ANALYSIS OF URBAN AND PERI-URBAN PASTORAL HERD COMPOSITION, LAND-USE CHANGES, AND DRIVERS OF PASTORALISM IN NAIROBI CITY

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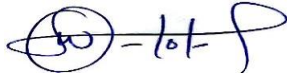
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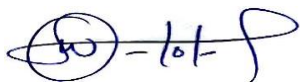**Registration Number:** A56/8312/2017

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DEDICATION

This thesis is dedicated to Mama Florance Awino Magero, you are most indelible; thanks for always praying, instructing, believing, and standing by me. To the dearest families of Mrs. Rosebella Auma Obatsa, Mrs. Martina Were Kubasu, Mrs. Mary Mutanda, Mr. Edward Bulumah, Mr. Ezekiel Jengo, Mr. Febio Shikuku, and Mrs. Mary Musikoyo; your invaluable sacrifices from the start of this journey, words-of-life even in the rough terrain, and practical lessons in my life are beyond rubies. To my siblings: Geofrey, Teressa, Agnes, and Conrad; I know you have been silently whispering your prayers, and waiting for this milestone. To all who have steered my academic wheel, I remain humbled, may your zealous exertions blossom the goodness, and favor of our Glorious God. To that person in despair, without a consoler, and fading purpose in this life: don't even trust yourself, alone to be entrusted is the Living God, the Father of all, with whom the light at the end of the tunnel abides.

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ASAL	Arid and Semi-Arid Land
BLR	Binary logistic regression
FAO	Food and Agriculture Organization of the United States
FGD	Focus Group Discussion
GDP	Gross Domestic Product
GIS	Geographic Information System
GoK	Government of Kenya
GPS	Global Positioning System
IFAD	International Fund for Agricultural Development
IGAD	Intergovernmental Authority for Development of Eastern Africa
IOM	International Organization for Migration
KCSAP	Kenya Climate Smart Agricultural Project
KIIs	Key Informants Interviews
KLA	Kenya Land Alliance
KNBS	Kenyan National Bureau of Statistics
LADA	Land Degradation Assessment in Drylands
LUCCC	Land Use and Land Cover Change
PGIS	Participatory GIS
RoK	Republic of Kenya
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme
USAID	United States Agency for International Development
WHO	World Health Organization
WISP	World Initiative on Sustainable Pastoralism

GENERAL ABSTRACT

Pastoralism supports more than 200 million pastoralist households globally, contributes significantly to the Gross Domestic Product (GDP) of several countries, and employs over 1.3 billion actors in livestock-related value chains worldwide. In Kenya, pastoralism is practiced in approximately three-quarters of the nation's landmass mainly in arid and semi-arid lands. Contrary to the expectation that herders would be pushed further away from the center of urban areas, pastoralists neighboring the city of Nairobi have increasingly migrated and settled in and around the city. This could be either as part of their seasonal migration routine to seek pasture and water during droughts or to settle and pursue complementary livelihoods in the city. This necessitates the need for requisite empirical evidence to guide the formation of policy and legislation in view of the current dynamics. This study was conducted to determine the drivers of pastoralists' migration to Nairobi City; the composition and structure of pastoral herds in the city, and land use and land cover changes within the grazing areas of the city over the past 20 years. Data was collected through 178 semi-structured household interviews, 21 key informant interviews, 12 focus group discussions, and four sessions of Participatory-GIS in the study sites.

Results of the binary logit model show that the search for pasture and water resources, and alternative markets were the main reasons for pastoralists' migration to the city. In addition, the findings show that herders with formal education were most likely to migrate and settle permanently in the city as they pursue wage employment besides herding. Poor access to pasture and water resources as well as lack of profitable markets for pastoralists' commodities at origin increased the probability of their migrating to the city by 36% and 30% respectively, while higher education levels increased their chances of migration by 23%. Although pastoralists encountered diverse livelihood opportunities such as wage employment and trade in livestock

products, they equally faced frequent road accidents involving livestock, displacements due to the development of real estates for settlement, and livestock poisoning from sewage and garbage wastes in the metropolitan. In view of these findings, there is a need for a more inclusive policy and regulatory framework that recognizes and considers pastoralism alongside other forms of urban and peri-urban farming. In addition, there is a need to investigate the viability of complementary livelihoods pursued by pastoralists in urban and peri-urban areas and their contribution to household income and resilience.

Analysis of pastoralist herd composition and structure shows that the livestock species kept mainly consisted of indigenous breeds with more grazers (cattle and sheep) than browsers (goats). Whereas breeding females comprised more than 50% of the herds, uncastrated males (bulls, bucks, and rams) formed the least class in the herds. Preference for crossbreed livestock was reported to be rising among the interviewed households, especially for the diversity of genotypical traits that make them suitable for multiple uses. There is a need for further research on the performance of the preferred crossbreeds in terms of their tolerance to drought and productivity in the face of climate change.

Participatory-GIS analysis of land use and land cover changes revealed a significant increment (between 187.8% and 955.5%) in the built-up area, and expansion (between 402.8% and 865.9%) of bare land area between the years 2000 and 2020. Whereas there was a reduction in grassland and forestland between (28.2% and 39.6%) and (28.1% and 76.7%) respectively, there was no significant change in wetland area during the two-decade period of study. The rapid expansion of real estate development into the former grazing land is restricting access to pasture, and therefore the need for policy interventions for inclusive and sustainable land use plans and by-laws that are cognitive of the multiple uses in the city.

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CHAPTER ONE

INTRODUCTION

1.1 Background

Pastoralism is globally recognized as the main economic activity in the vast arid and semi-arid rangelands of the world. It is practiced on approximately 25% of the earth's land surface, 66% of Africa, and 75% of Kenya's landmass (Ameso *et al*., 2018; Lugusa, 2015; UNDP, 2013). Pastoral production system sustains the livelihood of more than 1.3 billion people involved in livestock production and livestock-related value chains from over 200 million households; 90% of them are found in developing countries (Dong *et al.,* 2016; Karaimu, 2013; Reynolds *et al.*, 2011; UNEP, 2019). In Africa, pastoral livestock provides between 10 and 44 percent of the continent's gross domestic product (GDP) (Nyariki & Amwata, 2019). In Kenya, the pastoral production system is the mainstay of the livestock sector, which contributes 13% of the national GDP and provides more than 75% of the country's livestock which is worth US$860 million (Krätli *et al*., 2013; Nyariki & Amwata, 2019). In addition, over 90 percent of people in arid and semi-arid lands (ASALs) of Kenya rely on pastoralism as their main source of livelihood (GoK, 2010).

Traditionally, pastoralists' livestock serves several roles, for instance, as a source of food (meat, milk, and blood); hides and skins; manure for crop farming, cooking fuel (dry cow dung), and wet dung for plastering roofs and walls of traditional huts; animal draft power. Livestock is the main asset signifying wealth among pastoralist communities, that is easily sold during emergencies, and assists in meeting socio-cultural obligations such as payment of dowry, fines, and penalties on wrongs done, as well as for slaughter during ceremonies (Waters-Bayer &

Bayer, 2015). Ecologically, pastoralism enhances the growth of new and more nutritious forages through grazing; livestock excreta increase soil fertility, and increased plant growth which facilitates nutrient recycling, formation of stable soils, protection of watersheds from erosion, filtration and purification of rainwater, air purification and increased carbon sequestration. Grazer and browser species also protect rangelands from invasion by noxious plant species and control bush encroachment, thus regulating incidences of wildfires (McGahey *et al*., 2014; Kibet, 2016; UNEP, 2017).

Despite the enormous contribution of pastoralism to the local, regional and global economies, it experiences a myriad of challenges that continue to weaken, exacerbate and jeopardize its existence (Ickowicz *et al.*, 2012; Nkurumwa *et al.*, 2010; Omollo, 2017). Key of these challenges include increased subdivision of rangelands, changing land use and land tenure through anthropogenic activities like mining, large-scale cash crop farming, expansion of wildlife conservancies, and increasing demand for land by the settling communities (Ayantunde *et al*., 2011; Galaty, 2013; Njiru, 2012). In addition, pastoralists are facing extreme drought events attributable to climate change and increased land privatization leading to sedentarization of livestock herders, and consequently overgrazing, land degradation, poor livestock production, and impoverishment of pastoralists (Grădinaru *et al.*, 2018; Wasonga, 2009).

Pastoralists have been responding to these dynamics through various coping strategies, among them, keeping large and mixed herds, maintaining flexible stock sizes, selecting livestock for robust traits, maintenance of dry-season grazing reserves, and diversification of livelihoods (Descheemaeker *et al*., 2016; Silvestri *et al*., 2012). Unfortunately, most of these mechanisms have been rendered ineffective due to the increased environmental pressure and shocks on pastoral production, thus raising concerns about the sustainability and resilience of the system.

As these problems intensify, pastoralists are experiencing increased resource competition, often resulting in violent conflicts and insecure surroundings (Galaty, 2013a).

Over the last two decades, a growing number of pastoralists have been migrating and settling with their herds around the city of Nairobi (Alarcon, *et al*., 2017; IOM, 2015). As pastoralists migrate and interact with urban contexts, they are likely to access new opportunities for trade and wage employment (Van Zanten *et al.*, 2016), thus exiting pastoralism either temporarily or completely.

Although a number of studies have reported the reasons for pastoralists' migration to urban areas, the motives are however expected to vary in space and time. For instance, a study by Munishi (2013) found out that rural-urban migration of youths from pastoral areas in Tanzania is mainly employment-driven, while Leighton (2013) reported that cessation and drop-out from traditional pastoralism in Mongolia as pastoralists move to urban areas could be due to poor viability of rural livelihoods with the changing economic demands. Understanding the underlying causes of pastoralists' migration and settlement in urban areas is therefore fundamental in addressing challenges and transformations in the pastoral production system.

