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Situational Analysis: Options and scenarios of voluntary commitments for biodiversity in the Horticulture, Pastoralism and Charcoal Production Sub-sectors in dryland ecosystems in Kenya- BIODEV2030



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Abbreviations and Acronyms

AFD -French Development Agency

AFRI- African Forest Landscape Restoration Initiative

ASALs - Arid and Semi-Arid Lands

ASDSP- Agriculture Sector Development Support Programme

CBD -The Convention on Biological Diversity

CGIAR- Consortium of International Agricultural Research Centers

CIDP- County Integrated Development Plan

CI- Conservation International

CITES- Convention on International Trade in Endangered Species

CC- Climate Change

COP - Conference of the Parties

CPA- Charcoal Producers Association

CSO- Civil Society Organizations

CSR- Corporate Social Responsibility

EIA- Environmental Impact Assessment

EMCA- Environmental Management and Coordination Act

FAO- Food and Agriculture Organization

FGD -Focus Group Discussion

FLaRAK- Forestry and Land Restoration Action for Kenya's

FCMA- Forest Conservation and Management Act

FSC- Forest Stewardship Council

GDP- Gross Domestic Product

GEF- Global Environmental Facility

GHGs- GreenHouse Gases

GOK- Government of Kenya

IPM- Integrated Pest Management

IUCN -International Union for Conservation of Nature

KALRO -Kenya Agriculture and Livestock Research Organization

KEFRI -Kenya Forestry Research Institute

KEPHIS- Kenya Plant Health Inspectorate Service

KFS -Kenya Forest Service

KII -Key Informant Interviews

KNBS- Kenya National Bureau of Statistics

KWTA- Kenya Water Tower Agency

KWS- Kenya Wildlife Service

MoALFC -Ministry of Agriculture, Livestock and Fisheries and Cooperatives

MoEF -Ministry of Environment and Forestry

NBSAPs- National Biodiversity Strategies and Action Plans

NBS- Nature-Based Solutions

NCCAP- National Climate Change Action Plan

NCCP- National Climate Change Policy

NEMA- National Environment Management Authority

NGOs -Non-Governmental Organizations

NKCC- New Kenya Cooperative Creameries

NLC- National Land Commission

NRT- Northern Rangelands Trust

PELIS- Plantation Establishment and Livelihood Improvement Scheme

PES- Payment for Ecosystem Services

SSQ- Semi Structured Questionnaires

SWOT- Strength, Weakness, Opportunities and Threats

TWENDE- Towards Ending Drought Emergencies

UNFCCC- United Nations Framework Convention for Climate Change

UNFF- United Nations Forum on Forests

UNDP- United Nations Development Program

USAID- United States Agency for International Development

USD- United State Dollar

VC -Voluntary commitments to biodiversity

VCA- Value Chain Analysis

WWF -World Wide Fund for Nature

Executive summary

More than 80% of the land area in Kenya is arid and semi-arid with land degradation and land conversion being a major threat to biodiversity and livelihoods. There is a need to reverse the trend of degradation and promote more sustainable and resilient economies through mainstreaming biodiversity in the key economic sectors of the drylands (livestock, crops, and forestry sectors). Factors impeding conservation of biodiversity in the country include lack of a coherent integrated conservation policy that unifies dispersed and often conflicting legislation and policies in different sectors and institutional barriers such as lack of technical expertise, planning, and funding (GOK, 2019). Irrespective of the vast degradation and associated problems in the country. Kenya lacks clear policies to guide mainstreaming of biodiversity as well as voluntary commitments to biodiversity into key economic sectors in the drylands.

The BIODEV2030 project, funded by the French Development Agency (AFD), and implemented by the International Union for Conservation of Nature (IUCN) in close collaboration with the Ministry of Environment and Forestry (MoEF), aims to accelerate the mainstreaming of biodiversity into economic sectors which are key to biodiversity (BIO-) and development (-DEV), to ‘bend the curve’ of biodiversity decline and promote more sustainable and resilient economies. This assignment, under the project was aimed at identification of possible scenarios for voluntary commitments to biodiversity by private sector actors in the livestock (pastoralism), crops (tomatoes) and forestry (charcoal production) sectors in Kajiado County Kenya as a pilot study in the Kenyan drylands. The study used the Drivers, Pressures, State, Impact and Responses (DPSIR) framework to assess the main drivers to biodiversity losses, pressures to biodiversity, the impact, state, and response to biodiversity losses by private sector actors. We assessed the pastoralism, tomato, and charcoal value chains to identify their structure, actors, and impacts on biodiversity. We also reviewed the major policies affecting the three subsectors to identify their strengths as well as weaknesses in relation to biodiversity. Based on the findings, we recommend possible strategies for voluntary commitments to biodiversity by stakeholders and private sector actors in the livestock (pastoralism), crops (tomatoes) and forestry (charcoal production) sectors of Kajiado County, Kenya. The recommendations will be key in supporting the achievement of National Biodiversity Strategies and Action Plans (NBSAPs) as well as the various post-2020 global biodiversity targets.

Selection of the study area was based on information gathered from literature review as well as expert knowledge. We compared main economic activities in the different ASALs counties using parameters such as aridity score, livestock, crop production as well as forestry activities. In addition to weighting of the above factors, we prioritized counties with more IUCN related projects. From the analysis, Kajiado County was weighted highest among the ASAL Counties in terms of the impact of pastoralism, tomato, and charcoal production on biodiversity as well as existence of other IUCN affiliated projects in the County, thus selected as the Pilot County for the study.

Desktop review of literature, key informant interviews (KII) and focus group discussions (FGDs) were used for data collection. Value Chain Analysis (VCA), weights and scores, and participatory ranking techniques were used for data analysis. Target respondents for the assignment included value chain actors (input provision, producers, aggregators/ traders, processors, consumers), government agencies such as the Ministry of Agriculture, Livestock, Fisheries and Cooperatives (MoALFC), Ministry of Environment and Forestry (MoEF), Kenya Agriculture and Livestock Research Organization (KALRO), Kenya Forestry Research Institute (KEFRI), Kenya Forest Service (KFS), County Governments, farmer representatives, Development agencies and Non-Governmental Organizations (NGOs), such as the International Union for Conservation of Nature (IUCN), Conservation International (CI), Food and Agriculture Organization of the United Nations (FAO), and the United States Agency for International Development (USAID) among others. Synthesis of the findings from literature review, KII, FGD and expert knowledge were finally computed to identify possible strategies for voluntary commitments to biodiversity in the three sectors as well as the potential resource mobilization strategies.

The recommendations for voluntary commitments to biodiversity in the pastoralism, tomato and charcoal production, categorized into short, medium and long term strategies were as follows:

Pastoralism

Pastoralism in Kajiado County was characterized by overstocking which leads to overgrazing in the rangelands. Negative impact of the livestock sector on biodiversity includes degradation of rangelands and loss of biodiversity due to unsustainable stocking rates. Direct effects of the livestock sector on biodiversity include conversion of previously forested lands to pasture, increased emissions of methane and other greenhouse gases (GHGs), trampling and over grazing

that causes degradation, soil erosion and loss of biodiversity. The following are the proposed options for VC scenarios classified into short-, medium- and long-term strategies:

Table 1: Summary of recommended VCs in the pastoralism sector

Voluntary Commitment	Problem addressed	Actors	Expected change
Short term			
Build capacity and create awareness to actors	-Inadequate extension service providers -Inadequate knowledge on the impact of pastoralism on biodiversity and how to mitigate	-County Government -National government -NGOs/CSOs -Private sector	-Improved ecosystem health and biodiversity richness -Increased forage production -Increased livestock production -Reduced degradation
Mid term			
Develop and adhere to grazing management plans	-Overgrazing -Overstocking	-Pastoralists -County government -National government -Community and group ranch leaders -Local administration	-Improved health of rangelands -Improved forage production -Increased plant and animal diversity
Adoption of alternative pastoralism models	-Overgrazing -Degradation and loss of biodiversity	-Pastoralists -National and County governments -Private sector	-Increased forage production -Improved livestock productivity -Reduced degradation -Improved soil fertility
Tree growing on at least 10% of the total land area	-Degraded rangelands -Loss of biodiversity	-Pastoralists -County government -National government -Community and group ranch leaders -Local administration	-Improved health of rangelands -Reduced soil erosion -Reduced degradation
Long term			
Adoption of Sustainable stocking rates	-Unsustainable stocking rates -Degradation of rangelands -Biodiversity loss	-Extension service providers -Pastoralists	-Improved vegetation cover -Reduced soil erosion -Improved profitability -Reduced degradation
Certification schemes for animal products	-Lack of traceability of animal products	-Consumers -Livestock producers -Businesses	-Conserved rangelands -Quality food, feed and products

	-Negative impacts of pastoralism on biodiversity		
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Tomato value chain

Tomato production contributed to biodiversity loss in Kajiado County mainly due to heavy use of herbicides and pesticides, use of inefficient irrigation practices as well as conversion of previously forested lands to tomato production. It was reported that most farmers were not the actual landowners but tenants for a specified time thus did not factor biodiversity in their production decisions. In most cases, they cut down all trees to maximize on the land area under tomato production. Key recommendations for voluntary commitments in the tomato sector were as follows:

Table 2: Summary of recommended VCs in the tomato sector

Voluntary Commitment	Problem addressed	Actors	Expected change
Short term			
Awareness/ Capacity building actors	-Inadequate awareness of the impact of tomato production on biodiversity -Inadequate extension services	-Producers -National and County governments -NGOs	-Enhanced capacity of farmers on sustainable tomato production
Mid term			
Adoption of efficient farming technologies	-Biodiversity loss -Soil erosion Sedimentation of water bodies	-National and County Governments -CSOs -Extension service providers -Producers -Input suppliers	-Improved biodiversity in the tomato growing regions -Improved productivity -Improved soil fertility -Improved food and water safety
Tree growing on at least 10% of the total land area	-Conversion of rangelands to crop production -Biodiversity loss	-Landowners (public and private) -County and National Governments	-Improved biodiversity conservation -Improved soil fertility -Increased productivity

		-KFS -KEFRI	
Long term			
Certification and sustainability standards	-Land degradation -Soil erosion -Pests and diseases	-Improved food security and safety -Increased biodiversity in agricultural landscapes -Improved markets and profitability of tomato enterprise -Improved traceability of horticultural products	-Improved food security and safety -Increased biodiversity in agricultural landscapes -Improved markets and profitability of tomato enterprise -Improved traceability of horticultural products

Charcoal value chain

Fuel wood was found to be the main energy source in most households surveyed. In addition, Kajiado is strategically located closer to major towns in Kenya such as Nairobi and Machakos increasing charcoal demand in the county. Charcoal was mainly produced from indigenous species such as *Acacia* spp and *Terminalia brownii* from private and community lands. The charcoal producers used traditional earth kilns with low recovery rates for charcoal production. This has contributed to rangelands degradation, habitat and biodiversity loss. Recommendations for voluntary commitments to biodiversity in the charcoal sector were as follows:

Table 3: Summary of recommended VCs in the charcoal sector

Voluntary Commitment	Problem addressed	Actors	Expected change
Short term			
Capacity building and awareness creation	-Limited awareness on the impact of charcoal production on biodiversity	-MoEF -KFS -MoEF, KEFRI, County Department for Energy and forestry -Value chain actors -CSOs	-Increased awareness on the links between charcoal value chain and biodiversity -Reduced deforestation -Reduced biodiversity loss

Use of alternative energy sources	Deforestation -Degradation -Pollution -Increased use of charcoal	-Consumers -Businesses -National and County Governments -NGOs	-Reduced carbon emissions -Increased tree and forest cover -Increased biodiversity
Mid term			
Sustainable charcoal production (wood lots, efficient kilns,)	-Depleted forestry resources -Degradation -Low conversion rates of charcoal	-MoEF, KEFRI, KFS County Department for Energy and forestry -Charcoal producer associations -Group ranch -Producers -NGOs -Businesses	-Reduced biodiversity loss -Increased forest and tree cover -Reduced invasive species -Reduced emissions
Adoption of efficient charcoal utilization technologies (efficient stoves)	-Deforestation -High cost of charcoal	-MoEF, KEFRI, County Department for Energy and forestry -Consumers -Traders -CSOs -NGOs	-Reduced biodiversity loss -Increased efficiency in charcoal utilization -Reduced emissions
Tree growing or use of natural regeneration options on degraded rangelands	-Deforestation -Degradation -Soil erosion	-Landowners -Producers -CSOs -MoEF, -KEFRI -KFS -County depart responsible for forestry	-Restoration of degraded rangelands -Increased tree/ forest cover in the rangelands -Increase in sustainably produced charcoal

Adoption of nature-based solutions (apiculture, medicinal plants ecotourism, agro) as alternative income sources	<ul style="list-style-type: none"> -Inadequate knowledge on Non extractive values of the rangeland landscape -Deforestation -Degradation -Soil erosion 	<ul style="list-style-type: none"> -Landowners -Producers -CSOs -MoEF, -County department responsible for forestry 	<ul style="list-style-type: none"> Diversification of livelihood options Adoption of nature-based solution -Decline in charcoal production and use -Poverty reduction
Long term			
Adoption of Payment for ecosystem services Models for the forestry sector	<ul style="list-style-type: none"> -Deforestation -Degradation -Soil erosion 	<ul style="list-style-type: none"> -Charcoal producer associations -MoEF, -County depart for forestry -Consumers -CSOs -Businesses 	<ul style="list-style-type: none"> -Improved biodiversity -Increased adoption of PES -Reduced deforestation
Forests standards and certification	<ul style="list-style-type: none"> -Deforestation -High demand for charcoal 	<ul style="list-style-type: none"> -MoEF, -County depart for forestry -KFS -CFAs -Charcoal producers -Consumers -Businesses -Forest Stewardship Council 	<ul style="list-style-type: none"> -Sustainable charcoal production -Adoption of forest certification for charcoal production -Improved biodiversity

1.0 Introduction

1.1.BIODEV2030: Mainstreaming biodiversity into key economic sectors to support Kenya's Vision 2030

Funded by the French Development Agency (AFD), the BIODEV2030 initiative aims to accelerate the mainstreaming of biodiversity into economic sectors which are key to biodiversity (BIO-) and development (-DEV), to 'bend the curve' of biodiversity decline and promote more sustainable and resilient economies. In Kenya, the BIODEV2030 project is implemented by the International Union for Conservation of Nature (IUCN) in close collaboration with the Ministry of Environment and Forestry (MoEF), which will politically support the country's voluntary commitments to the global framework of biodiversity for the post-2020 period.

In the first step of the project, an assessment report based on scientific data identified the main threats to national biodiversity and the related economic sectors with greatest impacts in Kenya. Results of the assessment were reviewed and discussed by national stakeholders who identified key sectors for the "dialogue" phase of the project: the agriculture (crops and livestock) and forestry sectors. During a virtual multi-stakeholder dialogue on *"Sub-sectors Selection under Agriculture and Forestry for Mainstreaming Biodiversity into Economic Sectors"* in Kenya held on 29th July 2021, the participants agreed that the BIODEV2030 project adopts a landscape approach focusing on dryland ecosystems.

More than 80% of the land area in Kenya is arid and semi-arid and land degradation and land conversion due to agricultural expansion into marginal lands is a major threat to biodiversity in such ecosystems but also for sustainable livelihoods. There is therefore a need to reverse the curve and promote more sustainable and resilient economies. Factors impeding the conservation of biodiversity in the country include lack of a coherent integrated conservation policy that unifies dispersed and often conflicting legislation and policies in different sectors and institutional barriers such as lack of technical expertise, planning and funding (GOK, 2019). Irrespective of the vast degradation and associated problems in the country, Kenya lacks clear policies to guide mainstreaming of biodiversity as well as voluntary commitments to biodiversity into key economic sectors (agriculture and forestry) in the drylands.

This report therefore presents the situational analysis for mainstreaming biodiversity into key economic sectors to support Kenya's Vision 2030. The situational analysis focuses on examining the opportunities, constraints, and scenarios of engagement of actors in the agricultural (horticultural), pastoralism and charcoal production to reduce their pressures on biodiversity in Kenya. The study takes stock of the horticulture (tomatoes), charcoal production and pastoralism production sub-sectors, their value chain, their actors, and their impacts, and identify existing good practices and proposes possible strategies for future voluntary commitments by stakeholders in the sub-sectors in favor of biodiversity. The analysis will support the identification of priorities to guide future action plans that will be discussed by stakeholders and support the achievement of NBSAPs and of the post-2020 global framework targets.

1.2 Background of the situation analysis for biodiversity in the agriculture and forestry sectors in dryland ecosystems in Kenya (Description of ASALS, Kajiado county, land use changes (maps))

The Arid and Semi-Arid Lands (ASALs) occupy over 80% of the country's landmass. It is home to about 36% of the population, 70% of the national livestock and 90% of wildlife. The annual rainfall in arid areas ranges between 150 mm and 550 mm and semi-arid areas between 550 mm and 850 mm per year. Temperatures are high throughout the year, with high rates of evapo-transpiration. The ASALs in Kenya are spread across 22 counties with varying degrees of aridity. These extreme climatic conditions have had devastating effects on the environment and livelihoods of communities with spiralling vulnerabilities. The ASAL areas are represented in Figure 1 (PRISE, 2016). Majority of the communities (75% of the population) living in ASALs rely on pastoralism, small scale farming and use of forests products for their livelihood (Barrow and Mogaka, 2007).



Figure 1: ASALs Counties in Kenya (source: NIA, 2020)

Approximately 84% of the total land surface in Kenya (582, 650 KM²) is arid and semi-arid with about 12 million people (25% of the Kenyan population) residing in these areas (GoK, 2012). They are characterized by relatively low levels of rainfall incapable of supporting normal rainfed agricultural practices. The main land use systems in the ASALs include pastoralism, agro pastoralism, ranching, wildlife conservation, dryland forestry and to a low extent, crop production (Barrow and Mogaka, 2007). The utilization of most of these resources, however, remains sub optimal. Though there is great potential for improvement, the institutional and technical capacity remains low, coupled with unfavorable policy and legal frameworks.

Majority of the citizens residing in the drylands make their living by grazing livestock and growing food crops in the rangelands (Homewood, 2009). Irrespective of the vast degradation and associated problems in the country, Kenya lacks clear policies to guide mainstreaming of biodiversity as well as voluntary commitments to biodiversity into key economic sectors (agriculture and forestry) in the drylands. Factors impeding the conservation of biodiversity in the country include lack of a coherent integrated conservation policy that unifies dispersed and often conflicting legislation and policies in different sectors and institutional barriers such as lack of technical expertise, planning and funding (GOK, 2019). There is therefore a need to reverse the curve and promote more sustainable and resilient economies from forestry and agricultural sectors. This work will contribute to the identification of options and scenarios of voluntary commitments for biodiversity in the agriculture and forestry sectors in dryland ecosystems of Kenya.

