 5: Identifying methods of collecting information and analyzing the information

A range of different tools are used to collect, analyze and document both qualitative and quantitative data. Of importance is to find agreement to what the community and all stakeholders prefer and are comfortable with. Data can be collected through focus group discussions, measurements, pictures, survey methods (questionnaires and interviews) participatory impact diagrams, resource maps and social maps. Simple registers, records, meeting minutes, as well as FMNR -related journals and literature materials can also be used to obtain qualitative data.

Data should be analyzed in simple ways that can be easily understood by all stakeholders. The tools used in data analysis and presentation include simple graphs, tables and charts that enhance community understanding of the progress made, their achievements and what needs to be adjusted. The community performs simple analysis of the data they collect (e.g., data on level of attendance to training events to demonstrate trends) with assistance from the facilitator. The project team can also include images taken before and after the project to observe change, and use satellite images to study change observed as a result of FMNR.

Stakeholders should decide which tools will be used to collect information on which indicators. They should also agree on how sampling will be done, who should collect and analyze information on which indicators, how frequently this will be done and how the information will be shared. Communities manage the process of M&E using simple tools to collect and analyze data. Some common data collection tools include resource maps to collect baseline data and registers to record participation in community activities, visitors' books to record linkages with others, and input, output and account registers to record enterprise profitability.

Where the survey method is used, it is useful to train some local youth to help as enumerators; this embeds local ownership. When collecting data for monitoring and evaluation of FMNR, ensure that data is disaggregated in terms of gender: men, women, youth and the marginalized.

Step 6: Reflection, sharing and using the results of PM&E

After the M&E information is collected, the community/stakeholders and project team need to share and reflect about the results. The sharing is mostly done in a brainstorming workshop where all stakeholders meet. This process helps the FMNR project team and community analyze what is working and what is not working, and why. The external evaluator plays the role of facilitator to ensure focus is kept and every voice is reasonably heard. When presenting these reports such as at the end of the FMNR project workshop, you can invite some FMNR farmers and other community representatives to clarify on the impact that FMNR has had on their livelihoods. In this way, the audience will get first-hand information from the farmers.

Reflection allows stakeholders to ponder on the progress of the FMNR initiative towards achieving its goals and to adjust activities as required and where deemed necessary. It provides a forum for exchanging and evaluating information. It also allows community members to systematically review and look back to the start of their activities, comparing with their current position and to understand what has changed; and to reflect on the progress of the initiative and adjust as required. Reflections need to be carried out for each result or activity and its indicators, one at a time. This can be done using simple graphics or questions to examine the results of any data analysis.

Photo: Danyell Odhiambo/ICRAF

Some useful questions to use during reflection are:

- What have we achieved this season/this year, etc.?
- What worked well? What did not work well?
- What do we need to change?

The results of the reflection exercise are used to make decisions and to adjust activities if and when required, so that monitoring and evaluation is a learning process. At community level, the committee charged with the responsibility of data collection analyses the information with the facilitation of the community facilitators and shares it with the rest of the community (those collecting information and keeping records).

Step 7: Learning and change

In FMNR, PM&E leads to increased learning and better organization in the way the community manages their resources and how the project team engages with the community towards fulfilling their goals. Communities should be able to use the information to calculate costs and profits from production activities, improve participation in group activities, re-orient how FMNR is being implemented, acknowledge achievements by groups, and identify the process aspects that can either strengthen or weaken the project.

6.3 Monitoring & Evaluation reports

After an M&E exercise is completed, a report is drafted and shared with all stakeholders for purposes of learning, improving the techniques and design, and to encourage dissemination to many more practitioners for adoption and adaptation. A final report should be prepared after incorporating comments and suggestions made by the stakeholders involved.

Box 20. Main sources of data and collection tools for FMNR monitoring, evaluation and learning processes

Main data sources

- Field visits, exchange visits and field days
- Focus group discussions with different groups in the community
- Key informant interviews with individuals such as a sample of participants, FMNR champions, project staff, staff from partner organizations, community leaders and leaders from beyond the project area, etc.
- Household surveys of both participating and non-participating households
- Project reports e.g. reports on stocktaking done with the communities, survey and focus group reports, periodic financial and non-financial reports, etc.
- Tree cover, tree measurements and tree count sampling
- Farm records
- Minutes of meetings
- Remote sensing on land cover change (bird's-eye view of tree cover change across landscapes using either aerial photography or satellite imagery.
- Field tree surveys – data on species of trees present on the fields, stumps or seedlings that are being protected by the community, how they manage and utilize each tree species, ethnobotanical knowledge gained, total farm size under FMNR or land restoration initiatives, among others.

Important MEL tools

- Project implementation plans (including project theory of change and logical framework) which can be used to compare what has been achieved
- A GANTT or bar chart which shows when an event/activity was supposed to happen, and the time
- Farm records – specific farmer record books can be designed (ICRAF has some prototypes)
- Focus group discussions
- Household questionnaires and key informant interviews (use of Open Data Kit (ODK) for direct electronic entry encouraged)
- Checklists
- Geospatial tools such as the Regreening Africa App

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Annex 1:

Some Useful Tree Species for Kenyan ASALs

1. *Acacia abyssinica* Hochst. ex Benth. (common name: Umbrella thorn)

Agroecological value: *Acacia abyssinica* is indigenous to Africa, drought tolerant and well distributed in Kenya, particularly in Nyanza (especially along the Lake Victoria basin) and Rift Valley region. It is also found in wooded grassland and highland edges at elevations between 1200-2300m and very common in agroecological zones II-III. The tree provides economically valuable products such as firewood, charcoal, poles, tool handles, food (edible gum), medicine, fodder and bee forage. It is also a good nitrogen fixing legume tree suitable for soil conservation.

Propagation: *A. abyssinica* is usually raised from seedlings, direct sowing at site or wildings. The seeds of the tree species are quite small and a kilogram pack can contain 16,000-18,000 seeds. At propagations, damaged seeds are first separated by floating. Then good seed is pre-treated by soaking in hot water for a minute and removed. Water is allowed to cool and the seeds soaked again for 36–48 hours before sowing to break dormancy.

Tree management: *Acacia abyssinica* growth rate is medium to fast and establishes well both in pastureland and croplands. It is self-pruning though some pruning may be required when still young. The species coppices well when young but can also be lopped and pollarded.