1.2 Problem Statement

Pastoral production system in Kenya like in the rest of Africa is facing a myriad of challenges, the main one being declining grazing land that undermines livestock productivity and therefore livelihoods of pastoralist communities (Kimiti, 2016; Silvestri *et al*., 2012). This trend has been attributed to changes in land use and land tenure systems, land fragmentation, lack of supportive policies to protect pastoralists' land from privatization and conversion to other uses (Nkedianye *et al*., 2020), and invasion by noxious-alien plant species (Kibet, 2016). Among the most

affected by land tenure and land-use changes are the pastoral areas of southern Kenya, adjacent to the city of Nairobi (Said *et al*., 2016) that have undergone a sequence of changes since pre-independence and post-independence times, among them, the fragmentation of group ranches and communal grazing lands, eventually restricting the mobility of pastoralist herds.

Left with limited options for grazing due to the restricted herd movement, pastoral communities are gradually changing their traditional way of life (Reid *et al*., 2014), including migration and settlement in areas within and around Nairobi City (IOM, 2015; Njiru, 2012). These movements do not only set pastoralists in mixed social set-ups that are likely to trigger conflicts between them and urban residents (Kaptuya, 2013; Kipng'ok, 2017) but also further weaken the pastoral production system, making pastoralists more vulnerable to socio-economic and climatic changes.

1.3   Justification of the study

Pastoral production system is an important economic activity in Kenya, the most efficient utilization of rangeland resources (Jenet *et al*., 2017), and a source of livelihood not only for 20 million people directly supported in Kenya (Nyariki & Amwata, 2019) but also other several households countrywide involved at various levels through production and trade in livestock-related value chains. Despite the enormous contribution of pastoralism to Kenya's economy, it is largely undervalued. In addition, although there are several policies and initiatives in support of pastoral adaptive and coping strategies globally (FAO, 2017a; UNDP, 2013; UN, 2015; USAID, 2020; WISP, 2010), regionally (IGAD, 2013), and nationally (GoK, 2012a, 2016; KLA, 2015; Nyariki & Amwata, 2019; Schilling *et al.*, 2012; Syomiti *et al.*, 2015), most of these efforts are often inappropriate in addressing the current social, economic, and cultural transformations in the pastoral system.

Several studies have been done on the migration trends of pastoralists to urban and peri-urban areas in Tanzania (Msinde, 2011; Munishi, 2013), and in Mongolia (Leighton, 2013) and Niger (Snorek, 2016) focusing on youth migration to urban areas, pastoralist drop-outs, and livestock demand in urban areas. However, there is a paucity of information on the drivers of pastoralists' migration and settlement with their animals in and around the city of Nairobi, the composition and structure of their herds as they migrate, and changes in access to grazing resources in areas utilized by pastoralists in the city. Such information is relevant in guiding decisions and formulation of policy interventions for resilient and sustainable pastoralism in urban and peri-urban areas.

1.4 Research Objectives

1.4.1 Broad objective

The broad objective of the study was to determine factors influencing pastoralists' migration to urban and peri-urban areas; the composition and structure of their herds; and land use and land cover changes in grazing areas in Nairobi City to guide the formation of policy and regulatory frameworks for resilient and sustainable urban and peri-urban pastoralism.

1.4.2 Specific objectives

The specific objectives of this study were to:

    (i) Determine factors that influence migration and settlement of pastoral herders in Nairobi City.

    (ii) Characterize the composition and structure of pastoralists' herds in the city.

    (iii) Analyze land use and land cover changes in areas utilized by pastoralists for grazing in the city.

1.5 Research questions

(i) Which factors motivate migration and settlement of pastoralists in Nairobi City?

(ii) Does the composition and structure of pastoral herds change when pastoralists migrate to urban and peri-urban areas?

(iii)How has land use and land cover changed and impacted access to grazing by pastoralists in the city?

1.6 Ethical consideration

Informed consent was sought from all the respondents before interviews and engagement in group discussions and resource mapping. Interviewees were assured that the information provided will be kept confidential and used only for academic purposes. Prior to the commencement of the study, a research permit was also obtained from the National Commission for Science, Technology, and Innovation (NACOSTI) of Kenya.

CHAPTER TWO

LITERATURE REVIEW

2.1 Pastoral production system in Kenya

Pastoralism is an economic and cultural livelihood activity that involves extensive livestock production in arid and semi-arid rangeland ecosystems through the use of indigenous knowledge, skills, and experience passed from one generation to another (Dong *et al*., 2016; Lengoiboni *et al*., 2010; Nyariki & Amwata, 2019; Reid *et al*., 2014). Pastoral production is a livelihood system where more than 50% of household income is derived from livestock and livestock products, mainly practiced in the rangeland ecosystems (Gebisa, 2018; Jenet *et al*., 2017). Rangelands comprise 41.3% of the world's landmass, 43% of Africa, 79% of East Africa, and over 80% of Kenya (Cervigni & Morris, 2016; Lugusa, 2015; Mbogo *et al.*, 2014; Middleton & Sternberg, 2013; UNDP, 2013). About 60% of the world's rangelands are classified as warm and dry (Gaitho, 2018), and are home to over 2 billion people, over 90% of them in developing countries (Reynolds *et al.*, 2011; UNEP, 2019). In Kenya, pastoralism is mainly practiced in the drylands also known as arid and semi-arid lands (ASALs), inhabited by about 32.6% of the nation's population (Ogutu *et al*., 2016), and have more than 75% of the country's livestock (Nyariki & Amwata, 2019).

In Kenya, pastoralism is characterized by ownership of large herds comprising mainly indigenous cattle, sheep, goats, camels, and donkeys. Based on livestock mobility, Krätli & Swift, (2014) categorized pastoralism into three forms, namely; nomadic pastoralists (who traditionally travel with animals from place to place and have no fixed habitation); semi-nomadic or transhumance (who move seasonally between two fixed regions during dry and wet seasons);

and semi-sedentary or agro-pastoralists (who have settled and also practice crop farming). Pastoralism is the major supplier of Kenya's livestock which includes cattle, sheep, goats, donkeys, and camels both for local and international markets (CARE International, 2014; Fre & Tesfagergis, 2013; Omollo, 2017). Traditionally, pastoralism makes use of mobility to harness transient dryland resources where other forms of farming are not feasible (Flintan *et al*., 2013; Koech, 2014).

In Kenya, the history of pastoralism dates back to the 3rd millennium B.C. when the Southern Cushites of Ethiopia and Southern Nilotic speakers of Sudan practiced herding, hunting, and fishing as a means of livelihood (Kyala, 2011). Pastoralism has evolved over the years and is increasingly adapting to socio-cultural, biophysical, and political dynamics (Jenet *et al*., 2017). However, the system has continuously encountered a myriad of challenges over the years, among them frequent droughts leading to livestock losses, changes in land tenure and land use, and frequent conflicts. Such transformations have increasingly restricted herd mobility which is the key strategy for sustainable pastoralism, therefore exposing pastoralists to various vagaries of nature.

2.2 Economic and ecological significance of pastoralism

Pastoral production system sustains the livelihoods of more than 200 million households and employs over 1.3 billion people who are involved in livestock-related value chains globally (Ameso *et al*., 2018; Kaptuya, 2013; Nyariki & Amwata, 2019). It contributes significantly to the world's agricultural Gross Domestic Product (GDP) specifically; 40% globally, 35% in Africa, 40% in East Africa, and 42% in Kenya (FAO, 2009; GoK, 2019; Nyariki, 2017). In Kenya, the pastoral system supports over 70% of the country's livestock and is a major source of income for 95% of people living in the ASALs (GoK, 2012b). The pastoral system is also a source of

various products such as wild honey, traditional herbs, hides and skins, leather and fibre products, gums, resins, and draft power (CARE International, 2014; Nyariki & Amwata, 2019; Robinson *et al.*, 2014).

Ecologically, pastoral communities are environmental stewards who utilize transient rangeland resources that vary in space and time (Gakuria, 2013; Shaughnessy, 2018). Pastoralist communities make use of diverse strategies in the management of rangeland resources among them, including maintenance and use of reserve grazing areas for use during dry seasons, frequent livestock mobilities that control overgrazing and land degradation, and use of fire for vegetation management (Descheemaeke *et al.*, 2016; Silvestri *et al.*, 2012). In addition, pastoralists possess indigenous knowledge on important rangeland plants, enhancing the preservation of rangeland habitats, contributing to biodiversity conservation, carbon sequestration, soil formation, water and air purification, and a healthy rangeland ecosystem (Seid *et al.*, 2016). Livestock grazing regulates incidences of rangeland invasion by noxious plant species and bush encroachment (Kibet, 2016); enhances soil properties such as improved infiltration and water holding capacity; soil microbial processes resulting in stable and fertile soils that support the growth of diverse plants and maintenance of wildlife habitats (Bhasin, 2013; Rayne & Aula, 2020). These in turn facilitate access to a variety of goods and services such as wild food, firewood, and medicinal products, as well as promote tourism through the conservation of landscapes and wildlife (Melak *et al.,* 2014).

2.3 Challenges facing pastoral production system in Kenya

Pastoralists in Kenya face a myriad of challenges that negatively impact their livelihoods, among them, changing land tenure, poor infrastructure, conversion of pastoral land into other uses such as large-scale crop farming, wildlife conservation, mining, and real estate development for

settling communities as a result of the bulging population and expansion in urban centers (Kimiti *et al*., 2018; Nkedianye *et al*., 2020). Increased urbanization in pastoral areas is driven by escalating land demand by both public and private sectors in need of creating hubs for economic growth, without consideration of its impact on pastoralism (FAO, 2017b). In addition, the advent of devolution in Kenya's governance system has led to the accelerated conversion of the marginalized rangelands into urban centers, thus encroaching pastoral territories (Chepsiror, 2016; Hope, 2012). This trend has led to increasing land privatization resulting in rangeland fragmentation and fenced enclosures that obstruct livestock corridors, making pastoralism less productive and vulnerable to climate variability and change.