2. Methodology

2.1. Conceptual framework

The DPSIR biodiversity indicator framework (**Figure 1**) was used to assess the Drivers, Pressures, State, Impact and Responses to biodiversity in pastoralism, tomato and charcoal production (Biodiversity.F1, 2022). In the framework, we hypothesized the drivers to biodiversity changes in the Kenyan drylands are caused by several factors. The drivers directly impact on the pressure exerted on the ecosystem, this can be through overstocking rates, overgrazing, deforestation, or degradation, changing crop production patterns, among others. The pressures in turn influence the state of the dryland ecosystem which is manifested in the impact to biodiversity and the general population through lives and livelihood losses, economic losses as well as low resilience leading to increased poverty incidences. The impact of biodiversity losses in the ecosystem directly influences the utility derived by different actors as well as the quality of life in the ecosystems. These then directly affects their responses including their voluntary commitments to biodiversity.

The findings from literature review, key informant interviews, field observations, focus group discussions and observations and stakeholder feedback in the validation workshops were used to inform the proposed VCs. The following 4 steps were followed before designing and discussing voluntary commitments: Scientific diagnosis of threats to identify the drivers, threats, and pressures to biodiversity losses in Kajiado County, whether biodiversity losses should be halted or restored as well as actions to be taken; Mapping of stakeholders, their interests, and roles; Identification of possible good practices; and finally understanding the context in which the actors in the sectors operate.

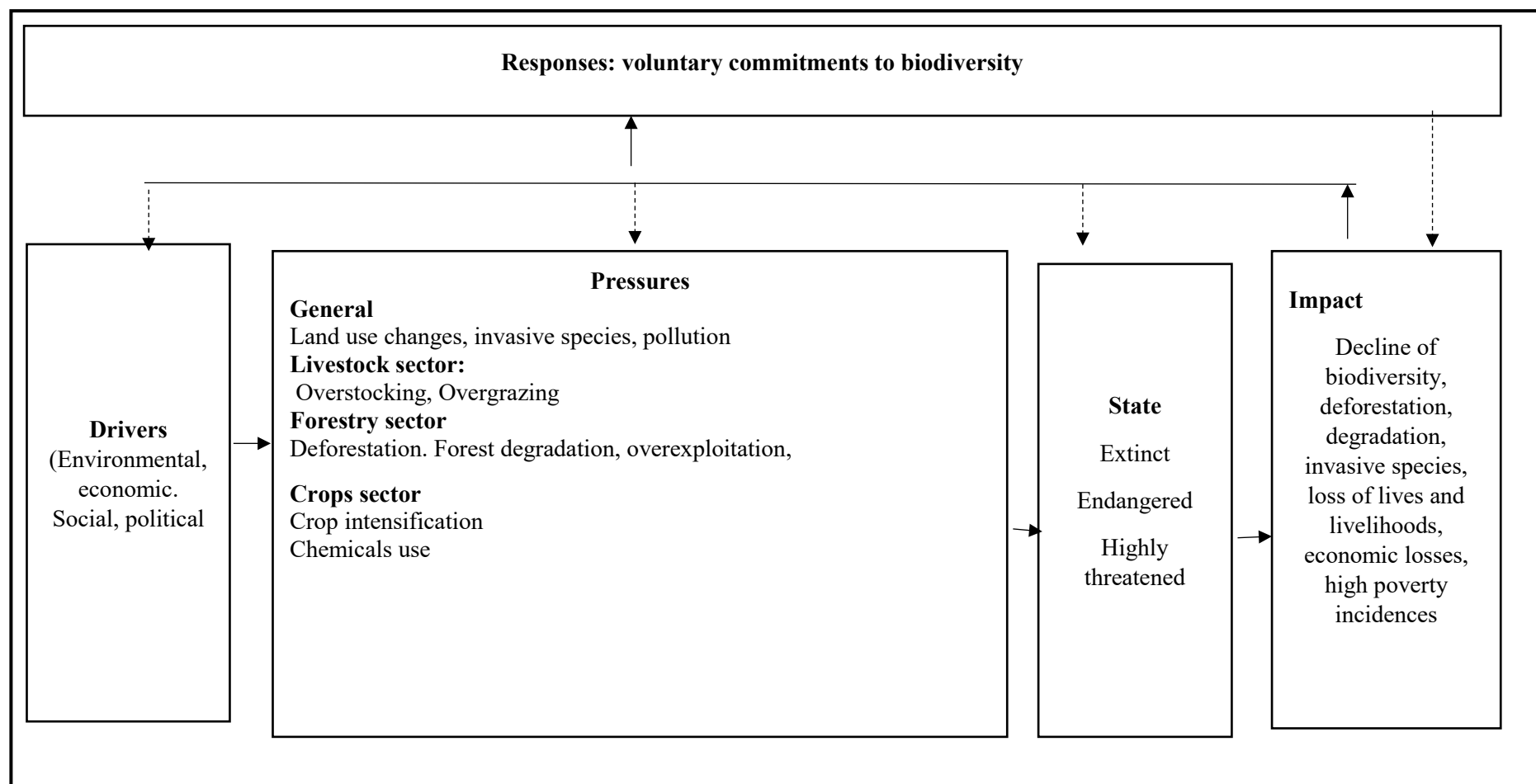


Figure 2: DPSIR biodiversity indicator framework

2.2. Selection of a county and priority sub-sectors from the Kenyan drylands

The following section indicates the procedure that was used to select the representative study site for the assignment, among ASAL counties whose aridity scores exceeded 50% as categorized by Njoka (2016)

A preliminary analysis of key economic sectors in the Kenyan ASALs was conducted where activities in the different counties were compared based on parameters such as aridity score, livestock (pastoralism), and crop production (tomatoes) as well as forestry (charcoal production) activities (Table 1). This enabled us to rank the counties that manifested most of the key economic activities of significance to the ASALs and were at risk of losing biodiversity because of the economic trends. Key economic parameters in the ASALS (livestock, and crop production, forestry, and wildlife) were weighted and scores used to select the target county of study.

Table 4: Assessment of key indicators used to guide the selection of the study site

Counties	Livestock production		Forestry	Crop production	Wildlife	Total score
	Pastoralism	Ranching				
Isiolo	XXX	XXX	XX	X	XX	11
Marsabit	XXX	X	XXX	X	X	9
Garissa	XXX	X	XX	X	X	8
Mandera	XXX	X	X	X	X	7
Wajir	XXX	X	X	X	X	7
Turkana	XXX	X	X	X	X	7
Kitui	X	X	X	XX	X	6
Tana River	XX	X	X	XX	X	7
Taita Taveta	X	X	X	XX	XXX	8
Kajiado	XXX	XX	XXX	XXX	XXX	14
Samburu	XXX	X	XX	X	XX	9
Tharaka Nithi	X	X	XX	XX	X	7
Makueni	X	X	X	XX	XX	7
West Pokot	XX	X	X	XX	X	7
Kwale	X	X	X	X	X	5
Machakos	X	X	XX	XX	X	7
Laikipia	XXX	XXX	XXX	XXX	XXX	15
Kilifi	X	X	X	XX	X	6
Baringo	XX	X	X	X	X	6

X-low, XX- medium and XXX- high

From the assessment, Kajiado County had the second highest weighted score (14), while Laikipia was the highest weighted overall (15). Kwale County had the least (5). While Kajiado County was scored as the second best, we chose it compared to Laikipia County due the existence of other IUCN affiliated development projects such as towards ending drought emergencies (TWENDE) Project, global environmental facility (GEF)7 (Strengthening Forest management for improved biodiversity conservation and climate resilience in the Southern rangelands of Kenya), the United Nations Development Program (UNDP) “Forestry and Land Restoration Action for Kenya’s NDC (FLaRAK) Programme and consortium of international agricultural research centers (CGIAR) Initiative on Nature-Positive Solutions. In addition, Kajiado with a per capital gross domestic product (GDP) of \$1,466 is the third richest county and this is positive in voluntary contribution as the farmers/ users of the resource hence probable improved willingness to work on sustainable long-term options. Based on these factors, we selected Kajiado County for piloting of this study.

2.3. Description of the study site

The study was conducted in Kajiado County (**Figure 3**)

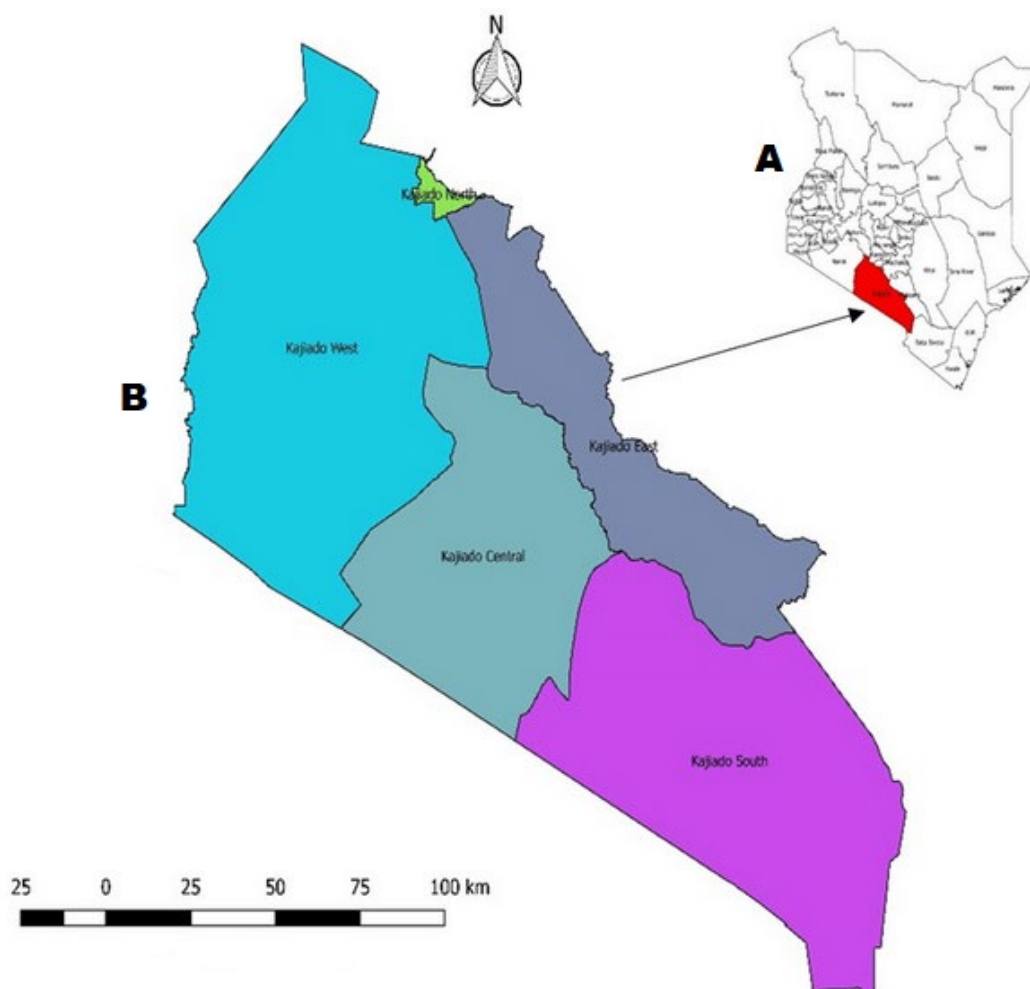


Figure 3: Study site. A) Kenyan map showing the location of Kajiado County shaded in red colour. B) Map of Kajiado County showing different sub-counties shaded in different colours (Source: Onono et al., 2019).

Kajiado County is in the southern rangelands of Kenya with a population of 1,117, 840 persons Kenya national bureau of statistics (KNBS, 2019). The County is highly cosmopolitan due to its proximity to Nairobi, Kenya's capital city where people from other parts of the country have bought land and settled in its urban areas. It boasts of vast land resources (21292 KM²) most of it being ASALs. Livestock production is the predominant activity on the land where most of the residents in the County especially rural areas practise pastoralism. The main livestock species in the County are cattle, sheep, and goats. Average annual livestock production is estimated at 912,000 litres of milk, 6600 tonnes of beef, 642.7 tonnes of mutton, 536.5 tonnes of chevon, 345.6 thousand poultry and 1.44 million trays of eggs (CIDP, 2018).

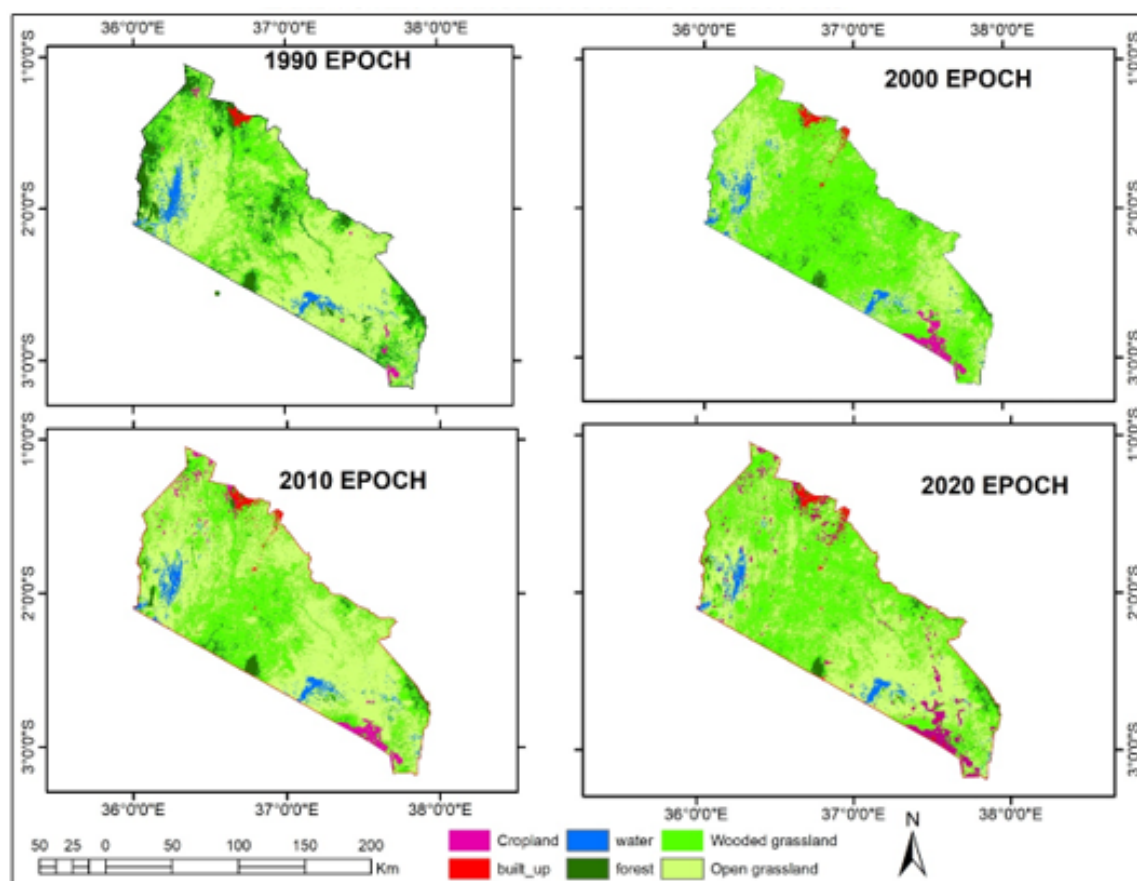
The land tenure system has greatly changed from communal land to private ownership. The number of communal group ranches has declined from 56 to only 10 currently. The other ranches were subdivided amongst group ranch members and converted to private ownership.

Wildlife is also a key economic activity in the county with the Amboseli National Park being one of the major tourist attraction sites. Others include Olorgesailie prehistoric site and the Ngong hills (scenery for picnics and hiking).

Area under crop production has increased from 0.55% to 4.36% between 1990 and 2020 (**Figure 4**) with evidence of small to medium scale crop farming being practiced in areas such as Ngong, Loitokitok, and Nkuruman mainly under irrigation due to the low annual rainfall in the County. Large scale flower farming is also practiced within Isinya and Kitengela areas.

According to the ASDSP Agribusiness Baseline Survey Report of 2014, commercial farming of onions and tomatoes is done throughout the county though some are in small quantities. Tomato production is majorly in Kajiado South in Kimana, Rombo and Oloitokitok under small-scale mixed farming. Large farms of more than 50 acres are mostly for rain fed agriculture although this is slowly becoming unpopular because of irregular rainfall patterns. The 2015 statistics show that tomato production in the county was worth approximately KES 989,740,000.

We assessed land use, land cover changes in Kajiado for the period between 1990 and 2020 and it was evident that the area under forest has declined from 10.7% to 2.2 while the wooded grassland reduced from 55.76% to 44.07 (Figure 4). Leading to increase in open grassland areas from 28.81% to 45.79. This could be due to challenges such as, among other things, government policies, failure of conservation (as a form of land use) to compete effectively with alternative land uses, habitat degradation and blockage of wildlife corridors, overexploitation and illegal resource extraction, wildfires and human population growth. The human population growth challenge could have significantly led to the changes in the land cover as shown by the increase in settlement areas from 0.51% to 1.1 % and crop production areas from 0.55% to 4.36%.



Year	1990		2000		2010		2020	
class	Ha	%	Ha	%	Ha	%	Ha	%
Wetland	74728.53	3.68	70336.53	3.11	69414.75	3.05	56998.62	2.45
Wooded grassland	1133038	55.76	709089.7	31.39	1238531	54.49	1025343	44.07
Open grassland	585373.8	28.81	1357021	60.07	806277.1	35.48	1065389	45.79
Forest	217496.1	10.7	62900.01	2.78	79104.96	3.48	51589.08	2.22
Settlements	10283	0.51	20618	0.91	21844	0.96	25644	1.1
Cropland	11249	0.55	39143	1.73	57592	2.53	101529	4.36

Figure 4:: Land use land cover changes map in Kajiado County from 1990-2020 (Source: Consultants)

2.4. Selection of subsectors for further analysis in Kajiado county

The Forestry, Livestock and Crop production sectors were purposively selected for the assignment. The analysis of the subsectors of these sectors in Kajiado county (Table 5) Error! Reference source not found. showed that pastoralism, tomato and Charcoal production ranked highest and were therefore selected for this study. The proposed voluntary commitments in these subsectors will help Kenya to fulfil her international obligations as a signatory of various global conventions, regional formations, and treaties, including the Convention on Biological Diversity (CBD), the United Nations Framework Convention for Climate Change (UNFCCC), and the Bonn Challenge, in which Kenya committed to restoring 5.1million ha of deforested and degraded landscapes by 2030; United Nations Forum on Forests (UNFF) and the African Forest Landscape Restoration Initiative (AFR100).