Pests and diseases: The seeds are very susceptible to attack by beetles while still in the pod as well as after extraction. It is recommended to add ash to reduce insect damage or store the seeds as seedballs.

2. *Acacia seyal* (Delile) P. Hurter (Common name: White-thorn acacia)

Agroecological value: *Acacia seyal* is indigenous to Africa and is common in many parts of Africa inclusive of East Africa. In Kenya, it thrives in seasonally flooded plains with black-cotton soil and river valleys 200-2200m. The species is also tolerant to high pH (6-8), salts, rocky soils and is less frequent on red soils. It does well in agroclimatic zones III-IV. The tree provides economically valuable products such as firewood, charcoal, poles, posts, edible gum, edible inner bark, drink (tea from ground bark), medicine (bark), fodder mainly for goats and camels (leaves, pods, flowers, also bark in dry season), bee forage, gum, tannin and dye (ground bark). It is a good nitrogen fixing legume tree suitable for soil conservation.

Propagation: The species can be raised from seedlings, wildings, direct sowing at site or from root suckers. The seeds are quite small and a kilogram pack holds 15,000-22,000 seeds with 70-80% germination rate. Pretreatment is not necessary for fresh seeds while stored seeds are nicked or soaked in cold water for 24 hours before sowing.

Tree management: *A. seyal* trees can be established as a woodlot species or in a mixed system. In its natural habitat, *A. seyal* establishes by self-seeding and root suckers. Its rotation age is 8 - 15 years depending on population pressure and demand for wood. Some of the management practices recommended for the species include (i) pollarding at 1.5 - 2 m above the ground which allows development of a new canopy; (ii) pruning of small branches which provides forage; and (iii) coppicing to enable regrowth from the stump. Where managed as a dry season source of fodder for livestock, it is recommended to shake the branches in order to detach leaves and pods without damaging the axially buds.

Pests and diseases: *A. seyal* is reportedly associated with more than forty insect species that predate on it with *Sinoxylon senegalense* being the most notorious. It swiftly locates and infests freshly cut woods especially if lying on the ground. Pest infestation can be controlled by removal of the bark and stacking cut stems upright. The wood can also be treated by creosote to prolongs its durability.

3. *Acacia polyacantha* Willd.

Agroecological value: *Acacia polyacantha* is a widespread acacia species indigenous to Africa. It is commonly found at an altitude of 200-1,800 m and within agro-climatic zones III-IV. It prefers sites with a high groundwater table, indicating eutrophic and fresh soils. It also grows well in poorly drained as well as stony soils. In Kenya, it is found at the coast, in the central highlands and the lake region. The tree provides economically valuable products such as firewood, charcoal, timber, tool handles, farm implements, medicine, edible gums, fodder (pods, leaves, seeds) and bee forage. *A. polyacantha* is a good nitrogen fixing legume tree suitable for soil conservation.

Propagation: *A. polyacantha* can be raised from seedlings, wildings and direct sowing at site. A kilogram pack of A. polyacantha seed has 14,000-16,000 seeds. To enhance germination, it is recommended to immerse the seeds in hot water and leave for 24 hours in the water as it cools. The seed can also be pre-treated by nicking the cotyledon (distal) end before sowing. The expected germination rate of a mature, healthy and properly pre-treated seed is 60-90%; occurring within 10-20 days from sowing. The germinated seedlings are pricked into containers and nurtured in tree nursery for 3-4 months before transplanting to the field.

Tree management: *A. polyacantha* is a fast-growing especially when on good sites. It shows a symbiotic relationship with certain soil bacteria, which form nodules on the roots and fix atmospheric nitrogen. Some of this nitrogen is utilized by the growing plant as well as other plants growing nearby[R57] thus a suitable species for soil fertility management. Management practices recommended for the tree include: (i) propping of saplings that have weak stems; (ii) pruning to avoid large branches breaking with heavy winds; (iii) coppicing; and, (iv) pollarding. Farmers can get firewood or wood for charcoal from use of branches rather than cutting the whole tree.

Pests and diseases: There is no information on diseases and pests for this species and no serious pest and/or disease problem known[R14].

4. *Acacia Xanthophloea* Benth.

Agroecological value: *Acacia Xanthophloea* is indigenous to Kenya, spreading southwards to South Africa and does well with agroclimatic zones III – V[R36]. The species commonly grows in sites with high groundwater table such as besides lakes or rivers at an altitude of 600-2,300m. The tree grows well in black cotton soil. In Kenya, *A. xanthophloea* is distributed in the Lake Victoria basin, around Nairobi, Naivasha, Kajiado, Nakuru, Narok or in the extreme northern and eastern parts of Kenya. The species provides economically valuable products such as firewood, charcoal, timber, poles, posts, food (edible gum, inner bark chewed), medicine (bark), fodder (foliage and pods) and bee forage. It is a good nitrogen fixing legume tree suitable for soil conservation.

Propagation: *A. xanthophloea* tree can be raised from seedlings, wildings and direct sowing at site. The seeds are very small and a kilogram pack of *A. xanthophloea* seed has 24,000-30,000 seeds. To enhance germination, stored seeds should be soaked in cold water for 24 hours or nicked at the distal (cotyledon) end before sowing. The germination usually starts after 14 days with a germination rate of 70%[R17]. It is recommended to prick in the seedlings into containers once the first two leaves appear and nurture in the nursery for 3-4 months before transplanting to the field.

Tree management: *A. xanthophloea* grows very fast both in the field and in its natural habitat. In pastureland, farmers are encouraged to thin and regularly prune the trees to allow grass growth. In croplands, lopping, regular pruning and thinning is encouraged to reduce shading effects on other plants, especially annual crops. Where the tree is managed for charcoal or firewood production, cutting of branches rather than whole

trees should be encouraged. Some low branches (at height out of reach by animals or human beings) should be maintained in case of bee keeping.

Pests and diseases: *A. xanthophloea seeds* are often attacked by Insects. The seeds can be stored as seedballs or in a cool dry place.