Further to the restricted access to grazing resources, frequent and extreme droughts as a result of climate change have escalated water scarcity, famine, pasture scarcity, land degradation, and livestock mortalities due to starvation; resulting in the impoverishment of pastoralist communities (Boles *et al*., 2019; Koech, 2014; Mogotsi *et al.*, 2013; Opiyo *et al.,* 2015). Currently, approximately 61.4% of Kenya's total land area is susceptible to land degradation particularly in ASALs (GoK, 2016). This is attributable to extreme climatic events, fragile ASAL soils, reduced mobility, overgrazing, deforestation, and unsustainable agricultural practices. As a result, pastoralists are unable to access adequate pastures for their herds, hence exposing themselves to environmental shocks that jeopardize their livelihoods (Ogechi & Hunja, 2014; Rija *et al.*, 2013). Faced with these challenges, pastoralists are responding through migration and settlement around urban areas as they seek alternative livelihoods (IOM, 2015). Kaptuya (2013) reported that migration of pastoralists into urban areas subjects them to mixed social setups that often lead to violent conflicts with other urban residents. Moreover, as pastoralists engage in new

livelihood options, some may exit pastoralism either permanently or temporarily, thus impacting the sustainability of the pastoral production system.

2.3.1   Changes in pastoral land tenure system in Kenya

Land stands out to be the most fundamental natural resource and the main productive asset on which most livelihoods rely globally. In Kenya, land is regarded as a means of living and the most vital asset of ownership, since its intrinsic value is ever-increasing (Sigunga & Wandahwa, 2011). Land ownership right in Kenya is either through communal ownership, public, or private entitlement also referred to as an individual right of tenancy (RoK, 2016). Traditionally, pastoralists owned land on a communal basis under the authority of the elders, who came up with rules guiding seasonal livestock grazing and migration patterns, and acted as arbitrators during disputes, thus enhancing harmonious resource-utilization and peaceful co-existence among pastoralists (Watakila, 2015). These systems were well regulated by the availability of water and suitable pastures for extensive livestock production, the presence of migratory corridors, respect for the council of elders, and secure areas of refuge. However, over the centuries, there have been rapid conversions and transformations in pastoralists' land ownership that are of concern to the pastoral production system. These shifts in land tenure are mainly ascribed to the rise in the human population that has led to increased demand and privatization of pastoralists' land, thereby weakening traditional governance structures under the council of elders. Such shifts have been witnessed in the rangelands of southern Kenya and other pastoral areas following the onset of the formal system of governance, breakdown of group ranches and conversion of former grazing areas into wildlife conservancies as well as extensive cash-crop production (Greiner, 2016; Nkedianye *et al*., 2020). As a result, most of the pastoralist migratory routes have been

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blocked, and access to critical grazing resources restricted, especially during droughts, thus undermining the productivity and sustainability of the pastoral system.

2.3.2 Changing pastoral land use in Kenya

Land use is a human-induced modification of the natural environment into forms that serve the special needs of the people such as settlement areas, administration centers, transport infrastructures, industries, trading hubs, large-scale mechanized farms, forestland, conservancies, and aesthetic zones. These conversions are mainly triggered by increased population growth, urbanization, shortage in food production, and demand for more land to accommodate important government developments (Kiio & Odera, 2015; Maina *et al*., 2020). In Kenya, rangelands, which are home to pastoralist communities are in rapid transition as a result of escalated demand for land by non-pastoralists interested in obtaining land for settlement and crop farming. Pastoral areas are therefore serving as sinks for those driven away by the growing population pressure in the high potential agricultural areas countrywide (Lengoiboni *et al*., 2011; Nyanjom, 2014). In addition to these pressures, are the government's newly established projects to spur economic development in the rangelands such as the expansion of road networks, administration and trading centers, large-scale agricultural projects, and mining (Downie, 2011), among others.

The weakened traditional regulatory institutions and mechanisms coupled with increased demand for pastoral land, privatization, and land sub-division among pastoralists have made it easy to sell and purchase the communally-owned land (Nkedianye *et al*., 2020). This has resulted in reduced mobility and increased resource competition, which accounts for over 40% of conflicts within the pastoral communities (Abdi *et al*., 2013; Meshesha *et al*., 2012). As a result of continuous diminish in grazing land as well as rangeland conversion to other forms of land use, pastoralists

have increasingly diversified into other livelihood activities such as farming, and search for wage employment in urban areas to sustain their household needs.

2.3.3   Urbanization and its impacts on pastoral production systems

Urbanization is the expansion of towns accompanied by increased infrastructural development, immigration, and settlement of people from all social backgrounds. Globally, approximately 54% of the human population resides in urban areas and it is projected that by the year 2050, nearly 67% of the global population will be residing in towns, thus creating an urban-based planet (Anderson & Galatsidas, 2014; UN-Habitat, 2016). Mutisya & Yarime (2011) pointed out that urbanization goes hand in hand with increased demand for land from the ever-growing human population, expansion of real estates, commercial hubs, and industries.

Nairobi City, like many other cities globally, is experiencing a rapid rise in human population, development of its metropolitan and therefore expansion of urbanization into the neighboring pastoral areas mainly driven by the rising demand for housing. Kajiado County, being proximate to Nairobi City has been facing a series of land sub-division and conversions from former communal and group-ranch ownership to private ownership and wildlife conservancies, resulting in the loss of grazing land (Nkedianye *et al*., 2020; Boles *et al*., 2019). In response to the accelerating changes, pastoralists are probably moving-in instead of moving away from the city of Nairobi, which is a traditional dry-season grazing reserve for Maasai pastoral herders (IOM, 2015; Njiru, 2012).

2.4 Factors motivating urban and peri-urban pastoralism

Migration and settlement of pastoralists with their herds in urban areas are dependent on several factors, that vary from one region to another (Munishi, 2013). These determinants are broadly classified into two; push and pull factors (Sani-Ibrahim *et al*., 2021). Push factors entail those at origin that compel pastoralist herders to exit rural areas, whereas the pull context involves existing opportunities for pastoralists attracting them to urban and peri-urban areas. The push factors include extreme droughts as a result of climate change, violent conflicts over scarce resources, armed cattle raids resulting in insecurity, and increased privatization of pastoralists' land for settlement, farming, or mining, thus leading to a reduction in land for grazing (Abdulazeez *et al*., 2018; Bedelian & Ogutu, 2017; Watakila, 2015). On the other hand, the pull factors comprise the presence of water and pasture resources, wage employments, ready markets for pastoralist livestock, and commodities such as beadwork, traditional medicine, wild honey, leather products, and sandals as avenues for diversifying their livelihoods (Evangelou, 2019; McCabe *et al*., 2015; Sani-Ibrahim *et al*., 2021).

Besides seeking pasture and water, as pastoralists migrate and settle in towns, they are therefore likely to participate in livestock trade, meat, and milk trade, and wage-employments in private and public sectors (Alarcon *et al*., 2017; Little *et al.*, 2014). On the other hand, they are also likely to encounter mixed social cultures resulting in cultural erosion as they adopt new lifestyles (Cobbinah & Korah, 2016); restricted herd mobility in the densely populated area, and resource-based conflicts with other urban dwellers (Grimm & Lesorogol, 2012; Melak *et al.,* 2014).

CHAPTER THREE

FACTORS INFLUENCING MIGRATION AND SETTLEMENT OF PASTORALIST HERDERS IN NAIROBI CITY

ABSTRACT

Pastoralism is globally recognized as the backbone of the economy in the vast arid and semi-arid rangelands. Despite its enormous economic contribution, the system is facing a myriad of challenges among them, land use and land tenure changes resulting in diminished grazing land. Accompanying such changes is the conversion of traditional grazing lands into other uses such as settlements, with urbanization being one of the key drivers of pastoral system dynamics. Understanding such dynamics in the face of compounding factors such as frequent droughts linked to climate change is key in guiding policy formulation and interventions aimed at achieving a sustainable pastoral production system. This study investigated factors determining migration and settlement of pastoralists in Nairobi City of Kenya. Data was collected through a snowball sampling approach using semi-structured household questionnaires, focus group discussions (FGDs), and key informant interviews (KIIs) in five Sub-counties of Nairobi City County. A total of 144 household interviews, 6 FGDs, and 16 KIIs were conducted to elucidate the drivers of urban pastoralism, opportunities, and challenges encountered by pastoralists in the city. A binary logistic regression model was used to analyze the determinants of their migration. Results show that the search for pasture and water resources, and alternative markets especially during droughts are the main reasons for pastoralists' migration. In addition, educated herders were found to be more likely to migrate to the city as they pursue wage employment. Whereas these findings revealed that migration to the city exposes pastoralists to diverse livelihood opportunities, they are equally faced with a number of challenges mainly road accidents

involving livestock, frequent land displacements to pave way for the development of the real estate, and livestock poisoning from sewage and garbage wastes. There is a need for policy and regulatory interventions to recognize pastoralism alongside other forms of urban farming and to address challenges facing sustainable pastoral production.

Keywords*: Alternative markets, Livestock mobility, Pastoralist Livelihoods, Pasture and water, Urban and peri-urban pastoralism*

3.1 Introduction

Pastoralism is widely accepted as the most reliable economic activity and efficient use of the scattered and variable rangeland resources (Freier *et al*., 2012; IGAD, 2013; Koech, 2014). It is an economic and cultural livelihood system that involves mobile livestock management in rangelands using the traditional knowledge, skills, and experience acquired over several years (Gaitho, 2018; Nyariki & Amwata, 2019). It is practiced on more than 25% of the world's land surface; approximately 66% of Africa; and over 80% of Kenya's landmass; which is categorized as arid and semi-arid land (ASAL) (Ameso *et al.*, 2018; Lugusa, 2015; UNDP, 2013). Rangelands are home to over 2 billion people, 90% of them relying on pastoralism to sustain their livelihoods, of which the majority of them are found in developing countries (Reynolds *et al.*, 2011; UNEP, 2019). In Kenya, the pastoral production system is the mainstay of the livestock sector that provides over 75% of the nation's livestock estimated at US$860 million (Krätli *et al*., 2013; Nyariki & Amwata, 2019).