Table 5: Selection of economic sectors/subsectors

Parameters	Livestock		Forestry			Crop production		
	Pastoralism	Ranching	Logging	Charcoal production	Gums and resins	Wheat	flowers	Tomato
Economic contribution	XXX	XXX	XX	XXX	XXX	X	X	XXX
Value chain development	XXX	XXX	X	XXX	XXX	X	X	XXX
Extent of practice	XXX	XX	XX	XXX	XX	X	X	XX
Effects on biodiversity	XXX	XX	XX	XXX	X	X	X	XXX
Total score per subsector	16	12	7	16	9	5	5	11
Total score per sector	28		32			21		

X-low, XX- medium and XXX- high

2.5. – Data Collection and analysis

The following section outlines the data collection and analysis methods used for each of the assignment objectives. Data was collected using different methods.

2.5.1. Desktop review of literature

Review of both white and grey literature was done for published works, government publications, policy documents, industry reviews and publications, as well as any other relevant literature to the assignment. This method was used to address the objectives on contextual analysis of the selected sub-sectors (pastoralism, tomato, and charcoal production), identifying the direct and indirect pressures on biodiversity associated with the 3 target sectors (type, geographical area) that the commitments should aim to reduce; and mapping the actors, their institutional context and their interactions. This was undertaken to understand key economic sectors in the county, main drivers to biodiversity losses, as well as how to halt/ prevent further losses in biodiversity. Stakeholder analysis was conducted to profile key stakeholders in each of the proposed sub sectors, their roles/ responsibilities in the value chain, (Annex 1). Value Chain Analysis (VCA) was then used to map all the actors in the sub sectors, their relationships, the activities/ processes undertaken in the value chain.

The findings of the literature review were compiled into a matrix of the most important sub sectors, contribution to economic development and community livelihoods, as well as the impact of the sub sector to biodiversity within the selected dryland Counties of Kenya (Table 5).

2.5.2. Key informant interviews

Key informant interviews (KII) were conducted with value chain actors, experts, and stakeholders (NGOs, communities, and government agencies) in the key economic sectors in agriculture, forestry, and livestock sectors. Targeted actors for data collection included government agencies such as the Ministry of Agriculture, Livestock, Fisheries and Cooperatives (MoALFC), Ministry of Environment and Forestry (MoEF), Kenya Agriculture and Livestock Research Organization (KALRO), Kenya Forestry Research Institute (KEFRI), Kenya Forest Service (KFS), County Governments, farmer representatives, Development agencies and Non-Governmental Organizations (NGOs), working in the sectors, such as the International Union for Conservation of Nature (IUCN), Conservation International (CI), Food and Agriculture Organization of the United Nations (FAO), and the United States Agency for International Development (USAID) among others). A total of 36 KII were conducted consisting of 12 per sub sector.

2.5.3. Focus Group Discussions

The team conducted focus 3 group discussions (FGDs), for each subsector, to identify the direct and indirect pressures on biodiversity associated with the practices of the selected sub-sectors and identify existing best practices.

2.6. Data analysis

Synthesis of the findings from literature review, KII, FGD and expert knowledge were finally computed in form of tables, graphs, charts among others. Weights and scores were assigned to possible scenarios for voluntary commitments disaggregated by sectors and sub sectors.

Strategies for resource mobilization were also developed. The findings were incorporated in the provisional report, and finally validated through a multi-stakeholder' workshop. The comments and recommendations, from these stakeholders, were subsequently incorporated, and a final report produced and submitted to IUCN.

3.0 Findings, Discussions and Recommendations

The following section presents the results of the assignment on identifying options and scenarios of voluntary commitments to biodiversity by private sector actors in the livestock (pastoralism), tomato and charcoal production sectors in Kajiado. The results are organized in two sections where section 1 focuses on preliminary findings and assessment of biodiversity in Kajiado County using the DPSIR framework. The second section narrows down to recommendations for VCs for the three sectors (pastoralism, charcoal and tomato production. A list of actors in the three sub sectors was developed to understand their roles and responsibilities as possible ways to engage them for VCs to biodiversity in the three sub sectors.

3.1 Main economic activities in Kajiado in order of priority:

Stakeholders were asked to rank the main economic activities in Kajiado County and the results were as shown in figure 5. From the results, livestock production was ranked as the main economic activity by 35% of the respondents, followed by crop production and charcoal burning, at 15% each. Other activities were wildlife conservation, bee keeping and sand harvesting at 10% each.

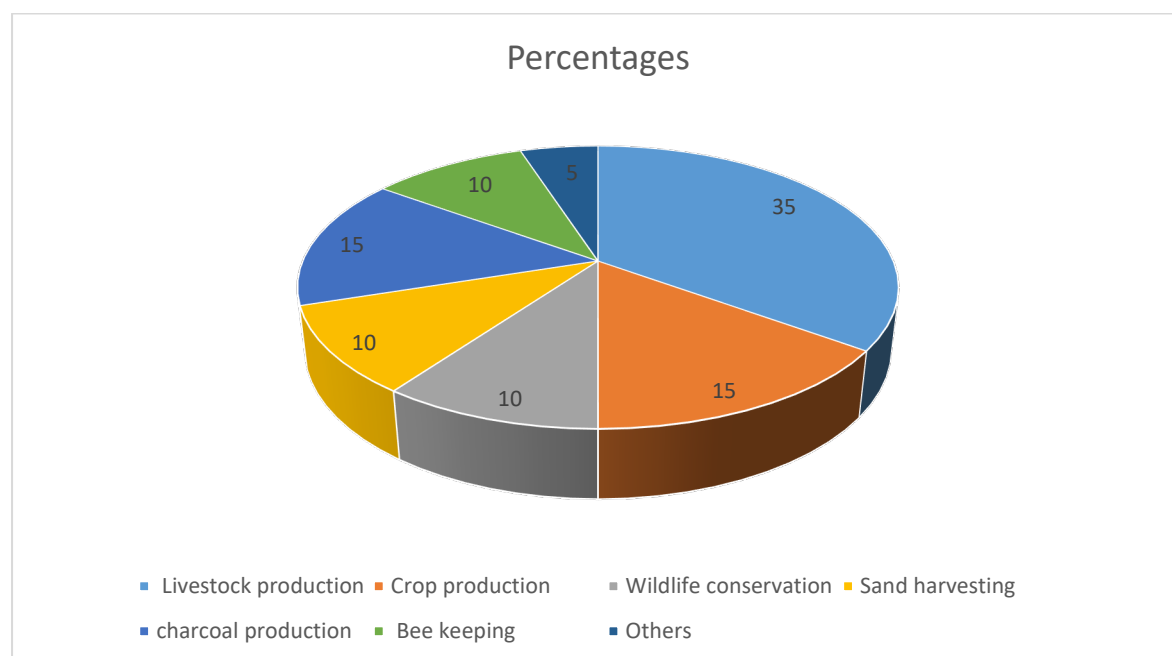


Figure 5: Respondents perception on the main economic activities in Kajiado County, Kenya

3.1.1 Production systems across the livestock, crops, and forestry sectors in Kajiado

Assessment of the main production systems for livestock, tomato and charcoal revealed that pastoralism was the predominant system of livestock production (86%). There was however evidence of agro pastoralism (13%) where farmers reared livestock under pastoralism but also did crop production. Other progressive farmers (7%) practiced zero grazing especially peri urban areas with smaller land sizes and higher demand for milk.

Tomato production in Kajiado County was done under intensive systems. Most actors produced tomato under open field irrigation (82%) while greenhouse farming was undertaken by 15% of the actors. This could be attributed to the cost of establishing and maintaining green houses. Only 3% of the farmers produced tomato through rainfed system especially in Kajiado South with relatively higher rainfall due to proximity to Mt Kilimanjaro. The results are as presented in Table 6. Other listed economic activities included apiculture done to supplement livestock

incomes as well as propel elephants from their farms. Tourism was practiced on parks within Kajiado such as the Amboseli and Tsavo National Parks as well as private lodges and group ranches that have hotels within Kajiado County. These institutions contribute to biodiversity conservation by working with communities to promote biodiversity conservation where part of the revenue is ploughed back to support communities to fund conservation initiatives such as tree planting, nursery establishment as well as apiculture.

Table 6: Production systems across the livestock, crops, and forestry sectors in Kajiado

Sector	Production system	%
Livestock	Pastoralism:	86
	Agro Pastoralism	13
	Zero grazing	7
	Paddock and feedlot	4
Crops (Tomato production)	Rainfed:	3
	Irrigation:	82
	Greenhouse production (horticulture)	15
Forestry sector (charcoal production)	Traditional kilns	100

3.2 Biodiversity assessment using the DPSIR Framework

The DPSIR framework was used to understand the drivers, pressures, State, Impact and Responses to biodiversity in Kajiado County. We used information from literature review and field work to describe the DPSIRs as well as in guiding the recommendations for voluntary commitments by actors in pastoralism, tomato, and charcoal production.

The main drivers to biodiversity losses in Kajiado County were associated with land tenure changes that caused changes in land use. Other drivers to biodiversity losses were population growth in the area, and economic development that changed the landscape from rangelands to human settlement areas and crop lands

The assessment revealed that biodiversity in Kajiado County was facing pressure from both economic development and land tenure associated effects. In Kajiado North and Kajiado East which are close to urban areas (Nairobi and Machakos), demand for real estate led to the conversion of the rangelands to homes. Heavy infrastructure development including the railway line, roads, and factories which either pass through/ are in the area negatively affected biodiversity especially trees and animals.

Land tenure changes has also been a source of pressure to biodiversity in the County, Community lands and group ranches have been converted to private ownership through land subdivision and titling to individual members. The process, although good for enforcement of property rights, still faces several challenges. Proper spatial plans are not followed during demarcation and land subdivision. As a result of this, riparian areas and wildlife corridors which are very key in biodiversity conservation have been allocated to private ownership. Farming in riparian areas lead to other negative effects such as increased erosion and surface runoff, filling up of water pans as well as general water scarcity.

The land tenure changes have also brought up land use changes in the County. There is increased demand for agricultural land to grow high value horticultural crops to supply the highly populated Nairobi and Machakos Counties. Farmers rent the subdivided lands, initially dotted with high value indigenous trees such as *Acacia tortillis* and *melifera*. The trees are then

clear felled to make room for agricultural land. The leasees have discovered that it is profitable to lease virgin land because of the high number of trees which can be converted to charcoal thus recoup a larger chunk of the rent investment.

Charcoal production is the predominant activity in the forestry sector. It is done using inefficient technologies (earth kilns). Indigenous species (*Acacia mellifera*, *Acacia tortilis*, *Balanites aegyptiaca*, *Acacia nilotica*, *Terminalia brownii*, *Acacia seyal*) are the most preferred species for charcoal production exerting pressure on the surviving plants. There was also evidence of increased invasive species such as the Mexican poppy weed and ipomea on clear felled bare lands initially forested lands that had been clear felled and converted to crop lands. The situation also leads to increased human wildlife conflicts as areas that used to be wildlife corridors, grazing and watering points are converted to human settlement and agricultural farms.

Increased demand of water for agriculture and household consumption has led to an increase in the number of boreholes sunk in the County. Respondents were concerned that borehole drilling permits were not issued procedurally following the recommended standards and were worried that this could deplete the aquifers if not well checked. Uncontrolled borehole development led to the drying up of boreholes up stream, this led to farmers abandoning the agricultural farms indirectly leading to increase in invasive species.

Due to the negative impact on biodiversity occasioned by land use land cover changes in Kajiado County, respondents believed that biodiversity was on the decline in the area. Overstocking and overgrazing in the rangelands led to degradation and severe decline in biodiversity in the rangelands. Intensive horticultural production characterized by heavy use of synthetic chemicals and fertilizers also negatively impacted on biodiversity within the County. Respondents believed that the severity of drought has been increasing in the last 10 years.

To cushion themselves against the negative effects of drought and biodiversity losses, different actors respond differently. Actors in the livestock sector (livestock producers) stated that they were selling small stock (goats) to buy pasture and fodder for the large stock (cattle). This left them more vulnerable since the goats were more adapted to the drought conditions than the cattle. Other farmers opted to sell their cattle which fetched little price of KES 20,000 for a bull that could go for KES 80,000 under normal conditions. Some farmers had moved their livestock to other areas within the region where pasture still existed to avoid more losses through livestock deaths

In the crops sector, there was evidence of increased number of boreholes to support farming. The irrigation was, however, mainly done under inefficient fallow irrigation systems instead of more efficient and precise drip irrigation. Demand for land close to rivers and along the riparian lands was also high because of water availability. Irrigation farming was perceived to be profitable and lucrative especially with availability of water.

There was also increased preference for charcoal production in the area as an alternative income source due to livestock losses because of drought. Statistics on the actual volumes of charcoal produced and sold in the region were however not available because of the existing logging and charcoal burning moratorium in public and community forests. All charcoal production in the region is thus illegal. It is however being practiced and transported to nearby Machakos and Nairobi Counties where there is ready market.

From the assessment, we recommend the following cross cutting strategies to mainstream biodiversity in the pastoralism, tomato, and charcoal production sectors in Kajiado County

Table 7: Cross cutting strategies for VCs in the livestock, crops and forestry sectors in Kajiado County, Kenya

S. No	Strategy	Sector	Scores (%)	Responsible actors
1	Capacity building of actors and improved awareness on the importance of biodiversity conservation and sustainability	Pastoralism, tomato, Charcoal production	40	<ul style="list-style-type: none"> • County governments • National government • NGOs • Community and religious leaders
2	Introduction of Payment for Ecosystem Services for biodiversity protection	Charcoal production	25	<ul style="list-style-type: none"> • Carbon market investors • Group ranch members and community • National and County governments
3	Tree growing on at least 10% of the total land area	Pastoralism, tomato, Charcoal production	15	<ul style="list-style-type: none"> • Landowners • Tenants • County government • spatial planning division
4	Training and capacity building on nature-based solutions as an economic activity i.e., ecotourism, bee keeping, medicinal trees and pasture production	Pastoralism, tomato, Charcoal production	10	<ul style="list-style-type: none"> • National and County governments • Research Institutes and Universities • Community members and group ranch officials
5	Strict adherence to spatial and land use plans during land adjudication and subdivision	Pastoralism, tomato, Charcoal production	5	<ul style="list-style-type: none"> • National and County governments • Landowners • Community leaders
6	Introduction of sustainability standards and certification to track the effect of the economic activities on biodiversity	Pastoralism, tomato, Charcoal production	5	<ul style="list-style-type: none"> • Consumers • Producers • Traders

				<ul style="list-style-type: none"> • National and County governments
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Specific sectoral recommendations are outlined in the next section starting with the livestock (pastoralism), crop (tomato production) and forestry (charcoal production) sectors.

3.3. Livestock sector (Pastoralism)



3.3.1 Situation Analysis in Kajiado County

Kajiado County is composed mainly of livestock-based pastoral economy, pastoralism is practiced as a form of savings, source of food, financial capital, and the basis of wealth description. The cattle breed majorly produced are Borans, Sahiwal and Zebu with the population of beef cattle being estimated at 581,020. The approximate slaughter value in 2016 was Ksh 2,048,765,278.00.

Opportunities for pastoral farmers immensely depend on the livestock assets that they own. However, pastoralists do face social, economic and environmental challenges that hinder their capacity to harness these opportunities for example, during the 2017/2018 prolonged drought, Kajiado County recorded 232,400 livestock deaths, most of them while searching for pasture.

3.3.2. Impact and pressures of livestock and pastoralism biodiversity (Focus on Kajiado)

The livestock sector affects biodiversity directly and indirectly through its effect on plants biodiversity, population, and ecosystems particularly the rangelands. The overall driving causes of biodiversity losses in the sector include increasing demand and consumption of animal products (meat, milk, and eggs) in Kenya and beyond that leads to habitat change and

over exploitation due to poor grazing management practices (MEA, 2005). Negative impact of the livestock sector on biodiversity includes unsustainable grazing impact on plants and animals when livestock populations expand. Direct effects of the livestock sector on biodiversity include conversion of previously forested lands to pasture, increased emissions of methane and other GHGs, expansion of land under feeds, trampling and grazing (Broom et al., 2013). The effects, however, depend on the magnitude of exposure to the threat, how sensitive biodiversity is to livestock and how biodiversity responds to the impact. Lack of adherence to grazing management plans and sustainable stocking rates has led to degradation and biodiversity loss in Kajiado County due to overgrazing and overstocking.

Unlike private ranching in Kenyan drylands, pastoralism is characterized by communal land tenure, informal, traditional livestock production and extensive pastoralism (Ndiritu, 2020). The pressures to biodiversity caused by this sector as well as its economic contribution in Kenya and developed value chain make it a good candidate for further analysis. Some of the best practices that can be adopted in pastoralism include social fencing, carrying capacity, grass banking, livestock fattening, diversification of income and restoration activities such as tree planting around the watering points as detailed in the response section.

3.3.3 Mapping of the value chains actors and stakeholders in pastoralism

Most of the cattle in Kajiado especially for pastoralists are used for both beef and milk production

3.3.3.1. Beef value chain

The beef value chain is as described in **Figure 6**.

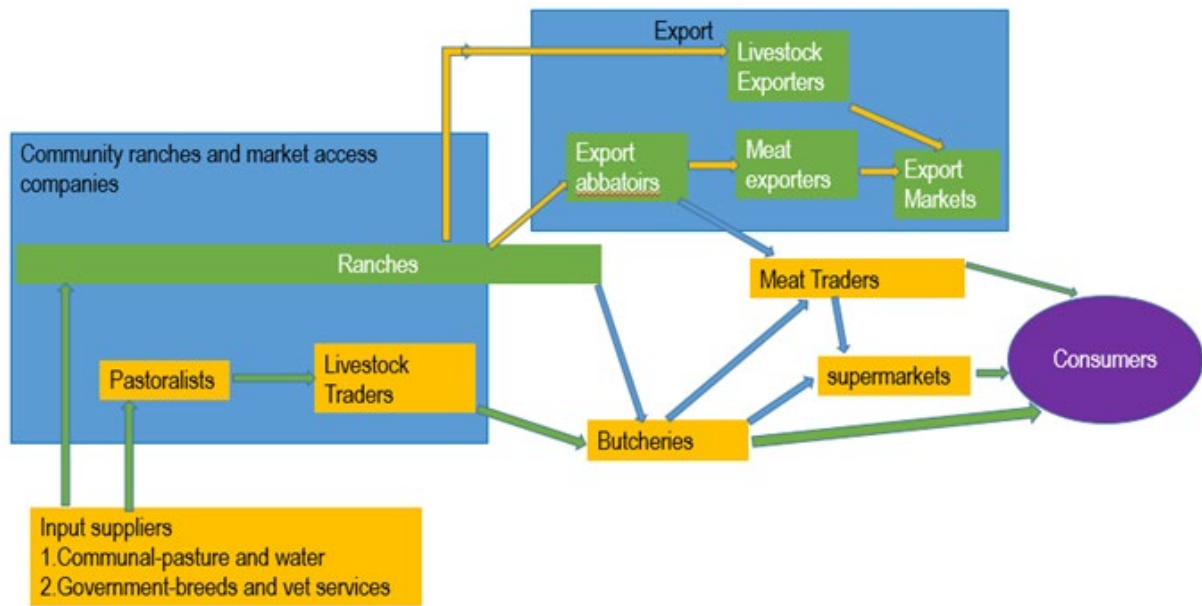


Figure 6: Beef value chain in Kajiado County adopted from Katiku et al. (2013) with minor modification

Inputs suppliers

Inputs to the extensive pastoral production beef value chain include water, pasture, feeds, veterinary services, livestock breeds and labor. Water for livestock is supplied in different ways, including from community boreholes, communal or private water pans and wells, rivers, and swamps.