5. *Acacia mellifera* (M. Vahl) Benth. (common name: Black thorn)

Agroecological value: *Acacia mellifera* is indigenous to Africa and widely spread in all arid and semi-arid areas of Kenya at elevation of 0-1,800 m. It is common in agro-climatic zones I-VI with annual rainfall range of 400-900 mm. It grows well in a wide range of soils including gravelly, loam, volcanic and sandy soils. The species provides economically valuable products such as firewood, charcoal, clubs, carvings, medicine (bark), fodder (pods, twigs, leaves, flowers browsed by camels and goats) and bee forage. It is also a good nitrogen fixing tree and is suitable for soil conservation.

Propagation: *Acacia mellifera* can be established by seedlings, wildings and direct sowing at site. a kilogram pack of *A. mellifera* seed has 17,000-20,000 seeds. Stored seeds are pretreated by immersing in hot water and left for 24 hours as the water cools before sowing but fresh seeds need no pretreatment. Mature, healthy and properly pretreated *A. mellifera* seeds germinate within 2 weeks at arate of 60-80%. Seedlings are pricked into containers and managed in the nursery for 3-4 months before transplanting to the field.

Tree management: When *A. mellifera* is established in croplands regular pruning is necessary to reduce shading on other crops with prunings can be used as fodder or firewood. In pastureland, pruning and thinning is to done in order to maintain a density and crown cast that allows robust undergrowth. The management practice adopted should be informed by the livestock in the farm whether browsers, grazers and/or bees. For browsers pollarding is encouraged at 1.5-2m high to enhance growth of more branches at the reach of the browsers. In addition, of all acacia species, *A. mellifera* is the most liked by bees. However, if left unattended, *A. mellifera* can grow to a dense, impenetrable thicket, sometimes hundreds of meters across, gradually outcompeting grasses and taking over grazing land[R17] and causing a considerable reduction in seasonal grass yields.

Pests and diseases: *A. mellifera* had no known serious pest infestation.

6. *Olea europaea* ssp Africana Wall. & G.Don (common name: African Olive)

Agroecological value: *Olea europaea* is indigenous to Kenya; it is found in most inland highland areas from Taita Taveta to western and northern Kenya regions especially at altitude range of 950-2,500 m and agro-climatic zones II-III. It also commonly found on rocky hillsides, forest margins and along dry riverbeds. It is resistant to both frost and drought. Once established, it can withstand poor soils with little moisture[R36]. The species provides economically valuable products such as food (olive oil and edible olives), fodder, firewood, charcoal (also used for cleaning calabashes), timber (wood is hard and heavy), poles, posts, utensils, seasoning (fermentation and flavoring milk), furniture ornaments (wall clocks and vases), jewelry items (beads, brooches and bangles), bee forage and medicine (root or bark decoction for malaria treatment).

Propagation and storage: *Olea europaea* is mainly raised from wildings and cuttings. It is difficult to raise from seedlings but where there is intent to do so, it should be noted that the seed is orthodox and requires hermetic storage at 30 C with 6-10% moisture content to maintain its viability for years. The seeds can be stored at dry room temperature for a few years. One kilogram of *O. europaea* has approximately 13,800 seeds.

Tree management: Unfertilized *O. europaea* seedlings show tolerance to drought unlike fertilized seedlings. Where regeneration is by seedlings, it is recommended to apply organic or inorganic fertilizer to increase shoot growth. The seedlings require adequate nutrition and water to grow. Pruning is important in *O. europaea* management for it helps to maintain the balance between tree growth and fruit production. The products of pruning such as wood and twigs are used as firewood or charcoal. The leaves are good fodder and farmers can used it as cut and carry fodder for livestock whenever pruning occurs. Direct browsing is

also encouraged in an integrated system combining livestock and olive oil production. This, however, should only be allowed after olive harvest[R18].

7. *Ficus sycomorus* L. (common name: Mulberry Fig)

Agroecological value: *Ficus sycomorus* is a large semi-deciduous spreading tree indigenous to Africa. It is widely distributed over Kenya in riverine vegetation, flood plains and places with high ground water. It is found at 0-2,000 m altitude and within agroclimatic zones II-VII receiving 250-1,200 mm annual rainfallR57. It grows well in alluvial, sandy or rocky soils. Some of the areas in the county include Tana River, Marsabit, Turkana, Machakos, Makueni, Narok, Homabay, Migori, and Siaya counties among others. *F. sycomorus* provides economically valuable products such as firewood, timber (suitable door frames, house construction and furniture), beehives, carvings, utensils (pestles, mortars, musical instruments, water troughs, bowls), boat building (canoes), food (edible fruit and inner bark), medicine (milky latex) and fodder. It also provides a good mulch for the farm and supports soil conservation, riverbank stabilization as well as other environmental benefits.

Propagation: *F. sycomorus* can be regenerated by cuttings, wildings and seedlings. *F. sycomorus* seeds germinates best at a temperature of about 200C but viable seeds are difficult to obtain. Where cuttings are used, large cuttings are recommended for planting directly into the soil. The cuttings should first be placed under shade for a few days to partly dry before planting. At planting, all leaves from the cuttings should be removed. The planting holes for the cuttings should be dug to about 1 metre depth and some sand placed at the bottom. The cutting is then directly planted into the hole. All these procedures are necessary to prevent rotting of the cuttings and stimulate root formation. Smaller cuttings (50-150 mm) can be used but it is recommended to first plant them in the nursery to induce rooting before planting out in the fieldR57. *F. sycomorus* can also regenerate naturally as wildings in croplands and pasturelands that farmers can nurture to big trees.

Tree management: *F. sycomorus* grows very fast and develops an extensive lateral rooting system which helps anchor the tree firmly to the ground owing to its large canopy. Farmers should bear in mind this rooting pattern when positioning the tree in farmlands. Under intercropping system, pruning and lopping is recommended purposely to reduce shading of other crops. Leaves from pruning and lopping should be left on the soil as mulch to improve soil fertility and soil moisture status while the woody parts are collected as firewood. Pruning, and lopping can also be undertaken in pastureland to encourage robust grass growth.