Despite the enormous economic contribution of pastoralism both locally and globally, it has been experiencing a myriad of challenges that undermine productivity and therefore resilience of the system. Some of the main challenges include frequent and prolonged droughts linked to climate change and increased change in land use and land tenure systems, thus diminishing land

available for grazing (Ayantunde *et al*., 2011; Biazin & Sterk, 2013; Njiru, 2012). Among the most affected pastoralists by these change dynamics is the Maasai pastoralist community located south of Nairobi City in Kenya, who primarily rely on livestock keeping as their main source of livelihood. In the last three decades, there have been rapid changes in land tenure arrangements among the Maasai herders due to weakening traditional system governance, the break-down of group ranches, increased land subdivision, and conversion of communally owned land to other land uses such as conservancies and large-scale agriculture, thus limiting access to grazing resources (Galaty, 2013b; German *et al.*, 2017; Said *et al.*, 2016b).

Furthermore, privatization of the traditionally owned land has become an issue of concern now than years before, resulting in the establishment of fenced enclosures, landlessness, and sedentarization of pastoralists due to restricted mobility (Boles *et al*., 2019; Snorek *et al*., 2017). Land privatization is largely attributed to the raised demand for land for settlement, and uncontrolled purchase and sale of pastoral land to non-livestock keepers, thus forcing pastoralists to become more immobile, subsequently resulting in overgrazing, increased land degradation, and impoverishment among pastoral households (Boles *et al*., 2019; Cobbinah & Korah, 2016; Egeru *et al*., 2019; Nkedianye *et al*., 2020). These trends have further occasioned the observed high livestock mortalities due to starvation, especially during extended droughts, increased competition for grazing resources, resource conflicts, and livelihood insecurity among pastoral communities (Brussels, 2012; Krätli & Swift, 2014). The outcome of these challenges is a decline in livestock productivity and pastoral livelihoods, thus necessitating a search for better grazing and livelihood options (Reid *et al.,* 2014; UN, 2011; WHO, 2019).

Pastoralists have traditionally responded to the spatial and temporal resource variability in the rangelands mainly through livestock mobility, which enables tracking of unevenly distributed

grazing and water resources. Herd mobility also facilitates escape from shocks like droughts, conflicts, and diseases, and enables access to markets, and other opportunities outside the pastoral system. Other coping strategies employed by the pastoralists include the selection of livestock for robust traits, keeping large and mixed herds, maintaining flexible stock sizes, livelihood diversification, and maintenance of dry-season grazing reserves (Descheemaeker *et al*., 2016; Silvestri *et al*., 2012). Unfortunately, most of these mechanisms have been rendered ineffective given the increased environmental variability and pressure on the pastoral production system. In the last two decades, an increasing number of pastoralists have been observed migrating from rural areas and settling with their herds within and around Nairobi City (IOM, 2015; Njiru, 2012), which traditionally served as a dry-season grazing area for the transhumant Maasai herders, having permanent homes but mobile with herds (Boles *et al*., 2019).

Generally, as pastoralists migrate and interact with the urban contexts, they are likely to encounter wider markets for their livestock, livestock-related products, and new opportunities outside their normal ways of life (Ancey *et al*., 2020; Van Zanten *et al*., 2016). Some of them are therefore thought to transit out of pastoralism temporarily or permanently to pursue other livelihoods in the city. In this paper, two forms of migration are considered; permanent migration, where herders move, settle, and occasionally engage in other economic activities in Nairobi City; and temporary migration, involving transhumant pastoralists who move to the city to escape drought and return to their homes in Kajiado and Narok counties as soon as it rains.

Although urban areas are gaining recognition as important refuge areas for migrating pastoralists, there is limited scientific knowledge on the determinants of these migrations. For instance, related studies by Ancey *et al.* (2020) in Chad and Burkina Faso, and Munishi (2013) in Tanzania examined rural-urban migration of youths from pastoral areas and their integration into

towns; Leighton (2013) studied the trends in pastoralist drop-out and urban migration in Mongolia; whereas Roessler *et al*. (2016) investigated the livestock demand in urban spaces of West Africa with low attention on determinants of permanent and temporary migration of pastoralists in towns. Understanding the underlying causes and implications of such relocations among pastoralists is fundamental in addressing the challenges facing pastoral systems in urban and peri-urban areas. The present study investigated the factors influencing the migration of pastoralists and their herds into Nairobi City. The results are expected to guide the decision-making and formulation of policy measures for resilient urban and peri-urban pastoral production and general city planning for multiple uses.

3.2 Methodology

3.2.1 Description of the study area

3.2.1.1 Location and geo-physical features

The study was carried out in the urban and peri-urban areas of Nairobi City, the administrative and economic capital of Kenya (Figure 3.1). Nairobi City falls between latitude $1^{\circ}\,09'$ and $1^{\circ}\,27'$ South of the equator, longitude $35^{\circ}\,59'$ and $37^{\circ}\,57'$ East of Greenwich. It is located in the central highlands of Kenya, at an elevation of 1400m towards the south-eastern side and 2200m towards the north-western region (Njoroge *et al*., 2011b). Although the City's land size covers 703.9 km^2, its metropolitan extends out to about 3,000 km^2 in the neighboring Kiambu, Machakos, and Kajiado Counties, which border it to the North and West, East and South respectively (Bekker & Fourchard, 2013).
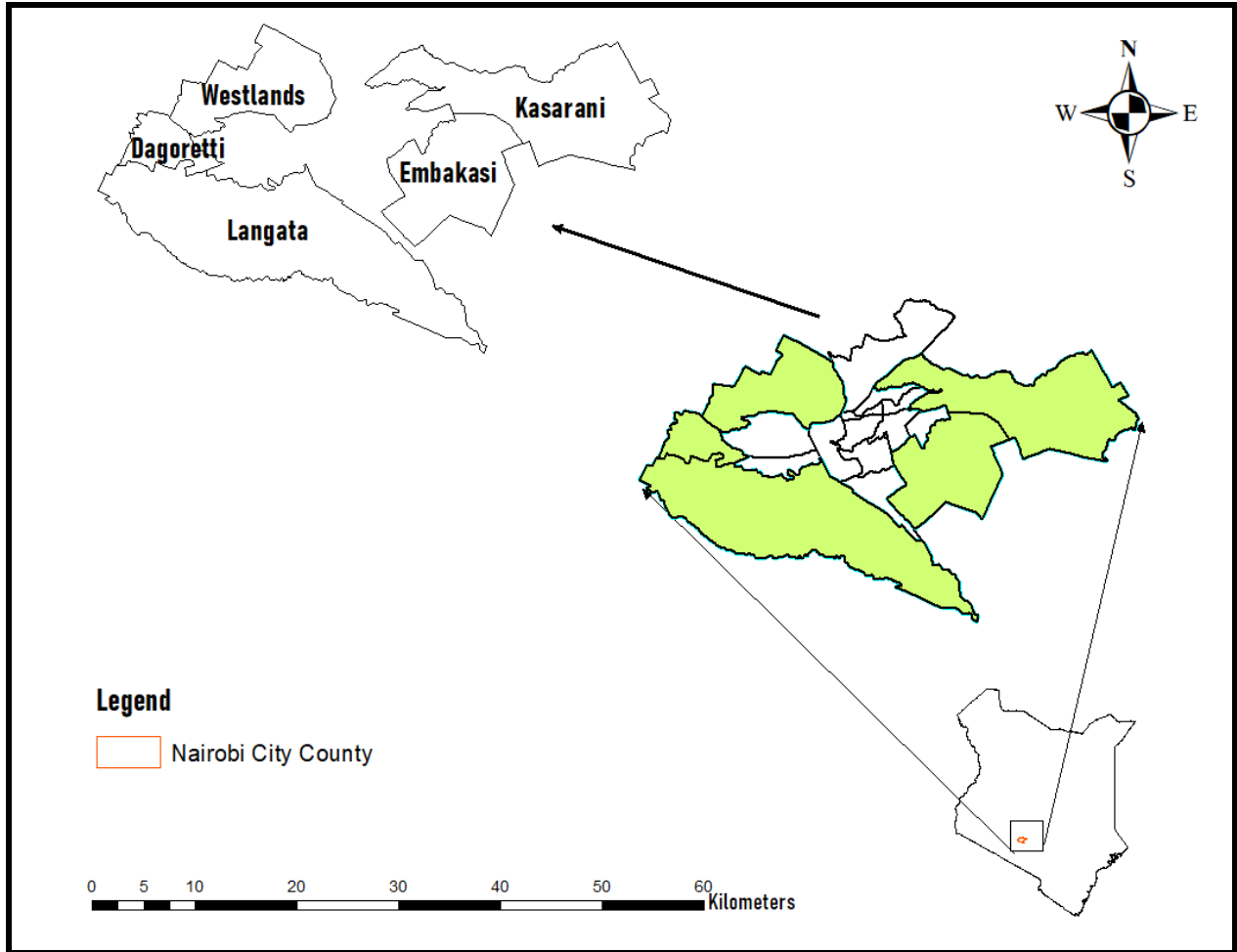
Figure 3.1: Study Area (Sub-Counties of Nairobi City County)

3.2.1.2 Climate

Nairobi City falls within agro-ecological zone III and experiences a typically sub-humid climate; with the coldest and cloudiest months between June to August, and warmest periods between December to March. It experiences a bimodal rainfall ranging from 638mm to 899 mm annually, and a minimum and maximum temperature of 10^0C and 29^0C on average, depending on the season and time of the day (GoK, 2014). The long rains occur from March to May, while short rains from October to December (Amwata *et al.*, 2015). The city is bordered by southern rangelands that include Kajiado and Narok Counties, which experience low and erratic rainfalls, and extreme, prolonged, and recurrent droughts (Omollo, 2017).

3.2.1.3   Land use

The major types of land use in the City include built-up areas (consisting of government offices, learning institutions, factories, commercial centers, and residential areas, recreational areas, transport infrastructure), forestland, unsettled grasslands, and water bodies such as dams, rivers, streams, and swamps (Morara *et al.*, 2014; Njoroge *et al.*, 2011). Other land use options include urban agricultural practices such as the cultivation of food and horticultural crops, agroforestry, fish farming, poultry farming, dairy farming, and pastoralism (GoK, 2015).