Pasture for livestock takes the form of communally and individually owned rangeland. Where pastures are managed communally, there is active rangeland management and restrictions on grazing are placed on certain pastures for dry season use. Some portions of land are used for grazing during the wet season, and when permission is granted by the grazing committee, livestock are allowed to move to the dry season grazing zone. On the individually owned land, in private owned pasture resources, farmers fence and exclude other livestock.

Access to veterinary services in both field sites in Kajiado County is poor with insufficient coverage of veterinary or animal health services. Government provision of veterinary services is weak with few county's veterinary officers considered available within the area. Livestock drugs are available from local agro- vet shops and suppliers at the local weekly markets.

Cattle breeds in both sites are a mixture of indigenous, exotic and cross-breeds. Producers are investing in exotic or improved breeds and cross-breeding their local indigenous Zebu cattle with Sahiwal and Borana for a higher market price.

Producers

The main producers are pastoralists and agro-pastoralists. Livestock are individually owned, although they may be either individually managed or managed together with livestock herds belonging to kin or neighbors. Some pastoralists belong to group ranches however, the group ranches in Kajiado are diminishing with time due to subdivision of land. Pastoralists are not commercially oriented, and livestock are kept as cultural assets to be sold only when necessary (KMT, 2014), mainly responding to the cash needs of a household rather than for profit-making opportunities, where pastoralists will usually sell their animals when they are in most need of cash for school fees, food purchases, health and veterinary costs, but rarely with the market in mind (KMT, 2014). The recurrent drought in Kajiado has forced farmers to rethink their production models and are now shifting to sustainable stocking and controlled production systems such as paddocking, zero grazing and feedlots

Livestock Traders

Livestock traders and brokers act as important market connectors along the value chain. Some traders buy weak livestock especially during the drought, fatten and sell them out. Traders buy cattle from producers at home or at primary or secondary markets and move them to terminal markets to sell to buyers. Small- scale primary (itinerant) traders purchase small numbers of cattle from pastoralists and sell them to secondary traders. Secondary traders purchase larger numbers of cattle from producers and itinerant traders and sell them at the terminal markets.

Traders may be full time traders or even producers themselves. Traders' mark-up the price of cattle as they sell them on to other traders and slaughterhouses and can accrue good margins. Livestock traders deal with live animals and need to have sufficient capital to buy livestock. They often sell livestock on credit to trusted meat suppliers. Livestock traders deal with live animals and need to have sufficient capital to buy livestock. They often sell livestock on credit to trusted meat suppliers.

Livestock trading occurs every day at the terminal slaughterhouses and on selected days in the primary and secondary markets. Market days usually occur on subsequent days as the animal moves from the primary market up through the secondary markets towards the terminal markets in Nairobi. Animals are also just bought and sold between pastoralists, either at the market or at home, and do not enter further markets along the chain.

Processors

There are two main types of processors in Kenya. The first are the high-end processors usually owned by well-known consumer brands such as Choice Meats, Quality Meat Packers or Alpha Fine Foods, that focus on premium quality fattened meat from quality breeds. These processors

are large scale and are mainly found in Nairobi. They typically offer value added services and products that are then distributed to high-end butcheries, supermarkets and large retailers. The second are the low-end butcheries that serve the informal market (local butcheries and wholesale markets).

Domestic markets

Meat may pass through several different channels depending on the quality and price of the meat. The meat trade and meat value chain are mostly carried out in Nairobi. Actors in the meat chain include meat traders, meat suppliers, butchery owners, as well as traders and retailers that deal with offal and other by products. Meat traders purchase livestock slaughter and transport meat to wholesale meat markets, butchers, processors and supermarkets. Meat traders can control prices according to supply and demand. Meat suppliers are meat traders who supply meat to butchery owners, institutions, schools and hospitals on a pre-arranged price and schedule. They either purchase livestock for slaughter or purchase meat from other suppliers. Butchery owners obtain meat from traders and suppliers for sale to consumers. They also frequently buy livestock directly from producers and convert them to meat. Butchers obtain meat from the slaughterhouses and processors either directly or through wholesale meat markets and meat traders. Butchers may purchase cattle directly from markets and slaughter themselves or they use the slaughter services offered by slaughterhouses and abattoirs. Butchers are thus both processors and retailers working across different stages of the value chain.

Butcheries are differentiated in terms of level of sophistication and price structure. At the lower end, butcheries purchase 'hot meat' that has been slaughtered on the day of purchase and is not refrigerated during transport or after it reaches its final point of sale. These involve meat kiosks rented to traders by Nairobi City County like in Burma Market. Buyers visit the market to purchase meat, but others decide to have it supplied to their shops. The kiosks cover a range of functions and products: Meat wholesalers who sell on to retailers to sell to consumers; different retailers that sell different specialized products, such as deboned meat, intestines, heads, hoofs, shoat meat and fish; and retailers that cook meat (roast, boiled or fried beef, goats and fish) for consumers who come to the market to purchase and eat cooked meat. At the middle-income level are the more evolved formal butcheries. These are larger and can offer a greater variety of cuts and can store meat for sales in subsequent days. At the high-end, meat goes to supermarkets, high-end butcheries, hotels, and restaurants. These target high-end consumers and sell high margin, value-added red meat products.

Consumers can be segmented according to their income levels, which determines their meat preferences, willingness-to-pay and meat consumption behavior (KMT, 2014). The highest income consumers, although representing a low percentage of the population, have a high meat consumption capita per year. In contrast, the lowest income consumers represent most of the total population yet have a low meat consumption capita per year.

3.3.3.2. Milk value chain

The milk value chain is divided into two, the formal and informal channels **Figure 7**.

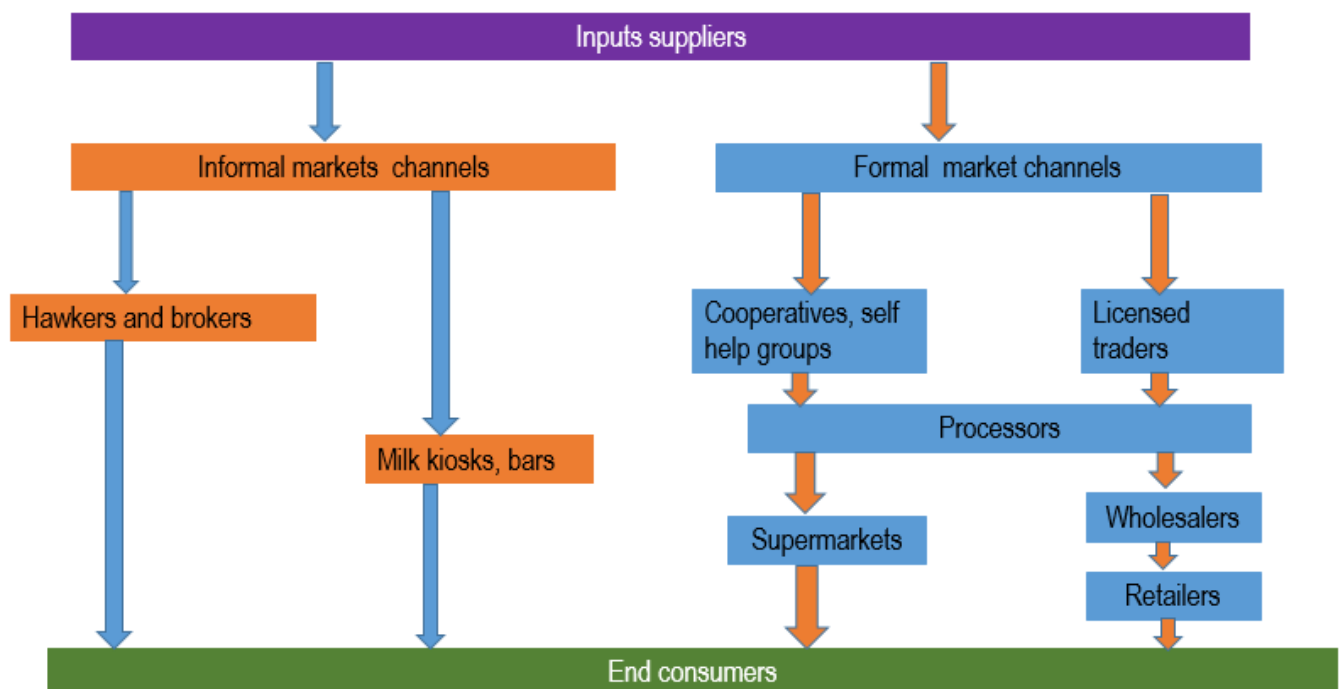


Figure 7: Milk value chain in Kajiado County (Source: Consultants conceptualization)

Inputs supply

The inputs supply for the dairy production is like that of beef as detailed above.

Production

Dairy producers in Kajiado County are majorly women. The producers are mainly pastoralists and agropastoral. The mode of production is like the beef production as detailed above.

Milk marketing

Informal channel

In the informal channel, the producers sell milk directly to consumers who are their neighbours or to the nearby shopping centre milk kiosks and bars where the consumers come to buy milk

in different quantities. In other instances, producers sell milk to brokers and hawkers who in turn sell to the consumers.

Formal channel

Here the producers sell the milk to licenced milk traders or to dairy cooperatives and self-help groups who sell the milk to processors. Like any other part in the country, producers in different regions within Kajiado County have formed dairy cooperatives with the help of the county government. Different processing companies located mainly in Nairobi have milk collection days in a week when they pass around different collection centres to collect the milk. These processors include New Kenya Cooperative Creameries (NKCC), Brookside, Tuzo, Fresha etc. The processors make different milk products such as yoghurt, cheese, butter, fermented, powder and processed milk packaged in different quantities. The processors sell their products to traders such as wholesalers and supermarkets. The supermarkets sell the milk directly to consumers while wholesalers sell to retailers managing shops and kiosks who sell to consumers.

All the actors in the livestock value chains can engage in the VCs as each has a role to play. The producers can be involved in sustainable production models as they have been awakened by the adverse effects the drought has on their livestock. The traders can help in fattening of livestock through buying the weak and low-quality livestock during drought. The processors and consumers can play a major role in certification standards of both meat and milk products.

3.4 Strengthen the transformative role of the national framework towards a sustainable Livestock sector (Policy and legislative environment)

The Kenya's Range Management and Pastoralism Strategy (2021 –2031) highlights strategies aimed at providing long term solutions to rangeland degradation and low productivity for the benefit of pastoral communities and the economy of Kenya. The strategies are: Awareness and capacity building on land ownership, settlement plans, livestock grazing plans, by-laws, traditional knowledge and ecosystem functions; conservancy rangelands governance; grazing planning and management; rangeland rehabilitation; settlement planning; grassland carbon project and research and monitoring (MoAL, 2021) A report by the World Initiative for Sustainable Pastoralism (2008) profiled policies that had worked for and in particular in six different countries. Some of the measures identified both for Kenya and other jurisdictions that would promote sustainable range management and pastoralism include community adopting appropriate breed choice and feed conservation among others. The adoption of appropriate breed choice as well as the feed conservation can be done by the pastoralists with the help of

the county government through awareness and capacity building. The appropriate breeds can also be developed by the national government through research by Kenya Agricultural and Livestock Research Organization (KALRO).

County governments in arid and semi- arid areas can support enhanced livestock productivity by strengthening their extension work in pasture production, organized grazing, and controlled breeding management. Strategic county feed reserves should be established to buy fodder grass from farmers and redistribute it during periods of drought, thereby reducing livestock mortality. Awareness creation should be made to the pastoralists on livestock production for commercial purposes and not only as a cultural venture. Livestock fattening by pastoralists should be encouraged by the extension workers. This will help in revenue generation.

3.5 Recommendations: Scenarios of commitments for livestock sector

Livestock production is the main economic activity in Kajiado County. Pastoralism is the dominant production system. Changes in land tenure systems from communal to private ownership, land subdivision, increased population, and conversion of land to settlement areas are among the main challenges to pastoralism production.

Lack of adherence to grazing management plans and sustainable stocking rates has led to degradation and biodiversity loss in Kajiado County due to overgrazing and overstocking. This increases the vulnerability to climate shocks such as drought through increased livestock deaths during drought. To reverse this, we recommend the following scenarios for voluntary commitments in the livestock (pastoralism) model to promote sustainability, biodiversity conservation and profitability in the pastoralism sector. The options are as listed in Tables 8 and 9

3.5.1 Build capacity and create awareness to actors

To achieve the objectives of the recommended strategies above, there is need for improved awareness and capacity building on the linkages between pastoralism, biodiversity, and economic returns. Most producers in Kajiado keep livestock as a way of life. They do not perceive pastoralism in a commercial way, and each would prefer to keep as much a large herd size as possible. That in turn leads to overstocking, overgrazing and great loss during drought. Farmers can be capacity build on sustainable livestock production management including stocking and marketing. Key actors to support this on a voluntary basis include national and county government departments, NGOs, the private sector, and farmers.

3.5.2 Develop and adhere to grazing management plans

Another strategy for voluntary commitments in the livestock sector (Pastoralism) is development and adherence to grazing management plans especially for the communal lands and group ranches. The strategy will contribute to sustainable utilization of the rangelands by following clearly documented grazing plans. This approach is common among the group ranches such as (Kuku A and B) in Kajiado South. The major challenge however remains its implementation because of inadequate capacity to enforce the guidelines. Some of the actors recommended to ensure the success of the strategy are pastoralists, County and national government, group ranch leaders, and NGOs working in the ASALs. The strategy will contribute to efficient management of common grazing lands, improved forage production, increased profitability among pastoralists as well as improved biodiversity in the rangelands.

Land tenure has been shifting from communal to private ownership in most parts of Kajiado County. This presents an opportunity for mainstreaming biodiversity in the livestock sector because of the associated property rights effects of private land ownership. Respondents indicated that with private land ownership, they can now fence their land and plan it accordingly by stocking only what the land can carry efficiently as well as plan for conservation areas. Some of the sites visited on Kuku ranch showed that fencing alone can improve biodiversity richness of an area as shown by the Moilo women group in Kuku ranch.



An example of how fencing and grass reseeding can help improve biodiversity in the rangelands, An Initiative by Moilo Women Group, In Kuku Group Ranch, Kajiado County

3.5.3 Adoption of alternative pastoralism models

There was evidence of increased controlled livestock production models occasioned by the recent drought and increase in private land ownership in the area. Alternative models of livestock production such as paddocking, agro pastoralism, conservancies and ranching could support biodiversity conservation in Kajiado since producers decide on the number of livestock to keep, how much to sell, when to sell depending on the season and the feed stock. This however require capacity building for behavioural change as currently, farmers keep livestock for both cultural and sentimental reasons. They are so attached to livestock and only sell when it is extremely necessary. This leaves much risk especially during periods of droughts when entire herds are wiped out.

Conservancy models, done either as a group or individually is another alternative to improve both profitability and sustainability in the livestock sector. With proper planning, conservancies can accommodate both livestock, wildlife, and biodiversity. The Kuku ranch in agreement with the Masai Wilderness Conservation Trust are using the model where a proportion of their land has been totally left for conservation purposes where restoration initiatives such as grass reseeding is taking place. This model also accommodates other nature-based enterprises such as bee keeping and ecotourism that serve as additional income to community members. Participation and buy in by community members is however critical for communal conservancies. This is promoted by transparent and fair benefit sharing to the community members to see the value of conservation in promoting their livelihoods.

3.5.4 Tree growing on at least 10% of the total land area

Development and promotion of tree species suitable for rangeland restoration such as *Acacia tortillis* and *Melia volkensii* is key to improving tree/ forest cover. as well as biodiversity in the rangelands. The culture of tree growing is not pronounced in the rangelands where community perceive forests as having the ability to regenerate on their own. The problem is further compounded by overgrazing and overstocking where any surviving saplings are either browsed or trampled by livestock. Over the recent periods though, pastoralists have been showing increased interest in tree growing and use of natural regeneration methods in the rangelands. This is especially because of the cushioning effect of trees through providing pasture and fuel wood during drought periods.

3.5.5. Adoption of Sustainable stocking rates

The pastoralism model of livestock production is characterized by overstocking and overgrazing because of public nature of the grazing lands (Non excludable). Overdependence

on common grazing lands leads to overstocking during the rainy season which in turns causes overgrazing of the rangelands and degradation of the rangelands and loss of biodiversity. The problem is further exacerbated by cultural beliefs among pastoralists where the more the livestock one has, the higher the perceived status in the society. This situation is further aggravated by communal land tenure systems which are common among pastoralists. Some of the impacts of overstocking include loss of biodiversity, emergence of invasive species, degraded pasture lands and increased soil erosion. The government has been using livestock offtake programmes to purchase livestock from farmers especially during drought periods. Adoption of sustainable stocking rates is expected to improve vegetation cover and biodiversity in the rangelands, reduce soil erosion and degradation thus improved profitability from livestock production. Actors to be involved in programmes to ensure sustainable stocking rates are extension service providers, pastoralists and NGOs working in the rangelands

3.5.6 Certification schemes for animal feeds and products

Development and adoption of certification and standardization schemes was also proposed as a strategy for mainstreaming biodiversity in key economic decisions concerning livestock production and marketing. The market-based approach would be used to guarantee that livestock products (meat and dairy) were produced in a sustainable, secure, and safe manner. Consumers could be made aware of an existing biodiversity standard on products to signify that the products were produced in a biodiversity friendly approach. If the strategy is bought by the product consumers, the producers will adjust accordingly to access the markets.