8. *Balanites aegyptiaca* (L.) Delile (common name: Desert Date)

Agroecological value: *Balanites aegyptiaca* is an important species that is indigenous to Africa and distributed from arid and semi-arid to sub-humid savanna. In Kenya, it is found in a variety of habitats in the dry parts of the Lake Basin, Rift Valley and semi-arid parts of former Eastern province but rare in the coastal region. It is commonly found at 250- 2,000 m in bushland and grassland and under agroclimatic zones IV- VI[R36]. The species grows best in low-lying, level alluvial sites with deep sandy loam and uninterrupted access to water such as valley floors, riverbanks or the foot of rocky slopes[R57]. It also grows well in open grassland with black-cotton soil. The tree provides economically valuable products such as timber (hard and heavy), firewood, charcoal, fodder (fruits and leaves, especially during dry season), edible fruits (fleshy pulp) and vegetables (leaves and young shoots especially during dry season), edible gum and vegetable oil. Other important uses include utensils and furniture making, medicine (roots), bee forage, resin, gum and windbreak. An emulsion of fruit kills snails and fish[R11].

Propagation: *B. aegyptiaca* can be regenerated from seedlings, direct sowing at site and root suckers. The seeds are large and a kilogram contains about 1000. Soaking the seeds in cold water for 48 hours (changing water after 24 hours) breaks dormancy and improves germination rate. Alternatively, seeds can be immersed in hot water for 7-10 minutes then cooled slowly. Seeds that have passed through the guts of goats or cattle germinate readily, however. Such seeds can be collected in pens or enclosure where the livestock are kept at night. The pre-treated seeds should be sown vertically (with stem end down) either in nursery containers or directly at site and completely covered with soil for best results. Germination takes 1-4 weeks

with germination rate of 50-70% guaranteed. Best germination results are obtained with fresh seeds. The species also abundantly produces root suckers which can be planted.

Tree management: *B. aegyptiaca* is a slow growing species and needs protection from browsers and tramping by animals. In the course of its growth, farmers and pastoralists are encouraged to regularly prune the tree for better growth. Where saplings are growing from the stump or as root suckers, coppicing is recommended to concentrate growth only on a selected few stems. The farmer can cut branches and collect the forage for livestock with woody part used as firewood or for charcoal production. Moreover, *B. aegyptiaca* pollards well and can regenerate after lopping and heavy browsing.

9. *Tamarindus indica* L. (common name: Tamarind, Mkwadju)

Agroecological value: *Tamarindus indica* is a large beautiful fruiting tree with extensive dense crown and indigenous to Africa. It is a very adaptable species, drought hardy, commonly found in semi-arid areas and wooded grasslands. It is found at 0-1,500 m and within agroclimatic zones III-V. The species grows in a wide range of soils but mostly well drained deep alluvial soil although it can tolerate salty soils. In dry areas, it is commonly found along the riverines. *Tamarindus indica* provides economically valuable products such as food (edible fruit pulp that is also used for souring porridge, drinks, fried seeds, seasoning, flavoring), timber, furniture, poles, posts, firewood, charcoal, utensils (pestles and mortars, carts), boat building, medicine (leaves, twigs, bark, roots), fodder, bee forage, shade, ornamental, mulch, nitrogen fixing, tannin, dye and veterinary medicineR36.

Propagation: Good mother trees should be selected for vegetative propagation which grows and matures faster than propagation by seedling and direct sowing at site. Main vegetative propagation technique recommended include in situ grafting and budding for best varieties. For seed propagation pretreatment by nicking or soaking in warm water for 24 hours is recommended before sowing in the nursery bed. A germination rate of about 90% is achieved but within 40-50 days. Best germination is achieved when seeds are covered by 1.5 cm loose, sandy loam or by a mixture of loam and sand. Transplanting to the field should take place when seedlings are at least 30 cm in height. Other propagation methods include air layering and cuttings[R57].

Tree management: *T. indica* is slow growing but long lived. It should therefore be closely protected from browsing and tramping by animals, weeds and insect pests. As the tree grows, regular pruning is recommended especially in early years of growth to encourage faster vertical growth. *T. indica* starts bearing fruit at the age of 7 - 10 years with maximum yields expected at 15 years onwards. The species can continue yielding fruits for 200 years with fruit yields of about 200 kilograms per tree expected depending on the crown development. The species responds well to coppicing and pollarding. Some symbiotic relationship has been reported between *T. indica* and certain soil nitrogen fixing bacteria[R57].

Pest and diseases: *T. indica* seeds are susceptible to weevil attack

Annex 2:

List of high value Medicinal tree species developed from interviews with farmers and herbalists in Embu and Meru counties

Species	Growth habit	Most frequent medicinal use stated by herbalists	
		Main diseases treated	Plant part(s) used
Albizia gummifera C.A.Sm.	Tree	Stomachache, worms	Bark
Aloe spp	Shrub	Malaria, pneumonia, wounds	Leaf sap, roots
Azadirachta indica A.Juss.	Tree	Malaria	Bark, leaves
Bridelia micrantha Baill.	Tree	Typhoid	Bark, leaves
Caesalpinia volkensii Harms	Shrub	Malaria	Leaves, seeds
Cordia africana Lam.	Tree	Rheumatism, joint pains	Bark, roots
Croton macrostachyus Hochst.	Tree	Wounds, diabetes, typhoid	Bark, leaves
Croton megalocarpus Hutch.	Tree	Amoeba, typhoid, wounds	Bark, roots, leaves
Dalbergia melanoxylon Guill. & Perr.	Tree	Cough	Stem
Erythrina abyssinica Lam.	Tree	Diarrhea, pneumonia, toothaches	Bark
Ficus sycomorus L.	Tree	Abdominal pains, toothaches	Bark, sap
Ficus thonningii Blume	Tree	Diarrhea, fibroids, rheumatism	Bark
Kigelia africana (Lam.) Benth.	Tree	Rheumatism, toothache, typhoid	Bark
Moringa oleifera Lam.	Tree	Blood purification, rheumatism	Leaves
Myrsine melanophloeos	Tree	Worms	Seeds
Ocotea usambarensis Engl.	Tree	Colds	Bark
Olea europaea spp africana (Mill.)	Tree	Amoeba, joint pains, rheumatism	Bark, leaves
Osyris lanceolata Hochst. & Steud.	Shrub	Coughs	Roots
Prunus africana (Hook.f.) Kalkman	Tree	Prostrate problems, typhoid, diabetes	Bark, leaves
Rhamnus prinoides L'Hérit	Shrub	Colds, joint pains	Roots
Senna didymobotrya (Fresen.)	Shrub	Amoeba, malaria, puscells	Bark, leaves
Solanum incanum Ruiz & Pav.	Shrub	Coughs, abdominal pains, toothaches	Roots, fruits
Strychnos henningsii Gilg	Tree	Malaria	Stem, leaves
Tithonia diversifolia A.Gray	Shrub	Typhoid, malaria	Leaves
Vepris nobilis (Delile) Mziray	Tree	Worms, malaria, allergies	Leaves, roots
Warburgia ugandensis Sprague	Tree	Malaria, pneumonia, tuberculosis	Bark, leaves
Zanthoxylum chalybeum Engl.	Tree	Malaria, coughs, abdominal pains	Bark, leaves
Zanthoxylum usambarense (Engl). Kokwaro	Tree	Joint pains	Bark