3.2.1.4   The People and Livelihood activities

Nairobi City is one of the fastest-growing and highly urbanized cities in Africa. The City's population is currently estimated at 4,400,000 people, which accounts for 8% of Kenya's human population (KNBS, 2019). It is a multicultural, multi-ethnic, and economic hub with residents from various social backgrounds who derive their livelihoods from various employment opportunities. Being proximate to the predominantly pastoral areas of Kajiado and Narok counties, and having been used traditionally by the Maasai pastoralists as a dry season area, the city supports pastoral herds that utilize water and pasture resources in unbuilt areas, especially during droughts.

3.2.2   Sampling Procedure and Data Collection

Five Sub-counties of Nairobi City were purposively selected for data collection based on the presence of pastoralist herds. The selected sub-counties included Dagoretti, Lang'ata, Embakasi, Kasarani, and Westlands. A reconnaissance study was conducted to identify the pastoral areas, pre-test the data collection tools, and adapt them to the local settings for efficiency during data collection. Upon citing the first *boma* (livestock kraal), a snowball sampling approach was used to identify the location of other *bomas* and *manyattas* (pastoralist settlements) in Nairobi City. A total of 144 households selected through a proportionate sampling of the five sub-counties were

interviewed in Dagoretti (13), Lang'ata (97), Embakasi (17), Kasarani (15), and Westlands (2) between February and October 2020. In addition, 16 key informant interviews (KIIs) and six focus group discussions (FGDs) were conducted to complement and validate the information from individual households. Each FGD comprised between six and eight participants consisting of a mixture of youth (between 18-35 years), men and women (35-60 years), and the elderly (above 60 years). On the other hand, KIIs consisted of the leaders of pastoralist groups in the city, livestock traders, transport service providers, and officials from the county and national governments including local administrative officers, agricultural extension, veterinary officers, and forestry department officers.

3.2.3   Data Analysis

Descriptive data analysis was done using STATA version 15 to generate means, standard deviations, frequencies, and percentages of the socio-demographic attributes of the sampled pastoralist households. A binary logistic regression model was used to determine factors motivating migration and settlement of pastoralists in Nairobi City.

3.2.4   Description of the binary logistic regression

The migration of pastoralists and their herds into Nairobi City was used as the dependent variable (Y) in the binary logit model. This variable was categorized into a binary response namely; pastoralists who have migrated permanently (who move out and into Nairobi City at different seasons) and those who have migrated temporarily (those moving into the city only during the extended dry season and drought periods and back home soon after it rains). The dependent variable was assigned a dummy value of 1 for the permanent migration and 0 for temporary migration. The independent variables hypothesized to influence the migration of pastoral herders included household herd size, household land size, access to pasture and water,

alternative markets, pests and diseases, gender of household head, age of respondent, household size, education level, and presence of relatives in Nairobi City (Table 3.1).

Table 3.1: Description of explanatory variables and expected influence on the dependent variable

Variable	Description and unit of measurement	Expected influence
Dependent variable		
Migration	Nature of migration (1=permanent migrants, 0=temporary migrants)	
Independent variables		
Household herd size	Number of livestock units owned by a household (TLU)	+
Household land size	Number of hectares of land owned by a household (ha)	-
Pasture and water	Access to pasture and water (1=Yes, 0=No)	-
Alternative markets	Seeking alternative markets (1=Agree, 0=Disagree)	-
Livestock pests and diseases	Presence of livestock pests and diseases (1=Yes, 0=No)	±
Gender	Sex of the household head (1=Male, 0=Female)	+
Age of respondent	Number of years of the respondent (1=18-35 years, 0=Above 35 years)	-
Household size	Number of persons living together under one household	+
Education level	Level of formal education attained (0=No education, 1=Primary, 2=Secondary, 3=Tertiary)	+
Relatives in Nairobi	Presence of relatives in Nairobi (1=Yes, 0=No)	+

(+) *implies likely to migrate permanently,* (-) *implies likely to migrate temporarily*

3.2.4.1   Household herd size

Herd size was expected to have a positive relationship with pastoralist migration. It was hypothesized that the larger the number of animals owned by a pastoralist, the faster depletion of available forage, which increases the chances of migrating permanently into new areas. For standardized comparison of livestock numbers, household herds were converted into Tropical Livestock Units (TLUs), a universal unit of measurement of which 1 TLU is equivalent to a

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250kg livestock life body-weight (Abebe, 2012) and calculation made using livestock species conversion factor as described by Gietema (2006) and Ducrotoy, *et al*. (2017)[1].

3.2.4.2   Household land size

Households' land size was hypothesized to have a negative influence on the migration of pastoralists to the city. It was expected that pastoral households owning small parcels of land were more likely to migrate to the city and stay longer than those with larger land sizes. This is partly because the size of land owned by a household is regarded as an indicator of wealth (Omollo, 2017). Wealthy households are therefore not only able to afford the cost of temporary migration both within and between seasons but also have somewhere to go back to as compared to small parcel owners or landless ones. In this study, household land size was a continuous variable measured in hectare (ha) units.

3.2.4.3   Access to pasture and water

Access to pasture and water resources was expected to have a negative influence on the migration of pastoralist households. It was expected that pastoralists with limited access to pasture and water at origin were more likely to migrate and stay longer in the city as compared to those having better access. This is because pasture and water are central to pastoral livestock production. In this study, access to pasture and water resources was a dummy variable assigned 1 if respondents migrated in search of pasture and water in the city, and 0 if they did not migrate for this reason.

3.2.4.4   Alternative markets

The availability of alternative markets and income-generating opportunities in the urban areas was considered to be positively correlated to the migration of pastoralists to the city. Poor

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[1] For tropical animals, 1 dairy cattle=1 TLU, 1 bull=0.8 TLU, 1 cattle=0.7 TLU, 1 heifer=0.3 TLU, 1 donkey=0.5 TLU, 1 sheep or goat=0.1 TLU and 1 chicken =0.01 TLU.

livestock markets and unsupportive market-based policies have been among the major constraints in the pastoral production sector (Amwata *et al*., 2016; Brussels, 2012). Therefore, perceptions of better market opportunities in urban areas are likely to trigger migration and longer stays in the city by pastoralists who wish to take advantage of trade opportunities to enhance their livelihoods. Alternative markets are opportunities for trade and attractive prices for pastoralists' commodities in the city not available at origin. Such market opportunities include the sale of live animals, milk, livestock manure, leather products (belts, wallets, and sandals), clubs, beadwork, wild honey, and traditional medicine in the city. Search for alternative markets by pastoralists in Nairobi City was a dichotomous variable assigned 1 if the respondent moved to seek alternative markets and 0 if they did not for this reason.

3.2.4.5   Livestock pests and diseases

Livestock pests and diseases was hypothesized to have both positive and negative effects on the pastoralists' migration. This is because the occurrence of pests and diseases such as East Coast fever (ECF), Foot and Mouth Disease (FMD), Rift Valley fever (RVF), and Trypanosomiasis among others, undermine the health and productivity of pastoral herds and thus expected to trigger migration to new areas of refuge (D'Alessandro *et al*., 2015). Pastoralists who have been previously exposed to pests and diseases are more likely to migrate permanently to other areas to evade such shocks. On the other hand, the outbreak of livestock pests as diseases was unlikely to cause the migration of pastoralists to the city, since pastoralists are well known to possess indigenous technical knowledge (ITK) for management of livestock pests and diseases that have previously faced them (Muricho *et al*., 2018; Oba, 2012; Onono *et al*., 2019). In this study, this was a dummy variable, denoted by "yes" if the respondent mentioned pests and diseases as the reason for migration to the city, otherwise "no" if they didn't give that as the reason for migration.

3.2.4.6   Gender of household head

The gender of the household head was expected to have a positive influence on the settlement of pastoralists in Nairobi City. Migration is normally labor-intensive and also requires resources. It was therefore hypothesized that male-headed households were more likely to migrate permanently since they are often privileged to have access to resources and can marshal the much-needed herding labor than their female-headed counterparts. Gender was a dummy variable assigned a value of 1 for the male respondent and 0 for the female respondent.

3.2.4.7   Age of respondent

Age was expected to have a negative effect on the migration and settlement of pastoralists in the city. It was anticipated that younger pastoralists, being in greater need of employment are more likely to migrate in search of opportunities in urban areas. Most pastoralist youths seek wage employment as security guards, drivers, civil servants, casual laborers, and engage in business or petty trade outside herding (Coppock *et al*., 2017; IOM, 2015; Munishi, 2013). In addition, the youths are the ones mainly entrusted with herding in pastoral systems, and therefore would be the ones to migrate with herds to the city. The respondent's age was assigned a value of 1 to the youth (aged between 18 and 35 years), and 0 if above 35 years.

3.2.4.8   Household size

Household size was expected to have a positive effect on the migration of pastoralists to the city. This is because large households that have readily available labor are likely to migrate and stay longer than their counterparts with no or less herding labor. Herding labor is a critical production factor in extensive livestock production systems (Roessler *et al*., 2016). Respondent's family size was a continuous variable measured as the total number of individuals in a household, consisting of the household head, spouse(s) of the head, children, relatives, and employed laborers.

3.2.4.9 Education level

Education plays a critical role in influencing social networks, access to information, and several employment opportunities (Kibera, 2013; Ochieng & Waiswa, 2019). The respondent's education level was hypothesized to be positively related to the settlement of pastoralists in the city. This is because pastoralists with higher education levels are more likely to access a variety of livelihood opportunities and stay longer in the city as compared to those with little or no education. In this study, education level was measured based on the level of formal education attained, and assigned four levels namely: 0 if not educated, 1 for primary education, 2 for secondary education, and 3 for pastoralists with tertiary education level.