Table 8: Recommendations: Scenarios of commitments for livestock sector

Voluntary commitment	Driver	Pressure: Problem addressed	State	Impact of the problem	response	Actors	Expected change	Broad indicator
Short term								
Build capacity and create awareness to actors	-Low capacity and awareness on sustainable use of rangelands -Land tenure system -Cultural beliefs	-Inadequate extension service providers -Inadequate knowledge on the impact of pastoralism on biodiversity and how to mitigate	Overstocking -Low forage production -Degraded rangelands -Vulnerable communities	-Reduced livestock productivity -Invasive species - Biodiversity loss -Reduced pasture/ forage	-Improved awareness -Improved capacity on sustainable use of rangelands	-County Government -National government -NGOs/CSOs -Private sector	-Improved ecosystem health and biodiversity richness -Increased forage production -Increased livestock production -Reduced degradation	No of extension service providers capacity built % of pastoralists capacity built Level
Mid term								
Develop and adhere to grazing management plans	-Lack of documented grazing plans -Inadequate implementation of existing grazing plans	-Overgrazing -Overstocking	-Degraded rangelands -Invasive species Soil erosion	-Livestock death -Loss of incomes - Degradation - Biodiversity loss	-Efficient management of common grazing lands	-Pastoralists -County government -National government -Community and group ranch leaders -Local administration	-Improved health of rangelands -Improved forage production -Increased plant and animal diversity	Number of grazing plans developed % of pastoralists who adhere to the grazing management plans % of pastoralists aware of the plans
Adoption of alternative pastoralism models	-Unsustainable livestock	-Overgrazing	-Degraded rangelands	-Loss of livestock	-Optimized livestock	-Pastoralists	-Increased forage production	-No of alternative models available

Voluntary commitment	Driver	Pressure: Problem addressed	State	Impact of the problem	response	Actors	Expected change	Broad indicator
	production models	-Degradation and loss of biodiversity	-Soil erosion	- Biodiversity loss	production (reduced losses) -Improved hay production and conservation, Feedlots, Paddockings -Adoption of improved livestock breeds under intensive systems -Social fencing -Agro pastoralism - Silvopastoralism	National and County governments -Private sector	-Improved livestock productivity -Reduced degradation -Improved soil fertility	-No of alternative models adopted % of pastoralists adopting the models
Tree growing on at least 10% of the total land area	-Overgrazing -Overstocking	-Degraded rangelands -Loss of biodiversity	-Degraded rangelands -soil erosion	-Loss of existing seedbanks for natural species	-Establishment of more tree nurseries with dryland species -Adoption of tree growing in degraded rangelands by pastoralists	-Pastoralists -National/ County government department responsible for forestry -CSOs NGOs	-Improved tree cover in the rangelands -Improved livestock pasture/ fodder -Improved forest/ tree cover in the rangelands	
Long term								
Adoption of Sustainable stocking rates	-Overstocking - Overgrazing	- Unsustainable stocking rates -Degradation of rangelands	-Highly threatened species	-Loss of vegetation cover	-Livestock offtake programs -Improved capacity to deal	-Extension service providers -Pastoralists	-Improved vegetation cover -Reduced soil erosion	% of pastoralists adopting recommended stocking rates % reduction in herd size

Voluntary commitment	Driver	Pressure: Problem addressed	State	Impact of the problem	response	Actors	Expected change	Broad indicator
		-Biodiversity loss	-Reduced food and feed security -Weak capacity to deal with drought	-Emergence of invasive species -Reduced natural resource base -Degraded pasture and -Increased soil erosion	with climate shocks (drought)		-Improved profitability -Reduced degradation	
Certification schemes for animal products	-Overstocking -Overgrazing	-Lack of traceability of animal products -Negative impacts of pastoralism on biodiversity	-Poor quality of animal feed -Inadequate monitoring and traceability of feed and products	-Reduced productivity - Biodiversity loss -Degraded rangelands	-Development and adoption of certification schemes -Enforcement of certification Bio-labelling	-Consumers -Livestock producers -Businesses	-Conserved rangelands -Quality food, feed and products	Adoption levels of certification schemes

Table 9: Opportunities and challenges to voluntary commitment in the livestock sector (pastoralism)

Voluntary commitment	Opportunity	Barriers	Mitigation measures
Build capacity and create awareness to actors	-Improved knowledge and capacity of farmers on sustainable livestock production -Improved biodiversity in the rangelands	-Inadequate knowledge on sustainable livestock production	-Trainings and dissemination on the benefits of sustainable livestock production to the rangelands and biodiversity
Develop and adhere to grazing management plans	-Improved pasture for livestock -Improved farmer profits and incomes -Improved biodiversity in the rangelands	Poor spatial planning Culture and traditions	-Capacity building on development and enforcement of grazing management plan guidelines
Adoption of alternative pastoralism models	-Improved pasture for livestock -Improved farmer profits and incomes -Reduced pressure for pasture in the rangelands -Improved biodiversity in the rangelands	-Culture and traditions -Lack of appropriate knowledge on alternative livestock production	-Peer to peer learning -Exchange visits
Tree growing on at least 10% of the total land area	-Improved tree/ forest cover -Improved biodiversity in the rangelands -Improved incomes/ profitability of pastoralists	-Culture and tradition that does not promote tree growing in rangelands -Overgrazing -Overstocking	-Promotion of dryland agroforestry/ cSommercial tree species for growing by pastoralists
Adoption of Sustainable stocking rates	-Improved pasture for livestock -Improved farmer profits and incomes -Improved biodiversity in the rangelands	-Culture and traditions	-Awareness creation and training on the benefits of sustainable stocking rates

Certification schemes for livestock and livestock products	<ul style="list-style-type: none"> -Improved traceability for biodiversity effects across the livestock value chain -Improved biodiversity in the rangelands 	<ul style="list-style-type: none"> -Inadequate frameworks to support certification and standardization of livestock and livestock products for biodiversity -Lack of incentives to encourage mainstreaming of biodiversity effects in livestock production systems 	<ul style="list-style-type: none"> -Design and development of certification schemes for biodiversity in the livestock sector -Design incentives for biodiversity friendly activities across the livestock value chain
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4.0 Crops sector (Tomato production)



Intensive tomato production (green house) in Isinya, Kajiado, County

4.1 Introduction

Dryland agriculture accounts for 3% and 7% of the agricultural and commercial outputs respectively in Kenya (Barrow and Mogaka, 2007). Crop production in the Kenyan drylands is mainly done for local consumption at the household level. A variety of crop types including maize, sorghum, millet, green gram, cowpeas, pigeon peas among others are grown under rain fed systems in the ASALs of Kenya (Nguluu et al., 2014).

Though there is evidence of expansion and intensification of crop production in the ASALs, there is still limited literature to support the magnitude, scale, and economic potential in the Kenyan ASALS except in Kajiado and Laikipia Counties. In Kajiado County, approximately 1,055 ha of land is cultivated with food crops such as maize, sorghum, finger millet, beans, cowpea, green grams, tomatoes, bulb onions amongst others (MoALF, 2017).

Horticulture is also gaining popularity through irrigation schemes mainly in Kajiado Central and North Sub counties. According to the ASDSP Agribusiness Baseline Survey Report of 2014, commercial farming of onions and tomatoes is undertaken throughout the county though some are in small quantities. Tomato production is majorly done in Kajiado South in Kimana, Rombo and Oloitoktok under small-scale mixed farming. Large scale production is mainly undertaken under rain fed system which is slowly becoming unpopular because of irregular rainfall patterns. The value of tomato production in Kajiado was estimated at approximately KES 989,740,000 in 2015 (MoALF, 2017). There is great potential for tomato production in Kajiado County, it is however important to ensure mainstreaming of biodiversity in key tomato

planning decisions to ensure the expansion does not negatively impact key biodiversity (especially indigenous tree species) in Kajiado County.

4.2. Assessment of the Drivers, Pressures, State, Impact and Responses to biodiversity (DPSIR) in the tomato value chain

The main horticultural products grown in Kajiado County are tomatoes, bulb onions and watermelon in addition to other crops. Our observations from the field revealed that horticultural production, was one of the leading causes of biodiversity loss in the county. It was observed that most farmers interviewed (73%) were not the actual landowners but tenants who had leased the lands for intensive irrigated tomato production. Their main objective was to maximize productivity during their lease period thus were least concerned of biodiversity protection in the farmed lands. It was also noted that horticultural production was practised on small to medium scale with majority of the famers using boreholes (80%) as the source of water for irrigation. The sector is characterized by heavy use of chemicals (pesticides) and synthetic fertilizers which adversely affect the biodiversity. The negative effects of pesticides are not just around application. Runoff and pesticide drift can carry pesticides into distant aquatic environments or other fields, grazing areas, human settlements and undeveloped areas. Other problems emerge from poor production, transport, storage and disposal practices. Over time, repeat application of pesticides increases pest resistance, while its effects on other species can facilitate pest's resurgence (Damalas and Eleftherohorinos, 2011) Alternatives to heavy use of pesticides, such as integrated pest management, and sustainable agriculture techniques such as polyculture mitigate these consequences, without the harmful toxic chemical application.

The best way of addressing the pressures of tomato production on biodiversity is through regenerative agriculture which is a conservation and rehabilitation approach to food and farming systems. It focuses on topsoil regeneration, increasing biodiversity, improving the water cycle, enhancing ecosystem services, supporting bio sequestration, increasing resilience to climate change, and strengthening the health and vitality of farm soil. Practices such as recycling of farm waste and adding composted material from sources outside the farm could be promoted to improve soil health and fertility in tomato production. Regenerative agriculture on small farms and gardens is often based on philosophies like permaculture, agro ecology, agroforestry, restoration ecology, keyline design, and holistic management (Schreefel *et al.*, 2020). These practises are however not adopted by producers because of their implication on cost and labour while the market does not differentiate between sustainably vs unsustainably produced tomatoes. There is thus need for actors along the tomato value chain to re assess the impact of the various value chain activities on biodiversity and promote measures that promote biodiversity conservation and sustainability. The market should also be able to distinguish between sustainably vs unsustainably produced tomatoes with a premium attached to it that can be used to support biodiversity conservation initiatives in the tomato sector.

4.3 Mapping of the tomato value chain in Kajiado County

Mapping of the tomato value chain in Kajiado County was done to understand value chain activities, actors, their institutional context, and interactions and results represented in Figure 8.

Tomato production in Kajiado is undertaken under intensive farming with greenhouse tomato production predominantly practiced in Kajiado East and North while open field irrigated tomato is found in Kajiado West and South. Kajiado County is the second highest tomato producing county after Kirinyaga. It accounts for approximately 9.1% of total production in the country. In 2013, the area under tomato production in Kajiado was 1,603Ha valued at approximately KES 921 million with the acreage increasing to 1,680Ha valued at KES 1.62 billion in 2014 (AFFA, 2014). Value chain actors include input suppliers and other service producers, Producers (small scale commercial, large scale commercial, small scale mixed farming and small scale mono cropping), traders (retailers, whole salers and cross border traders), processors and consumers.

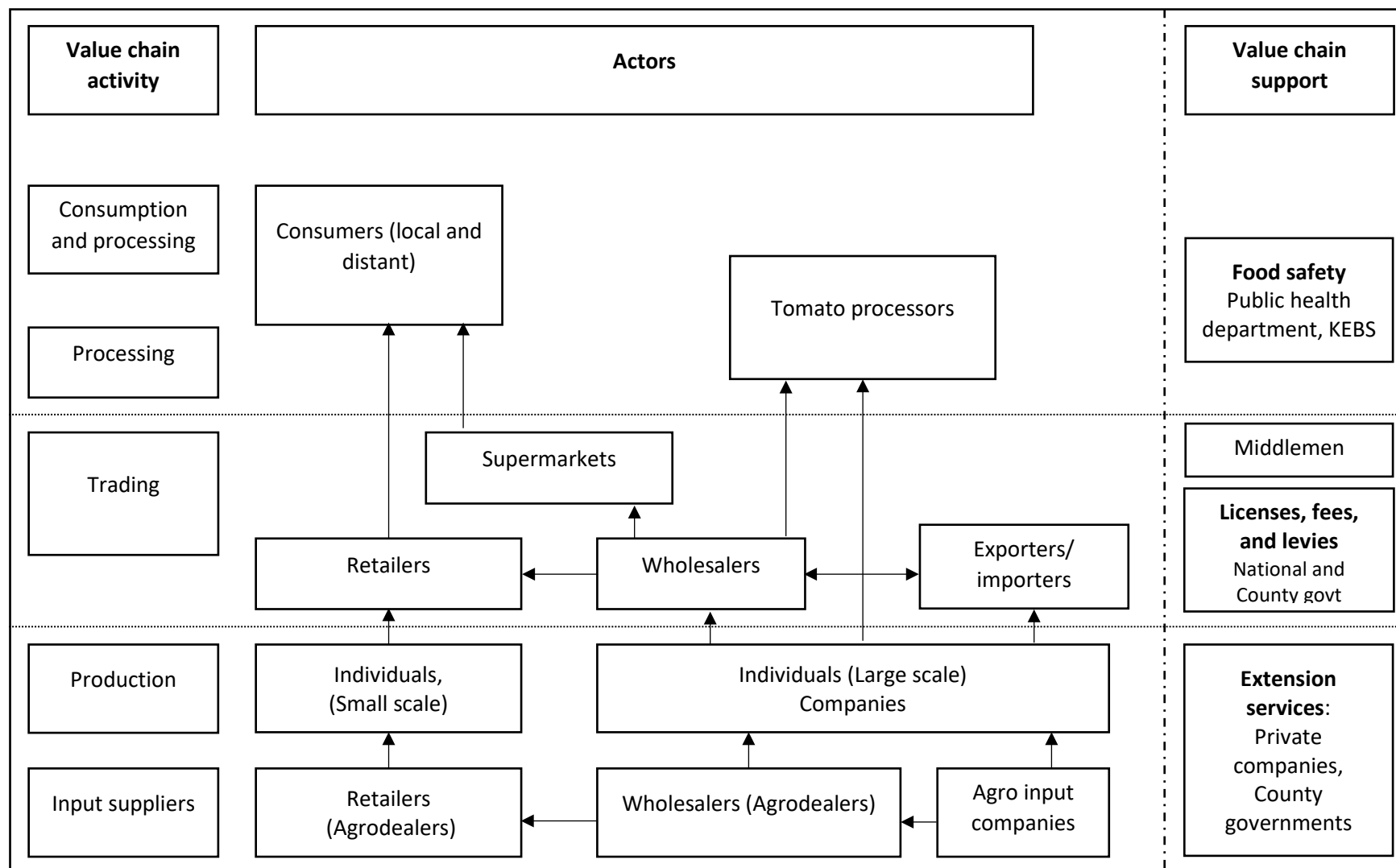


Figure 8: Tomato value chain in Kajiado County

In Kajiado County, the main suppliers of inputs are retail agro dealers who buy their products from wholesalers and agro input companies. The agro dealers do not specialize in tomato inputs only but target other horticulture and non-horticulture crops, as well other veterinary products. The agro shops concentrated in major urban centres and towns such as Isinya, Kajiado and Loitoktok

Tomato production is mainly carried out by individual farmers on small to medium scale with a few large-scale producers. The production is mainly done under irrigation using fallow or drip irrigation with boreholes being the main source of water. The producers are majorly nonlocals (eg Kamba, Kikuyu and Kisii) who lease land from private land owners for a specified number of years for horticultural production. Under the arrangement, the borehole belongs to the landowner who leases the land to the tenant, where the tenant uses the water for irrigation.

Tomato traders within the county involve wholesalers, retailers and a few exporters/ importers who sell tomatoes to other East African Countries such as Tanzania, Uganda, Rwanda and South Sudan or import the tomatoes from outside Kenya during periods of deficit. Farmers mainly sell their produce to either wholesalers, retailers or exporters at the farm gate. Prices at farm level mainly vary depending on the season and the supply/ demand conditions. Retailers mainly sell their tomatoes to consumers in urban centres and institutions (schools, restaurants) within the locality. Wholesalers sell their tomatoes to retailers within and outside the county as well as processors and cross border traders depending on market availability. The cross-border traders then sell to the external markets. The main markets for Kajiado tomatoes are located in major cities and towns such as Nairobi and Mombasa who sell them to consumers. The traders sell their produce in fresh produce markets such as Kongowea in Mombasa and Marikiti in Nairobi. Other wholesalers and big producing companies sell their tomatoes directly to supermarkets within Kajiado as well as Machakos, Nairobi and Mombasa.

Tomato processing mainly occurs in big towns such as Nairobi and Mombasa though on a very low scale where (<10%) of the total tomatoes produced in Kajiado is processed. The rest is directly sold to consumers in the markets within and outside the County. Companies such as Premier Foods Ltd and True Foods Ltd process tomatoes to different products such as pastes, juices, and sauces. The products are sold to Supermarkets, wholesalers, and retailers as well as in external markets. Tomatoes are consumed at household levels, establishments such as hotels and restaurants, schools etc as fresh tomatoes as well as processed products such as sauce and pastes.

4.4 Strengthening the transformative role of the national framework towards a sustainable crop sector: Policy & regulatory environment for the crops sub sector

The National Biotechnology Policy (2006) - adopted following Kenya's signing of the Cartagena Protocol on Biosafety in 2000 and the ratification requirements in 2003 - stresses the role of biotechnology as a lever for poverty reduction, food security, and conservation of the environment. The policy identifies industry and trade as key areas for using biotechnology, there is need to also ensure biotechnology does not contribute to biodiversity loss in the tomato sector in Kajiado. The National Horticulture Policy (2012) was developed to ensure the growth and competitiveness of the horticultural industry is sustained into the future. The policy considers promotion of physical markets, their management, the entire marketing function, and maintenance of standards to promote domestic horticultural market as well as advance the export market. Measures at ensuring both socio-economic and environmental sustainability are given prominence in the policy, It is key to ensure mechanisms that incentivise actors in the

tomato value chain to adopt biodiversity friendly activities to ensure sustainability in the value chain. The Crops Act (2013) provides for the growth and development of agricultural crops and aims at accelerating the growth and development of agriculture in general, enhancing productivity and incomes of farmers and the rural population, improving investment climate and efficiency of agribusiness and developing agricultural crops as export crops that will augment the foreign exchange earnings of the country, through promotion of the production, processing, marketing, and distribution of crops in suitable areas of the country. The Agricultural Produce (Export) Act (CAP 319 revised in 2012) provides for the grading and inspection of agricultural produce to be exported, and generally for the better regulation of the preparation and manufacture thereof. The act covers: Restriction of export of agricultural produce, prohibition of export of unsound produce, seizure and destruction of agricultural produce intended for export. The Plant protection Act (Cap 324) provides for the prevention of the introduction and spread of disease destructive to plants. The Act further empowers the Kenya Plant Health Inspectorate Service to issue Phytosanitary certificate before export of plants or plant parts. The Suppression of noxious weeds act (Cap 325) provides for the suppression of noxious weeds and empowers government officials to enter areas where gazetted noxious weeds, especially invasive ones are found and control them.