Azadiracta indica bark

Erythrina abyssinica bark

Olea africana bark

Warburgia ugan bark

Warburgia ugan leaves

Moringa oleifera

Photos: Najma Dharani/ICRAF

Annex 3:

Data collection Tools/Approaches

Appreciative Inquiry

The traditional approach to change in community development is to look for the problem, do a diagnosis, and find a solution; since we look for problems, we find them. Appreciative Inquiry looks for assets and what works. The result of the process is a vision that describes where the organization or stakeholder group wants to be. As the vision is grounded in real experience, people know how to repeat their success. Links to resources on Appreciative Inquiry:

http://appreciativeinquiry.case.edu
http://gbr.pepperdine.edu/2010/08/a-blueprint-for-change-appreciative-inquiry/ http://www.mindtools.com/pages/article/newTMC_85.htm

Participatory Rural Appraisal (PRA)

PRA is a growing family of participatory approaches and methods that emphasize capturing local knowledge and enabling local people to make their own assessments and plans. The purpose is to enable development practitioners, government officials, and community members to work together to plan context-appropriate programs. PRA methods include group activities and other exercises to facilitate analysis and action. Although originally developed for use in rural areas, PRA has been employed successfully in a variety of settings. Links to resources on PRA: *http://www.crsprogramquality.org/storage/pubs/me/RRAPRA.pdf*
http://www.wau.boku.ac.at/fileadmin/_/H81/H811/Skripten/811308/2_ WorldBankparticipation.pdf

Most Significant Change

Most Significant Change is a participatory monitoring and evaluation technique that collects impact stories from stakeholders. Participants are involved in telling their stories and in systematically deciding which stories are most relevant to describe project impacts. More information on this method is available at:

http://www.kstoolkit.org/Most+Significant+Change
http://www.mande.co.uk/docs/MSCGuide.pdf

Interviews

An interview is a conversation with a stakeholder to learn more about NRM. Having prepared your lines of inquiry, follow these steps:

1. Begin the interview by introducing yourself and the team, the overall purpose of the exercise, and the purpose of the interview.
2. Ask the stakeholder if he or she has any questions before you begin.
3. Use a conversational tone when asking questions. A good interview gets the respondent talking and the interviewer listening, asking probing questions, and summarizing. If more than one person is conducting the interviews, follow the success tip of letting each interviewer finish his or her set of questions before another one begins asking questions.
4. When interviewing a group of stakeholders, give everyone a chance to answer the questions and make sure no one dominates the conversation.

5. Use a non-judgmental approach. The job of the interviewer is to understand why the interviewee did something of interest, not to judge whether it was good or bad.
6. Be specific. Start with general questions but do not end there. For instance, if a stakeholder says he or she overcame “poverty”, ask what he or she means and what exact techniques were employed.
7. Close the interview by asking the stakeholder for any additional comments or questions, thanking him or her for the time, and telling him or her how to learn more about the results of your stocktaking exercise.

Annex 4:

Main Farming systems in Kenya and associated agroforestry options (Adapted from [R6])

AEZ	Description	Farming system	Main agroforestry options
I	Humid	The tea-based system	• Boundary planting with temperate fruits e.g. pears, peaches and plums • Shade trees e.g. *Grevillea robusta*
		Diary system	• Fodder trees on hedgerow e.g. *Calliandra calothyrsus*, *Morus alba*, *Leucaena spp*
		Coffee based system	• Shade trees e.g. *Grevillea*, *Cordia* and a few other compatible indigenous species • Boundary planting with temperate fruits e.g. pears, peaches and plums
II	Sub-humid	The maize-and-dairy system	• Intercropping crops with nitrogen fixing shrubs such as *Gliricidia sepium*, *Tephrosia spp*. • Dispersed high valued agroforestry tree species such as mango, avocado and macadamia in croplands • Hedgerows of fodder shrubs e.g. *Calliandra calothyrsus*, *Leucaena trichandra*, *Leucaena pallida*, etc. • Trees along soil-conservation structures • Small woodlots of high value species that are not compatible with crops e.g. timber • Boundary planting of diverse species which also serve as windbreaks • Live fences on segmented grazing fields and homesteads • Selected indigenous species compatible with crops such as *Markhamia lutea*
		The subsistence food crops systems	• Intercropping with nitrogen fixing shrubs such as *Gliricidia sepium*, *Tephrosia spp*. • Boundary planting • Fruit and fodder trees integrated in cropland • Selected indigenous species compatible with crops such as *Markhamia lutea*

AEZ	Description	Farming system	Main agroforestry options
II	Sub-humid	The sugarcane-based system	• Boundary planting • Dispersed trees in sugarcane plantation • Woodlots • Tree fallows with Sesbania sesban, *Tephrosia spp* and *Gliricidia sepium* purposely for soil fertility Improvement. • Fruit trees to diversify the system. • Other trees planted around homesteads
		The cereal-grain-legume system	• Trees along soil-conservation structures • Boundary planting • Dispersed high valued agroforestry trees on cropland • Woodlots • Fruit trees of improved varieties • Fodder trees and shrubs mainly used as a supplement for young stock and draught animals. • Selected indigenous species compatible with crops such as *Markhamia lutea*
		Maize mixed farming system	• Same as the maize-and-dairy system with less emphasis on tree fodder practices if livestock not strongly integrated
III	Semi-humid	The maize-and-dairy system	• Same as the maize-and-dairy system in the sub-humid system
		The subsistence food crops systems	• Same as the maize-and-dairy system in the sub-humid system
		The sugarcane-based system	• Same as the subsistence food crops system in the sub-humid system
		The cereal-grain-legume system	• Same as the sugarcane-based system in the sub-humid system
		Maize mixed farming system	• Same as the maize-and-dairy system with less emphasis on tree fodder practices if livestock not strongly integrated
IV	Semi-humid to arid	The livestock-cereal system	• Fodder trees and shrubs or fodder banks - for livestock feed production • Woodlots for production of poles, fuelwood and other wood products • Fruit trees • Indigenous species compatible with crops such as *Markhamia lutea*