3.2.4.10 Relatives in Nairobi

Pastoral communities rely on kinship ties, especially when faced with shocks such as droughts and as a result, individuals will tend to gravitate back to the family and clan bonds during hardships. It was hypothesized that the presence of relatives in Nairobi has a positive influence on pastoralists' migration and settlement in the city. Pastoralists with relatives in the city are usually assured of assistance in times of crisis and therefore likely to migrate and settle permanently in the city as compared to the ones without relatives in Nairobi. Those who have relatives were assigned 1, otherwise 0 for those without relatives in the City.

3.2.5 Specifications of the Binary Logit Model

A binary logit model was used to determine the factors that influence the migration of pastoralists to Nairobi City, given that the nature of the dependent variable elicited dichotomous responses of "permanent" and "temporary" migration. Binary Logistic Regression (BLR) was selected over Ordinary Least Regression (OLS) because it accommodates categorically measured variables, non-linear relationships, and non-normally distributed residuals (error terms). The

BLR model was chosen after the statistical test for normality confirmed that the error terms were logistically distributed at p<0.05.

The logit model was represented as follows:

$$Log\left[\frac{P_1}{1-P_1}\right] = Logit(P_1) = \alpha + \beta_i x_i + \mathcal{E}_i \quad\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$Y = In\left[\frac{P_1}{1-P_1}\right] \quad\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

The regression model for pastoralist migration was specified as follows:

$$Log\left[\frac{P_1}{1-P_1}\right] = \alpha + \beta_1 HDSZ + \beta_2 LASZ + \beta_3 APW + \beta_4 ALTM + \beta_5 LPD + \beta_6 GEN + \beta_7 AGE$$
$$+ \beta_8 HSZ + \beta_9 EDL + \beta_{10} REL + \mathcal{E}_i \quad\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Where:

P_1 is the probability of migrating permanently; $(1-P_1)$ the probability of migrating temporarily; $\left[\frac{P_1}{1-P_1}\right]$ is the odds ratio; Y is the dependent-categorical variable; x_i is the ith predictor variable; α and β_i are the estimated coefficients for predictor variables and $\mathcal{E}_i$ the error terms in the model.

The predictor variables in equation 3 are specified as HDSZ=household herd size, LASZ=household land size, APW=access to pasture and water, ALTM=alternative markets, LPD=livestock pests and diseases, GEN=gender of the household head, AGE=age of the respondent, HSZ=household size, EDL=education level, and REL=presence of relatives in Nairobi.

3.2.6   Multicollinearity statistical test

To ensure the non-correlation assumption is not violated in the binary logistic model, a multicollinearity test was carried out to establish the relationship between explanatory variables.

The Variance Inflation Factor (VIF) method for multicollinearity detection was preferred since it provides both magnitude and acceptable collinearity limits in the model.

The VIF equation was specified as follows:

$$\text{VIF} = \frac{1}{1 - R_i^2} \quad\text{.. (4)}$$

Where R_i^2 is the root-squared regression value with i^{th} predictor variable regressed onto the remaining independent variables. The VIF for the predictor variables in the model ranged between 1.09 and 1.73, with a mean VIF of 1.28, which is greater than 1 and less than 5 (Table 3.2), implying that there was no multicollinearity and therefore the variables were suitable for use in the model.

Table 3.2: Multicollinearity Test for Predictor Variables in the Model

Variable	VIF	1/VIF (Tolerance)
Household size	1.73	0.578
Age of respondent	1.62	0.618
Household land size	1.32	0.758
Education level	1.27	0.789
Household herd size	1.26	0.792
Relatives in Nairobi	1.20	0.834
Livestock pests and diseases	1.12	0.889
Access to pasture and water	1.12	0.891
Alternative markets	1.12	0.894
Gender	1.09	0.918
Mean VIF	1.28	

3.3 Results

3.3.1 Socio-demographic characteristics of the sampled households

The findings of this study show that 41% of the interviewed respondents were permanent migrants in Nairobi City (Table 3.3). The average household herd size was significantly different between the permanent pastoral migrants (28.97±2.44 TLU) and temporary pastoral migrants (23.30±1.91 TLU). The average household land size at the respondents' origin was 12.14±1.69

hectares and 17.79±1.79 hectares for permanent and temporary migrants respectively. However, there was no significant difference in the mean family size between permanent migrants (6.36±0.30) and temporary ones (6.84±0.30).

Most of the household heads were males (90.6%), confirming a male-gender bias concerning livestock ownership and herding responsibility among pastoralist communities. About 44.1% of the herders in the city were the youth aged between 18 and 35 years of the permanent migrants as compared to 62.3% of their temporary counterparts. Permanent and temporary migrants with primary education were 44.1% and 40% respectively, while those who had attained post-primary education were 27.1% and 8.2% respectively. Only a few (28.8%) of the permanent migrants had not attended school as compared to 51.8% of the temporary migrants.

Majority of the permanent migrants (69.5%) and temporary migrants (64.7%) had kinship alliances through relatives in the City. Only 39% of the permanent migrants indicated that they seek pasture and water resources in the city, as compared to 61.2% of temporary migrants. Search for alternative markets was mentioned as the key reason for migration to the city by 62.7% of the permanent migrants and 43.5% of the temporary migrants. Livestock pests and diseases was mentioned to be a driver for pastoralist migration by 25.4% of the permanent migrants and 21.2% of the temporary migrants.

Table 3.3: Socio-demographic attributes of the sampled pastoral households

Variable		*Proportion of respondents*	
		Permanent Migrants N=59 (41%)	Temporary Migrants N=85 (59%)
Continuous predictor variables		*Mean ± SD*	*Mean ± SD*
Household herd size		28.97±2.44	23.30±1.91
Household land Size		12.14±1.69	17.79±1.79
Household size		6.36±0.30	6.84±0.30
Categorical predictor variables		*Frequency (%)*	*Frequency (%)*
Gender	Male	52(88.1)	77(90.6)
	Female	7(11.9)	8(9.4)
Age of respondent	Youths	26(44.1)	53(62.3)
	Elderly	33(55.9)	32(37.7)
Education level	Not-educated	17(28.8)	44(51.8)
	Primary	26(44.1)	34(40.0)
	Secondary	15(25.4)	6(7.0)
	Tertiary	1(1.7)	1(1.2)
Relatives in Nairobi	Yes	41(69.5)	55(64.7)
	No	18(30.5)	30(35.3)
Access to pasture and water	Yes	23(39.0)	52(61.2)
	No	36(61.0)	33(38.8)
Alternative markets	Yes	37(62.7)	37(43.5)
	No	22(37.3)	48(56.5)
Livestock pests and diseases	Yes	15(25.4)	18(21.2)
	No	44(74.6)	67(78.8)

Source: Household Survey Data 2020, (N=144)

3.3.2   Determinants of pastoralists' migration to Nairobi City

The model was found to be suitable and had a good predictive ability as evident in the log-likelihood (-76.08%), Chi-square (42.75), and R^2 (0.346). Five out of the ten explanatory variables significantly influenced the migration of pastoralists to Nairobi City, which included household herd size, household land size at origin, access to pasture and water, search for alternative markets, and respondent education level (Table 3.4).

The household herd size had a positive and significant ($p < 0.05$) effect on the migration of pastoralists. An extra TLU increased the likelihood of migrating by 0.7 percent. This indicates

that the larger the number of animals kept, the greater the likelihood of pastoralists migrating and staying longer in the city.

Household land size at origin had a negative and significant (p<0.05) influence on the migration of pastoralists. An additional hectare of land reduced the chances of pastoralists' migration by 0.9 percent. This implies that the smaller the land available for livestock grazing, the higher likelihood of pastoral herders migrating to other areas.

Access to pasture and water resources had a negative and significant (p<0.01) effect on migration pastoralists. Pastoralists who had limited access to pasture and water had a higher tendency to migrate and settle permanently in Nairobi City. The marginal effect of -0.358 indicated that increasing access to pasture and water by one unit reduces the chances of migration by 35.8%.

Alternative markets at origin showed a negative and significant (p<0.01) influence on the migration of pastoralist herders. This suggests that the lack of reliable markets increases the probability of pastoralist migration and longer stays in Nairobi City, which is perceived to have attractive market opportunities. The marginal effect of -0.303, showed that increasing access to alternative markets by one unit reduces the chances of pastoralists' migration by 30.3%.

Education level had a positive and significant (p<0.01) influence on the migration of pastoralists, implying that educated herders had a higher tendency of migrating and settling permanently in Nairobi City as compared to those with no or low education. The marginal effect of 0.231, means that a unit change in the level of education of a pastoral herder increases the likelihood of migration to urban areas by 23.1%.

Table 3.4: Logit model estimates for determinants of pastoralists' migration to the city

Migration	Coef. (β)	z	p>z	Marginal Effect
Household herd size	0.031(0.013) *	2.31	0.021	0.007(0.003)
Household land size	-0.037(0.018) *	-2.08	0.038	-0.009(0.004)
Access to pasture and water	-1.561(0.442) **	-3.53	0.000	-0.358(0.093)
Alternative markets	-1.320(0.444) **	-2.97	0.003	-0.303(0.095)
Livestock pests and diseases	-0.428(0.503)	-0.85	0.395	-0.104(0.123)
Gender	0.084(0.736)	0.11	0.909	0.020(0.175)
Age of respondent	0.432(0.515)	0.84	0.402	0.103(0.122)
Household size	-0.052(0.104)	-0.5	0.619	-0.012(0.025)
Education level	0.973(0.322) **	3.03	0.002	0.231(0.077)
Relatives in Nairobi	0.415(0.480)	0.86	0.387	0.097(0.109)
Constant	-0.345(1.403)	-0.25	0.806	-

Statistical significance levels: **0.01 and *0.05; Chi-square (df=10) =42.75 (p<0.001); log likelihood = -76.08%; R^2=0.346; N=144; Standard errors in parenthesis.