The Seeds and Plants Varieties Act (Cap 326) governs the protection of new plant varieties in Kenya. Under the Ministry of Agriculture, KEPHIS oversees administering all issues related to the protection of new plant varieties. As such, plant breeder's rights do not apply to all plant species in Kenya. They are granted, in respect of species or groups specified by the Minister in charge of Agriculture, after consulting with all interested stakeholders. Under the Act, the breeder's right covers the protected variety itself; varieties that are not clearly distinguishable from the protected variety; and varieties whose production requires repeated use of the protected variety. However, varieties resulting from modern technology are not protected.

The Pest Control Products Act (Cap 346) regulates the importation, exportation, manufacture, distribution, and use of products used for the control of pests and of the organic function of plants and animals and for connected purposes. The Act further provides for labelling, disposal, registration, licensing, and advertising of pest control products in Kenya.

The Agriculture and Food Authority Act (2013) provides for the consolidation of the laws on the regulation and promotion of agriculture generally.

The KEPHIS Act (2012) established the Kenya Plant Health Inspectorate Service as a regulatory body for the protection of plants, seeds and plant varieties and agricultural produce; to provide that the Service shall be responsible for administering several other written laws and for matters incidental thereto or connected therewith. The Act also mandates KEPHIS as the competent regulatory authority to implement the national biotechnology policy and regulations on introduction, transit, and use of living modified plants, plant products and other regulated species of plants. The Act also mandates KEPHIS to implement the Plant Protection Act, (Cap. 324); the Seeds and Plant Varieties Act, (Cap. 326); the Agricultural Produce (Export) Act (Cap. 319); and the Suppression of Noxious Weeds Act, (Cap. 325).

The policy review above shows that there exists an elaborate framework to govern and coordinate the tomato value chain in Kenya. There is however need for coordination between the various agencies regulating the tomato value chain as well as the implementation of the various regulations. Finally, there is a general gap on incentives to promote mainstreaming biodiversity in the tomato value chain. There is a need to relook at the policies with the aim of identifying the various possible incentives to the value chain actors that will entice them to embrace voluntary commitments to biodiversity in their activities.

4.5 Recommendations for scenarios for voluntary commitments to biodiversity in the crops sector (tomato production)

Based on the DPSIR framework and value chain mapping of actors in the tomato value chain, we propose the following strategies for promoting voluntary commitments in the tomato value chain in Kajiado county. The strategies will contribute to sustainability in tomato production while increasing productivity and profitability for the actors. The commitments are as presented in Tables 10 and 11

4.5.1 Awareness/ Capacity building tomato producers

The study also revealed low awareness among crop producers on the impact of crop production on biodiversity and the ecosystem services which they depend on. Among the interviewed households, 75% indicated that their main objective for tomato production was profit maximization. The main drivers of biodiversity loss in tomato production were clear felling of trees for tomato production and excessive use of chemicals especially herbicides, pesticides and insecticides. The threat was particularly high for leasehold land where leasees did not see any need of biodiversity conservation in the leased land. It is thus important to improve on awareness creation and capacity building on the complementarity between horticulture (tomato) production and sustainability, both incomes, profitability, and biodiversity.

4.5.2 Adoption of efficient farming technologies

Efficient farming technologies such as drip irrigation, minimum tillage, optimum use of fertilizer and chemicals have a great impact on biodiversity, soil health, productivity, and profitability. There was evidence of poor crop farming techniques especially on leased lands, such as clear felling of trees for charcoal production and to create room for tomato production, farming on riparian lands and use of fallow irrigation. This contributed to biodiversity loss especially indigenous plant species, emergence of invasive species on bare degraded lands and increased soil erosion.

Climate smart agricultural practices and biodiversity friendly models such as agroecology and agrobiodiversity models could be adopted for improved biodiversity as well as profitability in the tomato sector. The Inter Sectoral Forum on Agroecology and agrobiodiversity (ISFAA) in Kenya is a voluntary member-based organization that promote biodiversity friendly horticultural production in Kenya with strong presence in Nairobi and Kajiado. There is a need for further assessment to the models to ascertain the benefits, costs, and incentive structures to the tomato value chain actors. Other key actors for the success of the strategy include the MoALF, County governments, CSOs, extension service providers, input suppliers, financiers, and tomato producers.



Emergence of invasive species on cleared forest lands in Kajiado County, Kenya

4.5.3 Tree growing on at least 10% of the total land area for improved soil fertility, tree cover, fuelwood, and biodiversity on farms

The agriculture (farm forestry) rules 2009 requires all crop farmers in Kenya to establish and maintain farm forestry on at least 10% of every of their agricultural lands. The proposal aims to reduce biodiversity loss caused by destruction of trees for agricultural expansion. It contributes to soil and biodiversity conservation and protection of riverbanks through reduced soil erosion. The rules are also part of the agriculture act of 2012 which seeks to maintain a stable agriculture, soil quality and fertility while stimulating sustainable agriculture and improved biodiversity (GoK, 2009; GoK, 2012). Governments, communities, and other responsible agencies should map and profile key biodiversity areas, especially those hosting endangered and threatened species for complete avoidance/ restriction to economic activities. Key actors for the success of this strategy will be land owners (public and private), County and National government agencies, KFS, KEFRI, MoALF. The strategy will complement tomato production by increasing pollinators, increasing income sources ie through selling fruits, and increased soil fertility through reduced soil erosion. The government of Kenya has launched an ambitious plan to grow 15 billion trees by 2037 with the first 5 billion trees planted by 2027. The initiative is aimed at improving tree/ forest cover in Kenya to 30% while also contributing to the national climate objectives. Most of the growing will be undertaken in private and community lands especially in the ASALs since the public lands are already stretched to the limit. There is need to follow up the implementation of the project to ensure appropriate species for the different agro ecological zones as well as for different purposes (sawn timber, fuel wood, poles, conservation, agroforestry, etc) are strictly adhered to.

4.5.4 Certification and sustainability standards

Development and enforcement of biodiversity certification and sustainability standards is a potential tool to trace and monitor the environmental and biodiversity footprint of tomato production including food safety and biodiversity loss across the value chain. Once consumers are biodiversity conscious and demand sustainably produced tomatoes, the producers will strive to change their production practices by reducing the use of synthetic fertilizers and chemicals, adoption of biodiversity friendly practices such as integrated pest management, organic farming and minimum tillage as well as adherence of spatial plans i.e. not farming on conservation areas, riparian and wildlife corridors. This approach will contribute to biodiversity

conservation and sustainable tomato production in the County. Key actors to ensure the success of the strategy include tomato producers, consumers, traders, MoALF, County Governments, and extension service providers.

Table 10:Recommendations: Scenarios of commitments for crops sector

Voluntary commitment	Drivers	Pressure: Problem addressed	Impact	State	VC response	Actors	Expected change	Broad indicator
Short term								
Awareness/ Capacity building actors	<ul style="list-style-type: none"> -Lack of knowledge on sustainable tomato production -Increased demand of tomatoes -Lack of adherence to spatial planning in land use 	<ul style="list-style-type: none"> -Inadequate awareness of the impact of tomato production on biodiversity -Inadequate extension services 	-Unsustainable and inefficient farming practices	<ul style="list-style-type: none"> -Low adoption of technologies -Degraded lands -Deforested lands -Depletion of aquifers 	<ul style="list-style-type: none"> -Mentorship and training programmes -Exchange visits -Adoption of sustainable crop production technologies (drip irrigation, minimum tillage) -Adoption of rainwater harvesting technologies -Reduced use of synthetic 	<ul style="list-style-type: none"> -Producers -National and County governments -NGOs 	<ul style="list-style-type: none"> -Enhanced capacity of farmers on sustainable tomato production 	<ul style="list-style-type: none"> -Proportion of farmers trained -Technologies adopted

Voluntary commitment	Drivers	Pressure: Problem addressed	Impact	State	VC response	Actors	Expected change	Broad indicator
					chemical and fertilizers -Adherence of spatial plans by crop producers			
Mid term								
Adoption of efficient farming technologies	<ul style="list-style-type: none"> -Inefficient irrigation practices -Water scarcity -Excessive use of synthetic pesticides and fertilizers -Farming on riparian areas -Uncontrolled drilling of boreholes -Land tenure system 	<ul style="list-style-type: none"> -Biodiversity loss -Soil erosion Sedimentation of water bodies 	<ul style="list-style-type: none"> -Increased Soil erosion -Biodiversity loss -Reduced food and water security and safety -Siltation of water pans -Depletion of aquifers 	<ul style="list-style-type: none"> -Soil infertility -Invasive species -Degraded rangelands -Low productivity 	<ul style="list-style-type: none"> -Adoption of Integrated Pest Management Practices -Adoption of climate smart agriculture -Adoption of agroecology and agro biodiversity models 	<ul style="list-style-type: none"> -National and County Governments -CSOs -Extension service providers -Producers -Input suppliers 	<ul style="list-style-type: none"> -Improved biodiversity in the tomato growing regions -Improved productivity -Improved soil fertility -Improved food and water safety 	<ul style="list-style-type: none"> -% of farmers adopting IPM practice -No of climate smart agriculture models adopted -% increase in productivity

Voluntary commitment	Drivers	Pressure: Problem addressed	Impact	State	VC response	Actors	Expected change	Broad indicator
Tree growing on at least 10% of the total land area	<ul style="list-style-type: none"> -Increased population -Energy needs -Forage needs -Land tenure 	<ul style="list-style-type: none"> -Conversion of rangelands to crop production -Biodiversity loss 	<ul style="list-style-type: none"> -Loss of pollinators -Loss of biodiversity -Soil erosion -Reduced productivity and incomes of tomato producers 	<ul style="list-style-type: none"> -Increased land under crop production -Threatened species -Degraded farmlands -Invasive species -Soil infertility 	<ul style="list-style-type: none"> -Adoption of nature-based solutions such as bee keeping 	<ul style="list-style-type: none"> -Landowners (public and private) -County and National Governments -KFS -KEFRI 	<ul style="list-style-type: none"> -Improved biodiversity conservation -Improved soil fertility -Increased productivity 	<ul style="list-style-type: none"> -% of land under conservation
Long term								
Certification and sustainability standards	<ul style="list-style-type: none"> -Reduced food safety -Pollution -Lack of environmental accountability in production -Lack of traceability in 	<ul style="list-style-type: none"> -Land degradation -Soil erosion -Pests and diseases 	<ul style="list-style-type: none"> -Biodiversity loss -Food insecurity 	<ul style="list-style-type: none"> Unsustainably produced foods (tomatoes) -Lack of certification standards and traceability 	<ul style="list-style-type: none"> -Reduced use of synthetic pesticides and chemical -Adoption of sustainable farming practices (IPM, organic farming, 	<ul style="list-style-type: none"> -Producers -Consumers -Traders -County and National Government -Extension service providers 	<ul style="list-style-type: none"> -Improved food security and safety -Increased biodiversity in agricultural landscapes -Improved markets and 	<ul style="list-style-type: none"> -No of developed and adopted sustainability standards -% of farmers adopting sustainability standards

Voluntary commitment	Drivers	Pressure: Problem addressed	Impact	State	VC response	Actors	Expected change	Broad indicator
	tomato value chain				minimum tillage etc) -Adherence to spatial plans (ie not farming on riparian areas and wetlands, conservation areas)		profitability of tomato enterprise -Improved traceability of horticultural products	

Table 11: Opportunities and challenges to voluntary commitment in the crops sector

Voluntary commitment	Opportunity	Barriers	Mitigation measures
Tree growing for improved soil fertility, tree cover, fuelwood, and biodiversity on farms	Increased biodiversity conservation in the rangelands	Land availability Poor incentives for conservation	Incentivizing conservation in tomato production Capacity building and awareness creation on complementarity between conservation and tomato production
Adoption of efficient farming technologies	Reduced cost of production Reduced biodiversity loss from crops production Increased income through sale of carbon	Capital constraint Inadequate incentive mechanism for climate smart agriculture	Development and promotion of incentives for biodiversity friendly farming i.e. carbon schemes
Awareness/ Capacity building actors	Improved biodiversity conservation in tomato production Improved incomes of tomato producers	Inadequate funding for extension services	Increased funding to dissemination and extension services
Certification and sustainability standards	Reduced negative effects of tomato production on biodiversity Reduced pollution Improved traceability in the tomato sector	Inadequate frameworks to support certification and standardization in tomato production Lack of incentives to encourage mainstreaming of biodiversity effects in tomato production	Design and development of certification schemes for biodiversity in tomato production Design incentives for biodiversity friendly activities in the tomato value chain Enforcement of certification schemes across the tomato value chain

5.0 The Forestry Sector (Charcoal Production)



Land clear felled for charcoal production and crop production in Kajiado South, Loitokitok

5.1 Introduction

Approximately 45% of the total forest cover in Kenya is made up of dryland forests (GoK 2019). These are comprised of a mixture of public, community as well as private forests. Forests have been reported to contribute to economic development through the provision of charcoal and firewood for domestic and commercial use in the Kenyan rural and urban households. They also support livestock system through provision of dry grazing pasture areas. Other economic values of Kenyan dryland forests are derived from trade of plant based genetic resources such as *Aloe vera*, frankincense, myrrh, gum arabica, dyes and medicinal herbs, honey, handicrafts, and minerals, all of which have a ready market locally and internationally (Ngugi *et al.*, 2011).

Total forest area in Kajiado County is estimated at 16,866 Ha comprising of indigenous and exotic forests. A total of 15,626 Ha of the forest land is gazetted while 1240 Ha is community land. Primary drivers of biodiversity losses in the forestry sector in Kajiado County are unsustainable land use practices such as excessive logging on community and private lands for firewood and charcoal (CGK, 2019). This in turn drives many individuals to move into charcoal production as an alternative income source. Most tree species felled for charcoal production are indigenous especially the *Acacia* species that thrive well in the ASALs. The loss of indigenous trees species to charcoal production contribute greatly to biodiversity losses in the ASALs. Other pressures to the forestry sector in Kajiado include changes in land use from

pastoralism to intensive horticultural production and land subdivision for settlement areas. This is attributed to proximity of Kajiado to Nairobi, the capital city of Kenya. The changing land uses as well as unsustainable practices in the forestry sector (inefficient charcoal production) contribute to degradation and biodiversity loss in the County.

5.2 Mapping of the charcoal value chains in Kajiado County, Kenya

The charcoal value chain mapping was done and presented in **Figure 9**.

The charcoal value chain is composed of six main activity categories (wood production, charcoal production, transportation, wholesaling, retailing, and consuming).

In Kajiado County, charcoal production was mainly done under two systems, subsistence, and commercial production. Subsistence production is mostly done on privately owned lands and group ranches using fallen dead trees.

Wood for charcoal commercial production is mainly found in community lands (very few), private lands and group ranches. Commercial production was mainly found on private leased out lands with the main aim of converting lands from forestry to crop lands. Indigenous species (*Acacia tortillis* and *Acacia melifera*) were the most used for charcoal production in the county. Under the system the trees are clear felled for charcoal production, where the land is later converted to intensive horticultural production. The system causes a major loss to biodiversity and leads to emergence of invasive species in case the land is later left bare.

After production, the charcoal is transported using motorbikes, public service vehicles, and transporters of back loads depending on the distance to the selling points. The transporters sell the charcoal to roadside sellers or traders within Kajiado County.

Charcoal wholesalers are mainly located in major urban centers within and outside Kajiado County such as Kajiado, Kitengela, Isinya, Machakos, Nairobi and Ngong. The wholesalers then sell to retailers in the major urban centers and towns. The main consumers of charcoal from Kajiado County are individual households, restaurants, schools, and colleges within and outside Kajiado County.

Currently, the country has imposed a ban on charcoal production from public and community lands to improve tree and forest cover in the country. The activity is however ongoing due to the high demand of charcoal production in urban areas of Kenya. It is estimated that approximately 36% of households in urban areas of Kenya use charcoal for cooking (CGK, 2018)(CGK, 2018). This calls for an urgent need to support and promote use of alternative energy sources for both domestic and industrial use.

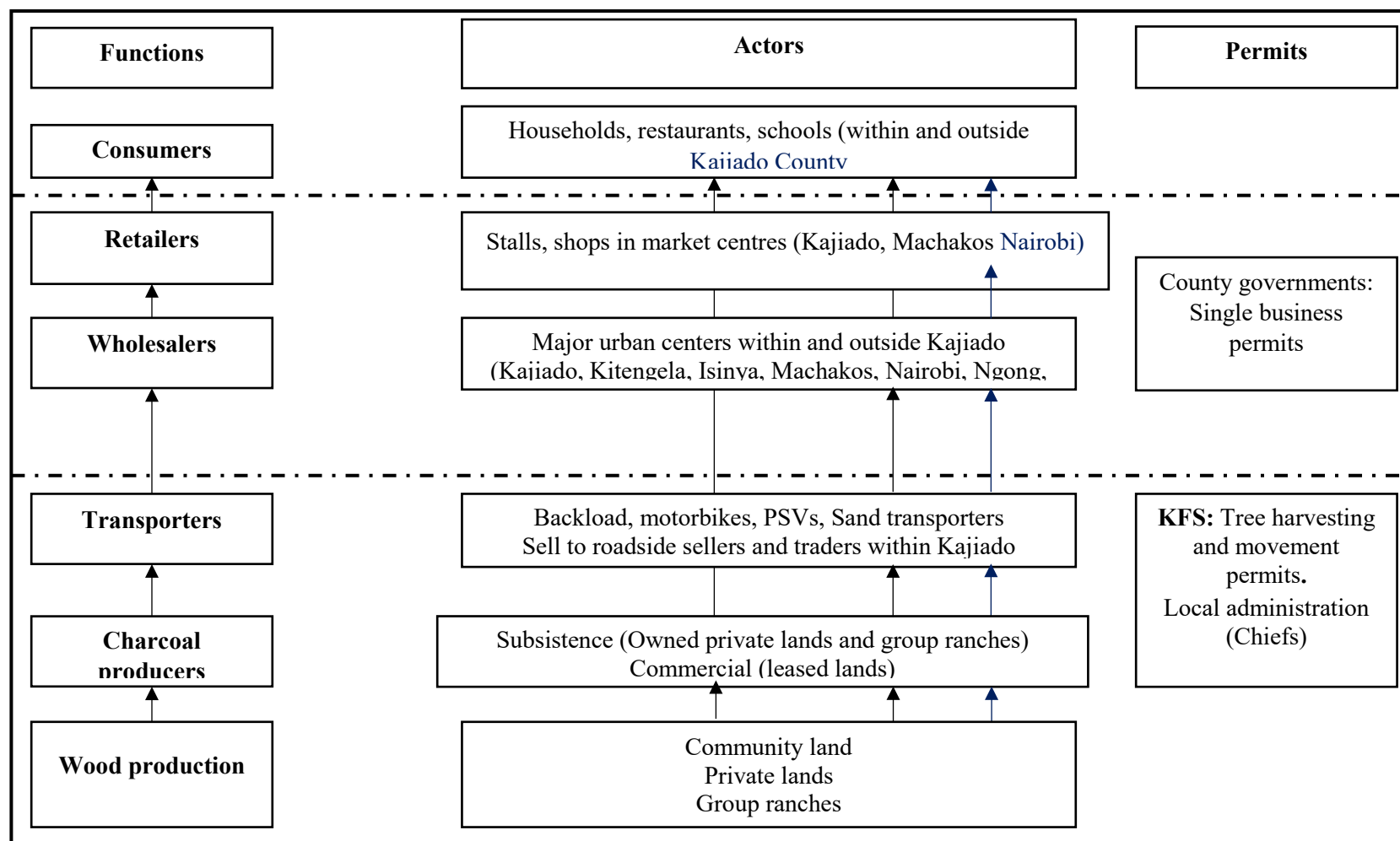


Figure 9: Charcoal value chain in Kajiado County

5.3 Strengthen the transformative role of the national framework towards a sustainable Charcoal sector (Policy and legislative environment)

The Ministry of Environment and Forestry is responsible for forests. Ministries responsible for Agriculture, Livestock and Cooperatives also deal with trees on private and community and agricultural land.