AEZ	Description	Farming system	Main agroforestry options
IV	Semi-humid to arid	The wheat-dairy system	• Alleys of mainly leguminous trees and shrubs such as fodder e.g. *Calliandra calothyrsus*, *Leucaena spp*, etc. • Other important agroforestry options - windbreaks, trees on boundaries, woodlots, live fences, trees on soil-conservation structures and fruit trees
		The subsistence food crops systems	• Same as the subsistence food crops system in the sub-humid system
		Fruit-based Agroforestry system	• Naturalized species such as Mango, avocado and guava usually improved through grafting and dispersed in croplands • Other indigenous species compatible with crops such as *Markhamia lutea*
		Maize mixed farming system	• Intercropping with nitrogen fixing shrubs such as *Gliricidia sepium*, *Tephrosia spp*. • Biomass transfers • Dispersed high valued agroforestry tree species in croplands e.g. Mango tree, avocado tree etc. • Trees along soil-conservation structures • Small woodlots of high value species that are not compatible with crops for wood products • Selected indigenous species compatible with crops • Boundary planting which also serve as windbreaks
V	Semi- arid	Agro-pastoral system	• Pasture production with palatable drought tolerant tree species dispersed as parklands • Fruit trees in croplands or indigenous fruit trees dispersed in parklands • Unmanaged bushland and abandoned farms with various tree species that can be managed productively • Enrichment planting with fruit trees and other high value species supported by water harvesting practices

AEZ	Description	Farming system	Main agroforestry options
		The communal pastoral system	• Pasture production with palatable drought tolerant tree species dispersed as parklands • Fruit trees in croplands or indigenous fruit trees dispersed in parklands • Unmanaged bushland and abandoned farms with various tree species that can be managed productively
V	Semi- arid	The communal pastoral system	• Enrichment planting with fruit trees and other high value species supported by water harvesting practices
		Group-ranching systems	• Pasture production with palatable drought tolerant tree species dispersed as parklands • Exclosures/enclosures and holistic grazing useful approaches.
		Fruit-based agroforestry system	• Pasture production with palatable drought tolerant tree species dispersed as parklands • Exclosures/enclosures and holistic grazing useful approaches. • Fruit trees planting under irrigation or use of micro-water catchment techniques
VI	Arid	The communal pastoral system	• Pasture production with palatable drought tolerant tree species dispersed as parklands • Exclosures/enclosures and holistic grazing useful approaches.
		Group-ranching systems	• Pasture production with palatable drought tolerant tree species dispersed as parklands • Exclosures/enclosures and holistic grazing useful approaches.
VII	Very arid	The communal pastoral system	• dispersed trees in extensive dry landscape • Planting of fruit trees along water sources such as oases, rivers and even water points.

Annex 5:

Legal instruments governing land use in Kenya including ratified global priorities and commitments

Policy and Acts	FMNR supportive window in the instruments
Constitution of Kenya 2010	• Requires that land in Kenya should be managed and used in a manner that is equitable, efficient, productive and sustainable. • Provides for regulation of land uses, revision of sectoral laws on land use and sustainable exploitation, utilization, management and conservation of the environment and natural resources. • Emphasizes achieving and maintaining at least 10% tree cover on all the land area of Kenya
Kenya Vision 2030	• Outlines Kenya's vision to be a nation living in a clean, secure and sustainable environment by 2030 • Recommends increase in forest cover from less 3% to 10% of total land mass • Promotes environmental conservation for better support to the economic pillar's aspirations among other strategies
Sessional Paper No. 10 of 1965 (on African Socialism and its Application to planning in Kenya)	• Recognized that the heritage of future generations depends on the conservation of natural resources and creation of the physical environment in which progress is enjoyed • Recommended conservation of productive land through maintenance of forests and windbreaks, proper methods of land cultivation with community and government cooperation • Underscores the importance of developing a national land use policy
Poverty Reduction Strategy Paper, 2003-2007	• Tasked government with formulating a national land policy to address land use and land tenure in order to stem escalating poverty in the rural areas • Recognizes adequate management of environmental resources as key for sustainable economic growth in rural areas
Forest Conservation and Management Act 2016	• Transfers the responsibility of promoting afforestation activities in the country to the county governments. • Allows county government to enter into joint management agreements with communities or individuals for management of community forests or private forests.

Policy and Acts	FMNR supportive window in the instruments
Agriculture Fisheries and Food Authority Act No. 13 2013	• Emphasizes need for the national government to prescribe guidelines for soil conservation • Recommends, where necessary, prohibiting, regulating or controlling the undertaking of any agricultural activity such as burning, clearing or destruction of vegetation so as to protect land against degradation, protect water catchment areas or otherwise, and for the preservation of the soil and its fertility • Other guidelines include the afforestation or re-afforestation of land among others
Environmental Management and Coordination Act No. 8 of 1999 (Revised Ed. 2018)	• Provides guidelines on sustainable utilization, conservation, management and preservation of natural resources including natural forests and rangelands as well as biological diversity both in-situ and ex-situ • Encourages planting of trees and woodlots by individual land users, institutions and community groups • (Water Quality) Regulations, 2006 discourages cultivation or undertaking any development activity within full width of a river or stream to a minimum of 6 meters and a maximum of 30 meters on either side based on the highest recorded flood level
County Government Act, 2012	• Provides for the protection and development of natural resources in a manner that aligns national and county government policies • Emphasizes on maintaining a viable system of green and open spaces for a functioning eco-system and work towards the achievement and maintenance of a tree cover of at least 10% of the land area of Kenya
Community Land Act, 2015	• Gives the community power to make rules or by-laws for regulating management and administration of their land • Makes provisions for: (i) land conservation and rehabilitation; (ii) land use and physical planning; and (iii) any other relevant matter which may include restoring degraded land
National Climate Change Action Plan 2013 -2017	• Recommends specific adaptations to key sectors of economy such as agriculture and forestry to enhance climate change adaptation and mitigation including: (i) intensified afforestation; (ii) promoting agroforestry-based alternative livelihood systems; (iii) promoting alternative energy sources and use of improved cook stoves; (iv) Community forest management; and, (v) reduction of mono-species plantation stands to protect and restore ecosystems
Agriculture (Farm Forestry) Rules, 2009 (Revised 2012)	• Requires every person who owns or occupies agricultural land to establish and maintain at least 10% of the land under farm forestry which may include trees on soil conservation structures or rangeland and cropland in any suitable configurations