3.3.3 Opportunities and challenges encountered by herders in Nairobi City

The results showed that pastoralists who migrated to Nairobi City come across both new livelihood opportunities and challenges (Table 3.5). The main livelihoods pursued by the herders in the City included trade in livestock (62.5%), cattle milk (70.8%), livestock manure (81.3%), and wage employment (40.3%). Other sources of income for pastoralists included the sale of beadwork (29.9%), traditional medicine (17.4%), clubs and leather products (10.4%), and wild honey (8.3%) as represented in Figure 3.2.

Figure 3.2: Market opportunities for pastoralists in Nairobi City

On the other hand, the key challenges faced by herders in the city included frequent road accidents involving livestock (65.3%), displacement from *bomas* (73.6%), and livestock poisoning from sewage and garbage wastes (52.8%). Most of the road accidents involving livestock were reported on the Eastern Bypass, Southern Bypass, and Mombasa roads at animal crossing points to access pasture and water. The key informants indicated that it was rare to find a pastoral herd without a lame animal as a result of road accidents. Also, most herders reported that the law does not protect them since no policy and regulatory frameworks are supporting both animal and motorist corridors for efficient mobility in the city. In addition, 29.9% of the respondents encountered conflicts over grazing and watering points with other city residents, 37.5% reported restricted access to pasture and water resources, whereas 26.4% mentioned inadequate access to veterinary services (Table 3.5).

Table 3.5: Opportunities and Challenges encountered in the city

Opportunities	*Frequency of respondents (%)*
Livestock trade	90(62.5)
Cattle milk trade	102(70.8)
Livestock manure trade	117(81.3)
Traditional medicine trade	25(17.4)
Wild honey trade	12(8.3)
Beadwork trade	43(29.9)
Clubs and Leather Products trade	15(10.4)
Wage employment	58(40.3)
Challenges	
Frequent road accidents involving livestock	94(65.3)
Displacement from *bomas*	106(73.6)
Conflicts over grazing and watering points	43(29.9)
Livestock poisoning from sewage and garbage wastes	76(52.8)
Restricted access to pasture and water	54(37.5)
Inadequate access to veterinary services	38(26.4)

Source: Household Survey Data 2020, (N=144)

3.4 Discussion

3.4.1   Characteristics of permanent and temporary pastoralist migrants in Nairobi

The results of this study indicated that the proportion of the temporary migrants in Nairobi City was higher than that of their permanent counterparts. This can be attributed to the fact that most pastoralists would traditionally move to urban areas just temporarily during times of scarcity, and return home after it has rained and pasture has regenerated. Njiru (2012) and Akapali (2018) reported the migration of several transhumant herders especially during droughts, in search of pasture and water to safeguard their herds from starvation, unlike the permanent herders who are already settled in the urban areas. However, these findings contrast those of Lea *et al*. (2020) in Turkana, which showed that there is no significant difference between the permanent and temporary herders moving to urban areas as a result of pasture and water scarcity at the origin.

The findings showed that the temporary pastoral migrants in Nairobi City owned larger parcels of land back at their homes of origin as compared to the permanent migrants. This explains in part why the former would find it easy to return home after drought unlike their counterparts owning small parcels of land who therefore opt to stay longer or permanently in the city to take advantage of flexibility and availability of pasture and water throughout the year. These results agree with the findings of Munishi (2013) in Tanzania, Kimiti *et al*. (2018) in the Amboseli ecosystem, and Roessler *et al*. (2016) in West Africa, which pointed out that pastoralists who have little or no access to grazing land are likely to migrate and stay longer away from the origin, than those with access to land for grazing when they get back home. In contrast, the findings disagree with those of Ogara (2018) in Marsabit, and Ogutu *et al*. (2016) in the twenty-one dryland counties of Kenya, which showed that irrespective of the land ownership rights among pastoralist herders, decisions for permanent or temporary migration is a factor of several factors

including extended drought periods resulting in famine, armed-cattle raids, insecurity, plagued livestock diseases, resource-conflicts, and dislocation from social amenities.

In the current study, the majority of the permanent herders in the city were educated (primary and levels beyond) as opposed to the temporary herders. This is probably because educated pastoralists are likely to secure wage employment or other business opportunities when they migrate, hence opt to stay permanently in the urban areas. In contrast, herders with little or no education are unlikely to move permanently to the city, because they lack the skills required for most jobs in towns, and therefore the reason why they migrate temporarily to the city and return home following rains. The findings of Ameso *et al*. (2018) in Laikipia, Ancey *et al.*, (2020) in West Africa, and Hoffmann *et al*. (2019) in India, showed that formal education offers migrating herders with tailored skills necessary for wage employment in the urban areas, thus likely to attract settlement among educated herders unlike their temporary counterparts with little or no formal education. Although several studies have been done on the role of education in the migration of pastoralists to towns, no findings specify differences in education among pastoralists who have migrated either permanently or temporarily to urban areas.

The findings showed that whereas most of the temporary migrants were mainly seeking pasture and water in the city, the majority of permanent migrants were in search of other opportunities besides water and pastures, such as alternative markets for livestock trade, selling wild honey, beadwork, traditional medicine, and leather products. This may be ascribed to scarcity in pasture and water due to extended droughts and seasonal variability necessitating migration of temporary herders; and the reducing dependence on livestock as the only source of livelihood among the permanent migrants. Similar observations were noted by Hauck & Rubenstein (2017) in Laikipia, Opiyo *et al*. (2015) in Turkana, and Ogara (2018) in Marsabit town. They noted that the

majority of temporary pastoralist migrants tend to relocate to urban areas which are less grazed especially during droughts and return home when it has rained and pasture has regenerated. On the other hand, the permanent migrants in the city are in search of something beyond pasture and water, hence likely to participate in the urban markets, which they can easily access, and have higher profits than those in rural and marginal areas. These findings are in support of studies conducted by Alarcon *et al.* (2017a) in Nairobi City, Tessema *et al*. (2019) in Ethiopia, McCabe *et al*. (2015) in Tanzania, and Little *et al*. (2014) in the Horn of Africa, which pointed out that urban markets serve as the terminal markets with higher prices and demand for pastoralists' commodities, and thus likely to attract migration and extended stays of pastoralists seeking better markets to sustain their livelihoods.

3.4.2 Factors influencing migration of pastoralists to Nairobi City

The results of the regression analysis show that household herd size, household land size, access to pasture and water, presence of alternative markets, and respondent's education level are the key determinants of pastoralists' migration to Nairobi City. These findings are in agreement with the results of Munishi (2013) in Tanzania, and Leighton (2013) in Mongolia, which showed that rural to urban migration of pastoralists is primarily a livelihood-linked phenomenon. In addition, environment-induced disturbances which result in inefficient livestock production and poor livelihood options among pastoralists exacerbate the need to migrate (IFAD, 2018).

In the current study, pastoralists with large herds were more likely to migrate because large herds are likely to deplete available forage resources more quickly, thus necessitating migration to less resource competitive areas. Owners of few herds are also likely to comfortably buy supplemental feeds like hay, which is expensive for larger herds. Furthermore, the increased rivalry for available resources may lead to violent conflicts and tensions among pastoral herders (Njiru,

2012), thus encouraging the relocation of pastoralists and an extended stay at their destinations. In contrast, the incidence of resource-based conflicts is less likely to be reported among pastoralists with fewer herds compared to those owning larger herds (Kagunyu, 2014; Kaimba *et al.*, 2011).

The findings revealed that pastoralists with small parcels of land have a higher tendency of migrating and settling in the city permanently as compared to their counterparts with large parcels at home. Small landholdings may be attributed to the increasing land privatization, and conversion to other uses such as settlement schemes, mining, extensive agricultural practices, and wildlife conservancies, diminishing land available for grazing as well as necessitating migration to new refuges for grazing (Galaty, 2016; Kimiti *et al*., 2018; Njeru, 2017). While this observation confirms the hypothesis that households with smaller land sizes are more likely to migrate permanently into the city, it also shows that small landholders are less wealthy and more vulnerable during droughts, necessitating relocation to new areas. In contrast, the studies by Pas (2018) in Samburu, and Lekapana (2013) in Marsabit, revealed that regardless of the amount of land owned, pastoralists migrate permanently due to increased conflicts, and insecure areas for livestock production.

The results also show that limited access to pastures and water is one of the main reasons for pastoralists' migration and permanent stays in Nairobi City. This could be attributed to the occurrence of frequent and extended droughts leading to water scarcity, inadequate pasture supply, and high livestock mortalities due to starvation (Boles *et al*., 2019; Koech, 2014; Opiyo *et al.,* 2015), which necessitate migration of pastoralists and extended stays outside their origins. In addition, the sedentarization of pastoralists at origin has led to increased resource-based

competition, which compels pastoralists to migrate and seek pasture and water resources in less competitive areas outside their homes (Gakuria, 2013; Nabenyo, 2020; Njiru, 2012).

This study revealed that the presence of ready markets for livestock, livestock products, beadwork, leather products, traditional medicine, and wild honey attracts pastoralists to the city. This can be explained by the fact that in East Africa, pastoralists are in search of strategic market opportunities to expand returns from livestock keeping, as well as livelihood diversification through livestock trade and livestock-related commodities (Homewood *et al*., 2012), leading to migration and permanent stays in their destinations. Studies by Alarcon *et al.*, (2017b) in Nairobi City and Roessler *et al*. (2016) in West Africa, also confirmed the existence of diverse market opportunities for pastoralists in urban areas. As Tully & Shapiro (2014) reported, pastoral areas have been characterized by poor livestock markets, market information barriers, and poor prices, thus upsetting the profitability and viability of the pastoral system.

The results of the study show that majority of the permanent pastoralist migrants in Nairobi City were educated as compared to their temporary counterparts who had low or no education. This may be attributed to the fact that education provides professional and technical skills necessary for wage employment in urban and peri-urban areas, thus motivating permanent migration to urban areas in search of wage employment. These results agree with the findings of Ochieng & Waiswa (2019) in Uganda and Siele *et al*. (2011) in Kenya, which showed that education enables the acquisition of skills and capacity of pastoralists to access decent employment in urban areas, therefore the tendency to relocate to urban areas to seek such opportunities.