The Constitution of Kenya classifies forests into three categories namely public, community and private forests. Public forests include all forests on public land; forestland lawfully held, used, or occupied by any State organ; forestland transferred to the State by way of sale, reversion or surrender and forestland in respect of which no individual or community ownership can be established by any legal process. The national and county governments are responsible for all forests on public land. Kenya Forest Service (KFS) is the national agency responsible for conservation and management of public forests. This role coincides with that of the national land commission (NLC), which is responsible for managing public land; Kenya Wildlife Service (KWS) in forests that have wildlife; Kenya Water Tower Agency (KWTa); National Environment Management Authority (NEMA) which supervises and coordinates environmental activities and implements environmental policies in all sectors within the country; community forest associations (CFAs); Plantation Establishment and Livelihood Improvement Scheme (PELIS) farmers; and County governments in which the forests are located. There are also private sector actors such as those involved in the timber industry.

The charcoal value chain is covered under the forestry and energy sectors. In Kajiado County, charcoal is primarily produced using wood illegally obtained from public and community lands as well as existing trees on private lands .

Over the past 20 years, Kenya developed laws and policies with the hope of bringing the sector into the formal economy and reducing its environmental impacts. This was after rampant destruction of forests and a realisation that what is not known cannot be regulated.

The Constitution of Kenya, 2010 requires the Country to increase and maintain tree cover at a minimum 10% of the total land area. Article 69 (1) (b) emphasizes on the need to “work to achieve and maintain a tree cover of at least ten per cent of the land area of Kenya”. The Kenya Vision 2030 places the environmental sector in the social pillar and emphasizes the need to conserve natural resources to support economic growth. For forests, the goal is to increase area under forest to 10% by 2030 and sustainably manage natural forest resources for environmental protection and enhanced economic growth. Charcoal production has to take into account constitution obligations, and this calls for sustainable charcoal production.

The Forest management and Conservation Act (FMCA), 2016 is an act of Parliament that guides the development, coordination, control, regulation and sustainable management of forests, including conservation and rational utilization of all forest resources for the socio-economic development of the country and for connected purposes.

Section 37(1) requires every County Government to, establish and maintain arboreta, green zones or recreational parks for use by persons residing within its area of jurisdiction. In this regard, every County shall cause housing estate developers within its jurisdiction to make provision for the establishment of green zones at the rate of at least 5% of the total land area of any housing estate intended to be developed. The Act establishes the Kenya Forest Service that is mandated “to conserve, protect and manage all public forests, prepare and implement management plans for all public forests and, where requested, assist in preparation of management plans for community forests or private forests in consultation with the relevant owners, receive and consider applications for licenses or permits in relation to forest resources or management of forests or any other relevant matter in accordance with this Act, establish and

implement benefit sharing arrangements in accordance with the provisions of this Act, approve the provision of credit facilities and technical training for community-based forest industries, and the provision of incentives to persons for the sustainable utilization of wood and non-wood forest products, implement and enforce rules and regulations governing importation, exportation and trade in forest produce among others”.

The Government of Kenya through Forests Act No. 7 of 2005, section 59, provides for formulation of rules for regulating the production, transportation and marketing of charcoal, The Forest (Charcoal) Rules, 2009 gives provision for formation of charcoal users association for ease of coordination and capacity building of actors across the value chain. Both national and county government, however, need to do more to operationalize charcoal rules.

The Environmental Management and Coordination CAP 387 and (Amendment) Act, 2015 Provides for protection of forests and environmental impact assessments of forest related developments. Section 44 of the Act requires that NEMA in consultation with other relevant lead agencies, develop, issue and implement regulations, procedures, guidelines and measures for sustainable management of hilltops, hillsides and wetlands.

5.4 Recommendations: Scenarios of commitments to biodiversity in the forestry sector

To entrench voluntary commitments in the ASAL forestry sector, a combination of approaches is proposed as described below (Tables 12 and 13):

5.4.1 Capacity building and awareness creation

Capacity building and awareness creation on the relationship between biodiversity conservation and the forestry sector was suggested by FGD discussants. Charcoal producers only considered the direct use values of trees such as charcoal and timber for benefits and not the associated ecosystem services offered such as carbon sequestration, provision of shade, reduced surface runoff, animal feed among others. Charcoal producers also did not account for the value of the tree in determining charcoal prices. They only accounted for their time and labour when determining the value of charcoal. This leads to undervaluation of both the tree and charcoal. There is thus need for improved awareness and capacity building on sustainable charcoal production, marketing, and utilization. Charcoal producers should be sensitized on threatened and endangered tree species and discouraged from using them for charcoal production. Key stakeholders for this initiative will include MoEF, KFS, KEFRI, County department for energy and forestry, CSOs, Consumers and traders.

5.4.2 Use of alternative energy sources

Illegal logging and illegitimate charcoal burning are among the major drivers of degradation and biodiversity loss in Kajiado County. Charcoal burning is predominantly done in Kajiado West and Central Sub Counties. The main market is located in urban centres within and outside Kajiado such as Kitengela, Rongai, Ngong, Isinya, and Nairobi. According to CGK (2018), the main sources of cooking energy in Kajiado County were paraffin, firewood and charcoal. Approximately 94.6% and 74.5% of residents in rural and urban areas respectively used either of the three smoky fuels for cooking. Use of alternative cooking energy such as briquettes and biogas may help to reduce charcoal demand in the county. There is however need to promote awareness and capacity building of actors on the alternative energy sources as well as improve on the costing to make them a viable alternative to charcoal production.

5.4.3 Tree growing on degraded rangelands for charcoal production

Charcoal production is one of the main economic activities in Kajiado County. Unfortunately, it is done using indigenous species such as *Acacia tortillis* and *Acacia melifera* with minimum effort to replace the used trees. This has led to loss of key biodiversity species especially of

indigenous trees perceived to have good charcoal properties. Research on, development and promotion of fast maturing dryland tree species suitable for charcoal production is key in preventing further loss of biodiversity from charcoal sector. Charcoal producers could be capacity built on planting and sustainable harvesting of the trees to ensure biodiversity conservation as well as sustainability of their enterprises.

5.4.4 Sustainable charcoal production (wood lots, efficient kilns)

Charcoal producers should be capacity built on tree growing through establishment of wood lots of the right species specifically for charcoal production, currently, KEFRI is working on improving and promoting the growing of *Acacia tortillis* in the drylands specifically for fuelwood and charcoal. There is need to organize the charcoal producers to working charcoal producer groups for ease of monitoring, coordinating, and formalizing the sector. The members of charcoal producer groups can then be trained on efficient and sustainable charcoal production as well as supported to acquire efficient charcoal production kilns. There is also need for awareness among the marketers and consumers of charcoal to only use sustainably produced charcoal. Policy institutions mandated to enforce the charcoal rules such as the Kenya Forest Services should only give movement permits to sustainably produced charcoal. There is need to capacity build charcoal producers on branding, and certification for sustainably produced charcoal.

5.4.5 Adoption of efficient charcoal utilization technologies (efficient stoves)

Wood fuel (firewood and charcoal) are the most common energy sources in Kenya, Kajiado included. This is attributed to their availability and affordability as compared to alternative energy sources. Demand for charcoal in Kajiado County is high due to population increase and urbanization of the County as well as proximity to major cities and towns such as Nairobi and Machakos. Charcoal from the county is also on high demand due to its perceived superior quality because it is mostly produced from indigenous hard wood species. Out of the 30 households interviewed in the assignment, 77% (23) stated that they used ordinary charcoal stoves for cooking with only 23% (7) using improved cookstoves. There is thus need to promote the adoption and use of improved charcoal cookstoves for cooking. This will indirectly lead to biodiversity conservation due to the associated reduction in charcoal use

5.4.6 Adoption of forestry friendly practises (apiculture, ecotourism) as alternative income sources)

Adoption and promotion of forestry friendly activities were also listed among the potential strategies for VCs in the forestry sector due to their potential to supplement incomes from charcoal production. The activities such as bee keeping, gums and resins and other non-timber forest product enterprises could be promoted in the communities as a part of economic incentives for biodiversity conservation. Low awareness on the potential of these enterprises for income supplementation, inadequate knowledge on non-extractive values of the rangelands landscape, poor incentive schemes for biodiversity conservation, and biodiversity livelihood nexus are some of the drivers to low adoption of the enterprises.

5.4.7 Adoption of Payment for ecosystem services Models for the forestry sector

Payment for Ecosystem Services (PES) models was also identified as a potential strategy for mainstreaming biodiversity in the forestry sector. This would act as an incentive for biodiversity conservation in forestry instead of cutting down trees for charcoal. Some of the reasons why PES is not developed in the country include low awareness and perception on the benefits of biodiversity conservation, inadequate knowledge of PES schemes and lack of PES best practices in the forestry sector. There is thus need to develop, package and disseminate

PES best practices in the country to the forestry sector, pilot the best practices. Some of the key targeted actors for this VC recommendation include charcoal producer associations (CPAs), MoEF, County department for forestry, civil society organizations (CSOs) and private businesses. Matonyok, a non-governmental organization, supported by German donors is supporting smallholders in Kajiado County on tree nursery establishment and growing trees for restoration and livelihood improvement. They later monitor the tree growth for carbon offsetting which acts as additional income to farmers and incentive for tree growing

5.4.8 Forests standards and certification

Forest standards and certification is another strategy for VC in the forestry sector for improved sustainability and traceability of charcoal. The Forest Stewardship Council (FSC) is the body responsible for forest certification in Kenya. Currently, Kenya has no FSC certified forest area (Forest Stewardship Council, 2021). The standards offers guidance for forest management including compliance with national laws, conserving areas with high conservation values, assessing environmental values and impacts, among others. The standards guide forest owners and managers on compliance with requirements for responsible forest management that confirm that a particular forest block or area is managed in a manner that conserves biological diversity and benefits the lives of local communities and workers while ensuring it sustains economic viability (Forest Stewardship Council, 2021; Star, 2021). There is however need to expand the standards to cover the charcoal sector in community and private lands in the ASALs and promotion of sustainability and traceability across the charcoal value chain by the actors.

Table 12: Recommendations for voluntary commitments in the in the forestry sector (charcoal production)

Voluntary commitment	Driver	Pressure: Problem addressed	State	Impact	VC response	Actors	Expected change	Broad indicator
Short term								
Capacity building and awareness creation	-Low levels of awareness on the links between charcoal value chain and biodiversity	-Limited awareness on the impact of charcoal production on biodiversity	-Low awareness on sustainable charcoal production, marketing, and utilization	-Deforestation -Degradation -Soil erosion -Increase in invasive species	-Increase in capacity building and awareness programmes (Radio talks, Tv shows, Fliers, Pamphlets -Workshops -Leverage on existing systems including indigenous and traditional knowledge on conservation initiatives -Increased no of extension service providers -Increased funding for	-MoEF -KFS -MoEF, KEFRI, County Department for Energy and forestry -Value chain actors -CSOs	-Increased awareness on the links between charcoal value chain and biodiversity -Reduced deforestation -Reduced biodiversity loss	-No of workshops and trainings held -% increase in funding to awareness creation initiatives -% increase in no of extension service providers

Voluntary commitment	Driver	Pressure: Problem addressed	State	Impact	VC response	Actors	Expected change	Broad indicator
					extension services			
Use of alternative energy sources	-Clean energy -Renewable energy Environmental conservation	Deforestation -Degradation -Pollution -Increased use of charcoal	-Degraded landscapes - Increased population -High poverty levels	-Reduced forest and tree cover -Soil erosion -Loss of natural habitats Biodiversity loss -Increase in invasion species	-Increased use of alternative energy (Briquettes, Biogas, Solar etc) -Capacity building and awareness creation -Efficient use of alternative energy	-Consumers -Businesses -National and County Governments -NGOs	-Reduced carbon emissions -Increased tree and forest cover -Increased biodiversity	-No of alternative energies available -% Increase in use of alternative energy
Mid term								
Tree growing on degraded rangelands for charcoal production	-Excessive use of Indigenous species for charcoal production	-Depleted forestry resources -Degradation	-Degraded landscapes -Loss of biodiversity	-Biodiversity loss -Degradation	-Establishment of wood lots for charcoal production -Research on, development and promotion of species suitable for dryland forestry	-Charcoal producers -National, County govt department responsible for forestry -NGOs	- Increased forest and tree cover -Improved biodiversity in the rangelands

Voluntary commitment	Driver	Pressure: Problem addressed	State	Impact	VC response	Actors	Expected change	Broad indicator
Sustainable charcoal production (wood lots, efficient kilns,)	-Inefficient charcoal production technologies (traditional kilns)	-Low conversion rates of charcoal	-Inefficient production systems -Degraded landscape	-Biodiversity loss -Degradation -Reduced forest cover -Low supply of charcoal in the market -Increased vulnerability to climate shocks (drought	-Establishment of wood lots for charcoal production -Adoption of improved charcoal production kilns -Use of invasive species for charcoal production (<i>Prosopis juliflora</i>) Capacity building and awareness creation	-MoEF, KEFRI, County Department for Energy and forestry -Charcoal producer associations -Group ranch -Charcoal producers -NGOs -Businesses	-Reduced biodiversity loss -Reduced invasive species -Reduced emissions	-No of Hectares under woodlots for charcoal production -% Increase in use of improved kilns
Adoption of efficient charcoal utilization technologies (efficient stoves)	-Inefficient stoves (jikos)	-Deforestation -High cost of charcoal	-High cost of improved stoves -Low efficiency in charcoal utilization	-Biodiversity loss -Degradation -Reduced forest cover	-Adoption of efficient cookstoves	MoEF KFS MoE, KEFRI, County Department for Energy and forestry	-Reduced biodiversity loss -Increased efficiency in charcoal utilization	No of existing improved cookstove technologies % Increase in use of improved cookstoves

Voluntary commitment	Driver	Pressure: Problem addressed	State	Impact	VC response	Actors	Expected change	Broad indicator
				-Increased vulnerability to climate shocks (drought -High cost of energy	-Capacity building and awareness creation	Consumers Traders CSOs	-Reduced emissions	
Adoption of nature-based solutions (apiculture, medicinal plants ecotourism, agro) as alternative income sources	-Lack of alternative livelihood options -Incentives to conservation -Increased awareness of the value of nature-based solutions -Linkages between livelihoods and conservation	-Inadequate knowledge on Non extractive values of the rangeland landscape Deforestation -Degradation -Soil erosion	-Limited livelihood options in the landscape -Poorly Managed landscapes -Degraded landscapes	-Decline in indigenous species -Decline in biodiversity	Improved capacity on the effect of NBS on biodiversity conservation Adoption of NBS	-Landowners -Producers -CSOs -MoEF, -County depart responsible for forestry	Diversification of livelihood options Adoption of nature-based solution Decline in charcoal production and use Poverty reduction	No of NBS adopted % Increase in funding to support NBS % of actors adopting NBS
Long term								
Adoption of Payment for ecosystem services Models for the forestry sector	-Inadequate knowledge of PES schemes	-Deforestation -Degradation -Soil erosion	-Lack of proper systems linking producers	-High deforestation	-Development, packaging, and dissemination of PES best practices	-Charcoal producer associations -MoEF,	-Improved biodiversity -Increased adoption of PES	No of PES schemes % Increase in funding to PES

Voluntary commitment	Driver	Pressure: Problem addressed	State	Impact	VC response	Actors	Expected change	Broad indicator
	-Lack of PES best practices in PES -Low perception on benefits of biodiversity conservation		and consumers of charcoal Poorly Managed landscapes Degraded landscapes	-Poorly management landscapes -Biodiversity loss	-Piloting of PES best practices Improved management of rangelands Willingness to pay and accept sustainably produced charcoal	-County depart for forestry -Consumers -CSOs -Businesses	-Reduced deforestation	% Increase in funding to biodiversity conservation
Forests standards and certification	-Lack of traceability of forest products -Inadequate standards	-Deforestation -High demand for charcoal	-Inadequate awareness of standards and certification schemes -Degraded landscapes -Increase in invasive species -Increase in threatened species	-Unsustainable extraction of forestry products -Biodiversity loss -Soil erosion -Degradation	-Development and review of standards for charcoal -Piloting of certification schemes -Improved awareness of the certification and standards -Improved certification schemes	-MoEF, -County depart for forestry -KFS -CFAs -Charcoal producers -Consumers -Businesses -Forest Stewardship Council	Sustainable charcoal production Adoption of forest certification for charcoal production Improved biodiversity	No of forests certified for charcoal

Table 13: Opportunities and challenges to voluntary commitment in the forestry sector (charcoal production)

Voluntary commitment	Opportunity	Barriers	Mitigation measures
Capacity building and awareness creation	Improved knowledge on the impact of forestry on biodiversity Improved biodiversity conservation	Inadequate funding for extension services and dissemination	Increased funding for extension services and dissemination on the impact of charcoal production to biodiversity
Use of alternative energy sources	Reduced pressure on charcoal demand Improved biodiversity conservation in forestry	High comparative cost of alternative energy such as LPG and electricity	Promotion of alternative energy sources such as briquettes and bagasse
Tree growing on degraded rangelands for charcoal production	-Sustainable supply of wood for charcoal production High demand of charcoal in Kajiado and surrounding counties	Preference of indigenous species for charcoal production Communal land systems with open access rights	Tree growing campaigns of indigenous species suitable for charcoal production Provision of seed and seedlings for charcoal production species
Sustainable charcoal production (efficient kilns,)	Improved efficiency in charcoal production	Lack of awareness and Inadequate technical capacity to do sustainable charcoal production	Awareness creation and promotion of sustainable charcoal production practices (wood lots and efficient kilns)
Adoption of efficient charcoal utilization technologies (efficient stoves)	Improved efficiency in charcoal utilization	Lack of awareness on sustainable charcoal utilization technologies High cost of efficient charcoal	Awareness creation and promotion of sustainable charcoal utilization technologies (efficient stoves)

		utilization technologies	
Adoption of nature-based solutions (apiculture, medicinal plants ecotourism,) as alternative income sources	Incentive for conservation	Lack of awareness on the potential of nature-based solutions as an alternative income to charcoal production Inadequate technical capacity to properly manage nature-based solutions	Awareness creation and promotion of NBSs as alternative income sources to charcoal
Adoption of Payment for ecosystem services Models for the forestry sector	Incentive for biodiversity conservation in the forestry sector Reduced charcoal production Improved biodiversity conservation	Lack of a national framework to guide PES in the forestry sector Lack of an incentive for PES in the forestry sector	Support the development of a national framework to guide PES in the forestry sector Support piloting of PES models in the forestry sector
Forests standards and certification	Reduced negative effects of charcoal production on biodiversity Reduced pollution Improved traceability in the forestry (charcoal) sector	Inadequate frameworks to support certification and standardization in charcoal production Lack of incentives to encourage mainstreaming of biodiversity effects in charcoal production	Design and development of certification schemes for biodiversity in charcoal production Enforcement of certification standards across the charcoal value chain

6.0 CONCLUSIONS AND RECOMMENDATIONS

The assignment entailed identifying options and scenarios for voluntary commitments for biodiversity in the agriculture and forestry sectors in dryland ecosystems of Kenya, a case of Kajiado County. Three key subsectors in agriculture and forestry sectors (Pastoralism, tomato, and charcoal production) were analysed to identify their main characteristics, Effect on biodiversity and proposed scenarios and options of voluntary commitments by the actors in the three livestock, horticulture, and forestry value chain. The specific objectives of the assignment were to identify the direct and indirect pressures on biodiversity associated with the livestock (pastoralism), crops (tomatoes) and forestry (charcoal) value chain in Kenya, map the actors, their institutional context, and their interactions, Identify the factors that favour the reduction of pressures and to voluntary commitments by actors in favour of biodiversity and finally, identify the constraints (external and internal to the actors and companies) that are unfavourable to the reduction of pressures and to voluntary commitments by actors for biodiversity. The study employed a mixed method approach including desktop review of literature, SWOT analysis, Value Chain Analysis and mapping, Key Informant Interviews (KIIs), and Focus Group Discussions (FGDs).