Policy and Acts	FMNR supportive window in the instruments
National Land Policy (Sessional Paper No. 3 of 2009)	• Recognizes land use planning as an essential element for efficient and sustainable utilization and management of land and land-based resources as well as attaining food security • Recognizes underutilization of land, land deterioration, land use conflicts caused by competing land uses, climate change and variability, overstocking, lack of alternative innovative land uses and planning for diversification of the rural economy as main deterrents to achieving sustainable land management and development. • Tasks government to facilitate environmental conservation and management as well as land restoration by (i) introduction of incentives to encourage the use of technology and scientific methods for soil conservation; (ii) encouraging use of traditional land conservation methods; and (iii) establishment of institutional mechanisms for conservation of quality of land
National Land Use Policy (Sessional paper, No. 1 of 2017)	• Addresses issues relating directly to use of land and its resources by providing principles and guidelines for: i) proper management of land resources to promote public good and general welfare, ii) land use planning to enhance sustainable development, iii) anchoring land development initiatives, and iv) promoting environmental conservation and preservation among other principles and guidelines. • Addresses environmental degradation, agricultural land management, rangeland degradation, arid and semi-arid lands management, biodiversity conservation and climate change
AFR100	• Kenya has committed to restore 5.1 million ha under forest, cropland, rangeland, riparian land among others by 2030.
Kenya National Adaptation Plan: 2015-2030	• includes domestication of National Climate change action plan by the 47 counties of Kenya into own county adaptation plans[34] [35].
Sessional Paper No. 3 of 2016 on National Climate Change Framework Policy	• This Policy was developed to facilitate a coordinated, coherent and effective response to the local, national and global challenges and opportunities presented by climate change. It focuses on appropriate mechanisms to enhance climate resilience and adaptive capacity, and the transition to low carbon growth
United Nation Convention to Combat Desertification (UNCCD) and Land Degradation Neutrality	• Aims to combat desertification and mitigate the effects of drought through national action programs that incorporate long-term strategies supported by international cooperation and partnership arrangements • Links to SDG 15 Target 15.3 on Land Degradation Neutrality (LDN), encouraging nations to strive for a land degradation neutral world by halting desertification and restoring degraded land by 2030 – Kenya has completed the target setting process aiming to achieve zero net land degradation by 2030

[34] Kenya National Adaptation Plan: 2015-2030, Government of Kenya, July 2016
[35] National Climate Change Action Plan (2018-2022), Government of Kenya, 2018

Policy and Acts	FMNR supportive window in the instruments
The 2030 Agenda for Sustainable Development (Sustainable Development Goals (SDGs)	SDGs related to landscape restoration initiatives include: • SDG 1. End poverty in all its forms everywhere (Target 1.5) • SDG 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture (Targets 2.1, 2.2, 2.3 and 2.4) • Goal 6. Ensure availability and sustainable management of water and sanitation for all (Target 6.6) • Goal 12. Ensure sustainable consumption and production patterns (Target 12.2) • SDG 13. Take urgent action to combat climate change and its impacts (Target 13.1) • SDG 15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss (Target 15.1, 15.2, 15.3, 15.5, 15.6)
Convention on Biological Diversity	• Advocates and champions for conservation and maintenance of genes, species and ecosystems, with a view of sustainable management and use of biological resources for the benefit of humanity. • Commits to 20 Aichi targets by 2020[36] of which FMNR can give significant contribution to Targets 1, 4, 5, 7, 14 and 150
The Paris Agreement (2015) on Climate Change by parties to UNFCCC[37]	• Brings all nations into a common cause to undertake ambitious efforts to combat climate change and adapt to its effects • Commits parties to take action to conserve and enhance, as appropriate, sinks and reservoirs of greenhouse gases as referred to in Article 4, paragraph1(d), of the UNFCCC, including forests. • Requires all Parties to put forward their best efforts through nationally determined contributions (NDCs) and to strengthen these efforts in the years ahead. In Kenya's NDC the agriculture sector commits agroforestry is the major contribution pathway

[36]https://www.cbd.int/sp/targets/
[37]The United Nations Framework Convention on Climate Change

Annex 6:

List of some invasive plant species of economic importance in Kenya[R21, R46 & R62]

Sno	Species	Local name	Growth habit	Impact on native plants, animals and ecosystems	Impact on humans (livelihood, transport, health etc.)
1	*Prosopis spp (juliflora and pallida)*	Mathenge, mesquite	Shrub	Loss of habitat and biodiversity; lack of ground cover	Reduces livestock foliage; deep roots enhance drought; thorns are poisonous
2	*Opuntia exaltata L*	Long spine cactus	Succulent tree/shrub	Out-competes native plants; precludes grazing and browsing near it	Poisonous spines
3	*Opuntia ficus indica*	Prickly pear,	Succulent tree/shrub	Poisonous to wildlife in parks and livestock	Affects potential tourism
4	*Lantana camara*	Pricky Berry, Lantana	Shrub	Out-competes other vegetation; threats to habitats and biodiversity; alters soil chemical properties	Toxic leaves mildly poisonous to livestock; habitat for tsetse flies
5	*Eucalyptus spp.*	Eucalypts	tree	Minimal, though there is some evidence it retards recruitment of native species through allelopathy	None
6	*Leucaena leucocephalus*	Lusina	Woody tree/shrub	A quick colonizer especially through self-disposal of its seeds. Out-competes undergrowth plants	None
7	*Acacia reficiens*		Woody tree/shrub	Out-competes native plants especially grass by quickly colonizing denuded lands	
8	*Parthenium hysterophorus*		Weed	Out compete grass growth due its fast growth and spread.	Reduced pasture
9	*Ipomoea spp.*	Morning glory	weed	Grows over and out-competes other plants	Reduced pasture