The main economic activities in Kajiado County are livestock production (Pastoralism), crop production (subsistence and commercial) and wildlife. The county is strategically located, close to Nairobi and Machakos, leading to high demand for agricultural products from the County.

Results of the findings revealed that the main economic activities in pastoralism, tomato and charcoal production are purely profit oriented and do not take account of their impacts on biodiversity. Pastoralism was mainly characterized by overstocking and overgrazing in the rangelands due to unsustainable stocking rates and lack of grazing management plans. Tomato production was mainly undertaken under intensive irrigation farming. Fallow irrigation was the predominant system. Farmers relied on boreholes for irrigation water. Others pumped water from nearby rivers to tomato farms. The production was characterized by heavy use of water and chemicals (pesticides, insecticides and herbicides). Tomato production was also done on leased lands by external people. This lands, mostly virgin lands with indigenous trees were clear felled to create room for intensive tomato production. In other cases, the leases abandoned the bare lands leading to emergence of invasive species and increased soil erosion. The heavy use of synthetic chemicals and fertilizers also negatively affected biodiversity in the County as well as food and water safety when the chemicals are washed down the rivers or consumed by animals.

Charcoal was mainly used using inefficient earth kilns. Moreover, indigenous species adapted in the ASALs were the most used to produce charcoal. This further negatively impacted on biodiversity leading to degradation of the rangelands. In other cases, charcoal producers, if not carefully, led to fire outbreaks in existing forests and wood lands thus negatively impacting biodiversity

We thus conclude that to ensure sustainability of pastoralism, tomato, and charcoal production in Kajiado County, it is imperative to properly value the impact of the three sectors on biodiversity and that value to reflect in the product prices. The value of ecosystem services offered by biodiversity and other natural resources should then be ploughed back to support restoration and rehabilitation of the rangelands. We thus propose the following strategies for

ensuring voluntary commitments by private sector actors in the three value chains as listed below

Livestock production (Pastoralism): Adoption of Sustainable stocking rates; tree growing on at least 10% of the total land area; develop and adhere to grazing management plans; Adoption of alternative pastoralism models; Capacity building and awareness creation to actors; Certification schemes for animal feeds and products

Tomato production: Tree growing for improved soil fertility, tree cover, fuelwood, and biodiversity on farms; Adoption of efficient farming technologies; Awareness/ Capacity building actors; Certification and sustainability standards

charcoal production: Tree growing on degraded rangelands for charcoal production; Use of alternative energy sources; Sustainable charcoal production (wood lots, efficient kilns); Sustainable charcoal utilization (efficient stoves); Capacity building and awareness creation; Adoption of Payment for ecosystem services Models for the forestry sector; Adoption of nature-based solutions (apiculture, medicinal plants ecotourism, agro) as alternative income sources; Forests standards and certification

To achieve the objectives of the above recommended voluntary commitments by private sector actors, an enabling environment must be ensured by the public sector agencies responsible for environment and natural resource management. All responsible government agencies must work in a coordinated approach to ensure the mainstreaming of biodiversity in key economic decisions. An example is where land subdivision should follow proper spatial plans for the county. Borehole drilling should be done after all due diligence and based on the maximum carrying capacity of the aquifer in the region. Charcoal production should not be done using indigenous tree species clear felled to pave way for expansion of agriculture. Heavy use of synthetic fertilizers and chemicals and farming on riparian lands should not be allowed in tomato production

There is also need for improved capacity building and awareness creation to value chain actors on the synergies and complementarity between, conservation, productivity, profitability, and sustainability to improve their voluntary commitments to biodiversity. In the short run, it might seem expensive to be biodiversity conscious in economic decisions but with time, the average cost of production per unit is lower in biodiversity rich landscapes

Proper systems and frameworks for accounting for the value of biodiversity in the livestock (pastoralism), crops (tomatoes) and forestry (charcoal) sectors should also be developed and implemented. The prices of final products should reflect the true scarcity value of our natural resources. This will help in justifying why mainstreaming biodiversity in key economic decisions is relevant

6.1 Resource mobilization strategies

There is need for concerted efforts from both the public and private sector to improve biodiversity conservation by mainstreaming biodiversity in key economic decisions in Kenya. Above that, private actors should understand the linkage between biodiversity and profitability to have a buy in to conservation initiatives willingly. Some of the proposed strategies for resource mobilization for voluntary commitment to biodiversity by private sector actors include:

Increased funding by national and County governments to biodiversity

There is need for increased budgetary allocation for biodiversity conservation, capacity building and monitoring the impact of economic sectors on biodiversity by national and county governments. This will contribute towards restoration and rehabilitation of degraded areas

Payment for Ecosystem Services

Proper valuation of ecosystem services offered by biodiversity and other natural resources is critical for biodiversity conservation. The correct value of the ecosystem services should be reflected in the final market products. It is thus critical to develop frameworks for PES and pilot them in the pastoralism, tomato production and charcoal sectors. This will encourage mainstreaming biodiversity in the three sectors as well as improved funding for biodiversity conservation by the end consumers of livestock, crops, and forestry products.

Certification Standards

This is a market-based approach to ensure sustainability in production practises in key economic sectors. Certification standards and marks could be given to actors in the livestock (Pastoralism), tomato and charcoal production as a confirmation that their production practices did not lead to any negative biodiversity effects. Value chain actors as well as consumers could be capacity built to understand the benefits of mainstreaming biodiversity in their economic decisions as well as getting a buy in from them. Consumers could also be enlightened on being biodiversity conscious in their consumption decisions and asked to be part of the process by paying a minimum amount to contribute to biodiversity conservation. This money will be used to support biodiversity conservation in pastoralism, tomato, and charcoal production.

Restoration and rehabilitation initiatives

Kenya could also leverage on the existence of various environmental commitments ratified by the country such as the Convention on Biological Diversity (CBD), the United Nations Framework Convention for Climate Change (UNFCCC), the Bonn Challenge, United Nations Forum on Forests (UNFF) and the African Forest Landscape Restoration Initiative (AFR100). The initiatives, when successfully undertaken, will contribute to the conservation of Key Biodiversity Areas through reduced deforestation and degradation in the rangelands.

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Annex 1: Value chain actors and their responsibilities across the value chains

Actor	Roles and responsibilities in the sub sectors
Livestock sector	
Pastoralists	Large/ small scale livestock production in the ASALs that may influence biodiversity in the landscape
MoALF	In charge of agriculture (crop and livestock sectors) in the country
MoEF	In charge of Forest, environmental and climate change policy
Ranchers	Large scale livestock production that may influence biodiversity in the landscapes
Charcoal producers Association	Produce charcoal for subsistence/ commercial purposes within the ASALs thus influencing biodiversity in the landscape
Indigenous communities	Derive livelihood from forestry resources within the ASALs thus influencing biodiversity within the landscapes
Crops (Tomatoes)	
Small/ large scale producers including companies	Produce tomatoes under rainfed/ irrigation systems which have either negative or positive impacts on biodiversity
Input suppliers (organic fertilizers, Inorganic fertilizers, agro chemicals, seed,	Provide fertilizers, agrochemicals, and other inputs to tomato producers. Key in monitoring the effect of the inputs on biodiversity
Marketers/ Exporters	Market tomatoes locally/ internationally. They are key in tracing for value chain effects on biodiversity
Processors	Monitor that their activities/ suppliers do not contribute to biodiversity losses
Forestry (Charcoal Production)	
Community Forest Associations	Involved in governance of forestry resources through participatory forest management thus influencing biodiversity within forest ecosystems
KFS	Development, conservation, and management of Kenya's public forest resource base. Assist County Governments in developing and managing forests on community and private lands through Transition Implementation plans
KEFRI	Conduct research and development in forestry and allied natural resources
NDMA	NDMA mandated with overall coordination over all matters relating to drought risk management in Kenya. Droughts is a key driver of biodiversity loss in the ASALS

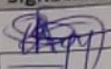
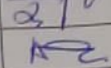
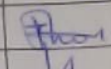
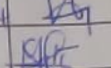
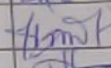
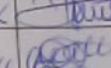
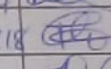
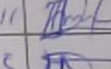
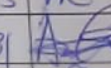
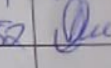

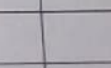


NMK	Collect, preserve, study, document past and present cultural heritage including biodiversity
Cross cutting	
National land Commission	In charge of implementing of Land policies and legislations
NEMA	Agency mandated with overall supervision and coordination of all environmental matters within the Country.
County governments/COG	Custodian of most dryland areas that is vested to communities. Also, in charge of implementing devolved environmental (forestry) function as well as agriculture and livestock that is fully devolved
Local administration (Chiefs, sub chiefs ward admins etc)	In charge of coordination, overseeing and mobilizing of local community activities
Kajiado County Natural Resource Network	Support Kajiado County in Natural Resources protection and restoration of degraded landscapes
Matonyok Organization	
IUCN	Work supportively, and in collaboration with members and partners, including NGOs and governments, to achieve a new paradigm for sustainable development based on the concept of people centered development.
Conservation International	Support societies to care for nature responsibly and sustainably, our global biodiversity, for the well-being of humanity.
WWF	Conserving of nature while reducing the threat to diversity on the earth
FAO	Experience working with communities and government in the ASALS on restoration initiatives
USAID	Experience working with rural communities and government entities on sustainable agriculture and forestry initiatives

Annex 2: List of participants in data collection



Tumaini
Gardens

Name of Organization: WJWF
 Date: 5th October 2022

No	Name	ID Number	Tel. No.	Signature
1.	David Sorimpan	11384461	072264847	
2.	Roseline Taloy	11587604	0721346612	
3.	Maxine N. CHEGE	23135120	0722235893	
4.	Tipha John	29776325	0745138877	
5.	Lucy Katita	25110871	0721873764	
6.	Makui KISHAM	23348741	0720863532	
7.	ENNIAHUKU NEMUSI	22828619	0724911973	
8.	DAVID LETO	24459960	0701570328	
9.	SALOME WANGUI	24577453	0714055944	
10.	TIMOTHY TIMOTHY	29901172	0717885918	
11.	Jacob Nkanamai	22971895	0723937011	
12.	Lengh Nchang	24515138	0715219705	
13.	ALIAS IENANA MOMOI	13611577	0721795231	
14.	Irene Kstete	10402071	0722987952	
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Name of Organization: WWF
 Date: 5th October 2022

No	Name	ID Number	Tel. No.	Signature
1.	David Sorimpu	11384461	072264847	[Signature]
2.	Roseline Takoy	11587604	0721346612	[Signature]
3.	Maxine N. CHEGE	23135120	0722235883	[Signature]
4.	Tipira John	29776325	0745138877	[Signature]
5.	Lucy Kaita	25110871	0721873764	[Signature]
6.	Markus KISHAM	23348741	0720863532	[Signature]
7.	Ennamukwa NEMUSI	22828619	0724911913	[Signature]
8.	DAVID LETO	24459960	0701570328	[Signature]
9.	SALOME WANGUI	24577453	0714051944	[Signature]
10.	Timothy Timatio	29901172	0717885918	[Signature]
11.	Jacob Nkanamai	22971895	0723937011	[Signature]
12.	Lenah Nchang	24515138	0718219705	[Signature]
13.	ALIAS LENANA MOKO	13611577	0721795231	[Signature]
14.	Irene Kstata	0402071	0722987982	[Signature]
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Name of Organization: WINE
 Date: 5th October 2022

No	Name	ID Number	Tel. No.	Signature
1.	David Soringan	11384461	072054847	[Signature]
2.	Rosalina Takey	11587604	072134612	[Signature]
3.	Maxine N. CHEGE	22135120	0722235273	[Signature]
4.	Tipha Jothu	29776325	0745138877	[Signature]
5.	KUCH KATHA	25110571	0721873760	[Signature]
6.	MAKWI KISHAM	25348741	070863532	[Signature]
7.	ENINAKURU NEMUSI	22828619	0749911973	[Signature]
8.	DAVID LETO	24489960	070197032K	[Signature]
9.	SALOME WANGUI	24577453	0714055944	[Signature]
10.	TIMOTHY TIMOTHIO	29901172	0717885918	[Signature]
11.	Jacob Nkanamari	22971895	0703937011	[Signature]
12.	Lengh Nchang	24515134	0715219705	[Signature]
13.	ALAN KANANA MOKO	13611577	0721795231	[Signature]
14.	Irene Kistofe	0402071	0122987952	[Signature]
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Being payment of Community mobilization facilitation
Date: 20th - 25th / 09 / 2022

Approved by: Dr. Anthony Madonia Date 24/09/2022

Paid by: Dr. Margaret Kaur Date 24/09/2022



ambition for Biodiversity
BIODEV
2030



FIELD PAYMENT VOUCHER

Being payment of..... Key Informant Interview Facilitator - IUCN Biodiversity

Date:

Name	P/No. or ID/No.	Stakeholder	Type of allowance	Rate	No. of Days	Total	Signature
<u>Paul MEILIARA</u>	<u>9367784</u>	<u>Livestock</u>	<u>Transport</u>	<u>1,000/-</u>	<u>1</u>	<u>1,000/-</u>	<u>Meiliara</u>
<u>Michael MBUKVA</u>	<u>9022398</u>	<u>CGK</u>		<u>1,000/-</u>	<u>1</u>	<u>1,000/-</u>	<u>MBUKVA</u>
<u>Murahini EZEKIEL</u>	<u>27325330</u>	<u>Livestock</u>		<u>1,000/-</u>	<u>1</u>	<u>1,000/-</u>	<u>AAE</u>
<u>Melton Melita</u>	<u>28445965</u>	<u>Agri Input</u>		<u>1,000/-</u>	<u>1</u>	<u>1,000/-</u>	<u>Melita</u>
<u>Palhacha Keteko</u>	<u>12741210</u>	<u>Transport</u>		<u>1,000/-</u>	<u>1</u>	<u>1,000/-</u>	<u>Keteko</u>
<u>Emmanuel Soro</u>	<u>27332001</u>	<u>Crops</u>		<u>1,000/-</u>	<u>1</u>	<u>1,000/-</u>	<u>Soro</u>
<u>Mellie Masi</u>	<u>35111639</u>	<u>Forestry</u>		<u>1,000/-</u>	<u>1</u>	<u>1,000/-</u>	<u>Masi</u>
<u>Emily Lois</u>	<u>11385835</u>	<u>Crops</u>		<u>1,000/-</u>	<u>1</u>	<u>1,000/-</u>	<u>Lois</u>
TOTAL						<u>8,000/-</u>	

Approved by: Dr. Magrath Karingi Date: 24/09/2022

Paid by: Dr. Anthony Madona Date: 24/9/2022



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BIODEV
2030



FIELD PAYMENT VOUCHER

Being payment of... TRANSPORT FOR FGA DISCUSSANTS

Date: 22/09/2022

Name	P/No. or ID/No.	Stakeholder	Type of allowance	Rate	No. of Days	Total	Signature
Elcana Kimani Mugo	21867997	Agro-impact		1000/-	1	1000	
Kimani Mugo	3366014	Farmer		1000/-	1	1000	
Leveton Olatofin	8336262			1000/-	1	1000	
Emmanuel Soroka	27332001	Oleshuru Irrigation Scheme		1000/-	1	1000	
Jane Siriniket	28570398	Mkulima		1000/-	1	1000	Jane
MEMUSI MOITA	24961421	Farmer		1000/-	1	1000	
Consolata Njoni	25478651	Farmer		1000/-	1	1000	
Daniel Mwaniki	25785258	Farmer		1000/-	1	1000	
JOHN MAPASHI	12741564	Farmer		1000/-	1	1000	
Mxbanus musyoka	MUTUA 0712064952			1000/-	1	1000	Musyoka
MICHAEL MBUGA	9022398	Agriculture		1000/-	1	1000	
Murahni Ezekiel	2019004043	MOAFC		1000/-	1	1000	
AMOS SILONKA	23956748	Farmer		1000/-	1	1000	Silonka
Naleto Neentu	24503472	Farmer		1000/-	1	1000	Naleto
Josephine Maseto	31386470	Input Supplier		1000/-	1	1000	
NKAYIO CHOKE	23358910	Community Mobilizer		1000/-	1	1000	Nchoke
Nyagoto tajeu	17953107	charcoal		1000/-	1	1000	Tajeu
Dickson sngir	29159256	charcoal		1000/-	1	1000	
Justine Kotukei	3929147	livestock		1000/-	1	1000	Kotukei...
TOTAL				1		19,000	

Approved by: Dr. Margaret Kinyua Date: 22/9/2022

Paid by: Dr. Anthony Madson Date: 22/9/2022