Sno	Species	Local name	Growth habit	Impact on native plants, animals and ecosystems	Impact on humans (livelihood, transport, health etc.)
10	*Psidium guajava*	Guava tree	Woody tree/shrub	Outcompetes native plants, lowering species diversity; limits pasture growth due to thick density	Reduced pasture but fruit is food to livestock and humans; increased cultivation labor costs
11	*Acacia polyacantha*	White thorn	Woody tree/shrub	Suppresses native plant species	Reduced pasture under thick canopy and high density
12	*Caesalpinia decapetala*	Mauritius thorn	Woody tree/shrub	Shades out grassand shrubs eaten by animals; limits animal movement	Reduced pasture; affects livestock and wild animals' production
13	*Acacia farnesiana*	Sweet acacia	Woody tree/shrub	Forms impenetrable thickets that suppress growth of native species; limits access to water	Reduced pasture and affects livestock production
14	*Acacia mearnsii*	Black wattle	Woody tree/shrub	Outcompetes native plants hence lowering biodiversity; increased water loss	Reduced pasture
15	*Solanum incanum L.*	Sodom apple		Weed	
16	*Agave spp (sisalana Perrine and angustifolia Haw.)*	Sisal	Succulent tree/shrub	Spread fast by suckers smothering other species	
17	*Cascabela thevetia (L.) Lippold (Syn.: Thevetia peruviana (Pers.) K. Schum*	Currant-tree	Woody tree/shrub	Outcompetes native species and other undergrowth like grass	
18	*Tithonia diversifolia (Hemsl.) A. Gray*	Mexican sunflower	Woody tree/shrub	Weed, a fast colonizer.	
19	*Opuntia monacantha (Willd.) Haw.*	Drooping Prickly Pear	Succulent tree/shrub		
20	*Cuscuta campestris Yunck*	field dodder	Climber	Covers native plants with extensive network of stems hindering access to photosynthetic light	
21	*Convolvulus arvensis L.*	European bindweed	climber	Allelopathic chemicals inhibit growth of native plants around it	

Annex 7:

Priority tree species selection template

Desired products/ services	Contributions that trees could make to these needs	Required tree characteristics	Known tree species that may be useful
E.g. Fodder for livestock in dry season	• palatable leaves, bark and seed pods • improved grass growthunder light tree canopy	• palatable fodder tree • open canopy with light shade for grass growth or the ability to be pruned for light shading	• *Acacia tortilis* • *Acacia nilotica* etc

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Annex 8:

Local tree species list template

Location_____

List compiled by _____ **Date** _____

Scientific name	Local name	Defining Characteristics	Photo *(Insert photo name and file location, or a small image)*
E.g. *Faidherbia albida*	Momona (Ethiopia)	• Small leaves and thorns • open canopy • white/cream flowers • dark grey bark • tall • leaves drop in the wet season	

Note: If not all information is known, record what information you can with the community and fill any gaps from a photo and list of defining characteristics will be important to help accurately identify the tree species in the future.

Current use in community	Potential uses	Restrictions on use

reference books, online resources or expert knowledge later. If the scientific or local names are unknown, Be sure to share any additional information you find with the community!

Annex 9:

Community Assessment Checklist[38]

1. **How can I better engage community members?**
    i. Who are community members? *(It is good to classify the community into significant sub-groups of interest to FMNR such as herders, agro-pastoralists, charcoal producers, female headed households, tree nursery operators, others)*
    ii. Are members aware and concerned about community and/or sustainable land management *(including tree integration)* issues? *(This can also be collated for each sub-group)*.
    iii. Are members motivated to take action to address community and/or sustainable land management *(including tree integration)* problems?
    iv. Are members able to take action to address community and/or sustainable land management (including tree integration) problems?
    v. What drives actions? What constrains actions *(both **behavioral** and **structural**[39] barriers)?*
2. **How can I tap existing social networks or encourage community members to work together?**
    i. How do community members interact? Are social interactions positive? Is there conflict?
    ii. How are information and ideas exchanged in the community?
    iii. How do members influence one another? (e.g., Who are leaders? Who do people trust?)
    iv. Do strong social networks exist? Do they include diverse members?
    v. Do members cooperate to address community and/or sustainable land management (including tree integration) problems?
    vi. What drives cooperation? What constrains cooperation?
3. **How can I develop or strengthen partnerships with community organizations?**
    i. What organizations (especially community based) exist to address community or sustainable land management (including tree integration) issues?
    ii. Are they influential in the community? What drives/constrains their influence?
    iii. Do organizations engage and unite diverse community members?
    iv. Do organizations effectively address community and/or sustainable land management (including tree integration) problems? Are there capacity gaps?

[38]Adapted from [R8]
[39]***Behavioral barriers*** are issues related to people's perceptions, beliefs, and behaviors. They may include things like cultural practices and social norms, poor communication, lack of trust, misunderstandings of concepts or the likelihood of events, or other ingrained rules by which we make decisions and biases like risk aversion. ***Structural barriers*** are issues created by circumstance, including lack of infrastructure, insufficient regulation, distance, expense and other type of constraints. They aren't easily altered without changes in policy, investment, environmental attributes, or economic conditions.

4. **How can I create, strengthen or coordinate programs to address land management and tree resource issues?**
    i. What programs exist to address community issues including or land and tree resources' management?
    ii. Do programs effectively engage diverse community members?
    iii. Are programs coordinated across organizations? Is there conflict?
    iv. Are programs successful in addressing community or water resource problems?
5. **How can I increase the likelihood that land resource planning and management is viewed as fair and legitimate in the community? How can I build sufficient trust to sustain integration of trees in agricultural and/or pastoral lands?**
    i. What relevant projects have been undertaken in the past that can be built on?
    ii. How does the community view outside support? Are there past experiences that could have bred mistrust?
    iii. Are there unresolved grievances related to land management or tree resources?
    iv. What drives intervention success? What constrains intervention success?
6. **How do cultural differences shape community engagement in land resource planning and management including integration of tree in agricultural and/or pastoral lands?**
    i. What cultural issues are relevant to land management and tree growing?
    ii. Are there negative perceptions related to trees in agricultural land? Can they be refuted?
    iii. How are the various demographic groups (women, youth, landless etc.) motivated or barred from investing in tree-based value chains?

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