3.4.3   Opportunities and Challenges encountered in Nairobi City

The findings of this study indicated that pastoralists who have migrated to Nairobi City have income-generating opportunities from trade in livestock, livestock manure, cattle milk, and

employment both in the formal and informal sectors. The results further reveal that despite their relocation to urban areas, their livelihoods are still centered around livestock-related enterprises. These results agree with the findings from other researchers (Nyariki & Amwata 2019; Little *et al*. 2014; and Roessler *et al.* 2016) which confirmed that opportunities for pastoralists in urban areas largely consist of selling animals, milk, livestock manure, and casual employment.

Most of the pastoralists who have migrated into Nairobi City reported frequent road accidents involving livestock, displacement from *bomas* and *manyattas* to pave way for real estate developments, and livestock poisoning from sewage and garbage wastes. These may be attributed to the heavy vehicle traffics; increased land privatization and establishment of new infrastructural developments such as settlements, factories, and business hubs; and poor waste and sewerage disposals in the densely populated city environment. As Alarcon *et al*. (2017b), Asadu *et al.* (2021), and Wilson (2018) noted, livestock production in urban areas is highly constrained by frequent animal-vehicle accidents, increased conversion of available land to other uses, and poor dumping of wastes that are toxic to livestock.

3.5 Conclusions

Contrary to the expectation that herders would be pushed further away from the center of urban areas, pastoralists from neighboring Kajiado and Narok Counties have increasingly moved to the city of Nairobi either as part of their seasonal migration routine to seek pasture and water during times of scarcity or to settle and pursue complementary livelihoods besides pastoralism. The results have revealed that whereas pastoralists mainly migrate to Nairobi City to track pasture and water, a significant number are pulled by the economic opportunities in the city. The findings indicated that even with migration to the city, pastoralists' livelihoods are still livestock-centered, mainly involving the sale of live animals, livestock manure, and milk. Other economic

opportunities in the City include trade-in beadwork, traditional medicine, wild honey, clubs, and leather products. In addition, once in the city, educated herders often diversify their livelihoods by pursuing wage employment.

Despite these opportunities, herders in the city encounter several challenges, mainly, frequent road accidents involving livestock, displacement from settled areas to pave way for expanding real estate development, and poisoning of livestock from sewage and garbage wastes. There is a need for a more inclusive policy and regulatory framework that recognize and consider pastoralism together with other forms of urban and peri-urban farming. Furthermore, there is a need to investigate the viability of complementary livelihoods pursued by pastoralists in urban and peri-urban areas and their contribution to household income and resilience.

CHAPTER FOUR

CHANGE IN HERD COMPOSITION AND STRUCTURE AS PASTORALISTS SETTLE IN URBAN AND PERI-URBAN AREAS: THE CASE OF NAIROBI CITY

ABSTRACT

Herders have often responded to frequent and extended droughts, conversion of communal grazing land, and consequent loss of livestock productivity by migrating to urban areas either to track pasture and water for their livestock or to seek alternative livelihoods. Nairobi is one of the cities which have experienced such migration from the neighboring pastoral areas of Kajiado and Narok Counties. These trends are accompanied by a number of changes not only in the general lifestyle of pastoralists but also in practices, with implications on the integrity and role of the system. Among the changes expected when pastoralists migrate to urban areas are changes in size and composition of their herds, which are attributed to changes in resources, aspirations, and purpose of keeping livestock in their new environments. This study sought to understand the composition and structure of herds kept by pastoralists in the city compared to those in the neighboring rural parts of Kajiado North Sub-County. A total of 178 households were interviewed using a semi-structured questionnaire on the type species, breeds, and class of animals kept by herders in the city and neighboring pastoral areas. In addition, key informant interviews and focus group discussions were used to authenticate the information from individual interviews. Results show that pastoralists' herds in the two study sites are mainly comprised of indigenous breeds. However, preference for crossbreeds is rising among pastoralist households in the city unlike those in the neighboring rural areas. In Nairobi city, pastoralists mainly raised livestock for the market as live animals, milk, and manure unlike in the rural Kajiado North Sub-County, where livestock is mainly for meeting subsistence and socio-cultural obligations. There

is a need for further research on the performance of the preferred crossbreeds in terms of their tolerance to drought and productivity.

4.1 Introduction

Pastoral production in Kenya, like elsewhere in the world, immensely benefits millions of people and is responsible for the sustenance of the ecological integrity of rangelands (Van Zanten *et al*. 2016). Overall, pastoralism contributes to 40% of the world's agricultural Gross Domestic Product (GDP), 35% in Africa, 40% in East Africa, and 42% in Kenya (GoK, 2019; Nyariki, 2017). It is a critical source of revenue for approximately ninety-five percent of people in arid and semi-arid lands (ASALs) of Kenya (Omollo, 2017). Given the diverse benefits, pastoralism has a great potential for the achievement of local, national, and international goals for economic development.

The ruminant livestock for Kenya comprises 15.8 million cattle (82% indigenous, and 18% exotic breeds), 19.3 million sheep, 28 million goats, 4.6 million camels, and 1.2 million donkeys (KNBS, 2019). Pastoral systems dominate livestock markets, providing over 75% of the nation's ruminant livestock for local and export markets (Nyariki & Amwata, 2019; Wafula *et al*., 2022). Livestock species play both social, cultural, ecological, and economic roles among pastoral communities. These roles include livestock as a source of food (meat, milk, and blood); manure for crop farming and dry cow dung for fuel; supply of leather products; animal-draft power; insurance during emergencies; payment of dowry, and payment of fines when settling disputes in the community (Djohy, 2017; Nyariki & Amwata, 2019; Waters-Bayer & Bayer, 2015). Besides,

pastoral livestock are the major commodities of exchange through cross-border and export trade from the Horn of Africa to the Middle-East countries (Musa *et al*., 2020; Ng'asike *et al*., 2020).

Traditionally, pastoralism has evolved and adapted to various dynamics such as climate variability, forage scarcity, and inter-communal conflicts, and has become the most efficient means of utilizing rangeland resources (Dong *et al.,* 2016). Pastoralists employ various coping strategies to the vagaries of nature, among them, frequent livestock mobility, keeping large herds of mixed species, creation of dry-season grazing reserves, and maintaining flexible stocks in the harsh environment (Descheemaeker *et al.*, 2016; Silvestri *et al.*, 2012). However, most of these adaptive strategies have been weakened partly due to increased extreme climatic events, including droughts and floods, rise in population that has put pressure on pastoral land, leading to their conversion and privatization, thus resulting in restricted livestock mobility, high livestock losses, and poor pastoral livelihoods (Lugusa, 2015; Nkedianye *et al*., 2020). The situation is made worse by either the absence or weak customary institutions that traditionally regulated resource use in pastoral areas.

These trends are normally accompanied by a number of changes in the general lifestyle of pastoralists and particularly the practices, with implications on the sustainability of the pastoral production system. Among the changes expected when pastoralists migrate to urban areas are shifts in size and composition of their herds, which are attributed to changes in resources, aspirations, and objectives of keeping livestock in their new environments. The purpose of this study was to compare the composition and structure of pastoralists' herds in Nairobi City to those in the nearby rural parts of Kajiado North Sub-County. The findings are expected to influence the development of policies and strategies which will ensure the sustainability of the pastoral

production system in the face of current environmental and climatic changes, particularly in urban and peri-urban areas.

4.2 Methodology

4.2.1   Description of the study area

This study was conducted in Nairobi City (as described in section 3.3.1), and Kajiado North Sub-County, south of Nairobi City. Kajiado North Sub-County is located between latitude 1° 17' and 01° 27' South, and longitude 36° 42' and 36° 49' East. It covers an area of 110.6 km^2 and has a population of 306,596 people (Census, 2019). The study area experiences an average temperature range of 13^{0}C to 25^{0}C (Morara *et al.*, 2014), and a bimodal annual rainfall of 979.2mm; long rains are expected between March and May, while the short rains between October and December (Amwata *et al.*, 2015). The main source of livelihood in Kajiado Sub-county is extensive and semi-extensive livestock production, with a number of households also practicing crop farming for both subsistence and commercial purposes.

4.2.2   Sampling Procedure and Data Collection

The sampling procedures described in section 3.3.2 were employed in the two study sites, Nairobi City and Kajiado North Subcounty. The latter was selected as a rural origin of the majority of pastoralists in the city, as revealed during the reconnaissance study. The five wards of Kajiado North Sub-county were selected for this study namely; *Ongata Rongai, Oloolua, Olkeri, Ngong,* and *Nkaimurunya*. Data for this study was collected using a semi-structured survey questionnaire designed to capture the number of livestock species, breeds, and classes of livestock kept by the interviewed households. A total of 178 households, consisting of 144 in the city and 34 in Kajiado North Sub-county were sampled to provide data for the survey. In

addition, 21 key informant interviews and eight focus group discussions were conducted to provide a detailed understanding of the nature of herds, preferences, and purpose of livestock kept by pastoralists in Nairobi City and rural Kajiado North Sub-County.

4.2.3   Data Analysis

The collected data was analyzed to generate descriptive statistics on types of livestock species, breeds, and classes kept by pastoralists in Nairobi City and rural Kajiado North Sub-County. Mann-Whitney U test, which allows the determination of significant differences in two grouped data with different observations, was conducted to compare the composition and structure of pastoral herds in the two study areas.

4.3 Results

4.3.1   Composition and structure of livestock species kept in Nairobi City and neighboring rural areas of Kajiado North Sub-County

Most of the livestock species kept by pastoralists in the two study areas consisted of cattle, goats, and sheep (Table 4.1). Whereas these results show significant differences in cattle kept by pastoralists in Kajiado North Sub-County and Nairobi City (52.67% and 44.28% respectively) and goats (9.62% and 16.66% respectively), the proportion of sheep in Kajiado North Subcounty (37.71%) and Nairobi City (39.07%) was insignificantly different. The dominant cattle breed kept by pastoralists in Nairobi City was the pure Boran (41.92%), while the East African Zebu dominated (85.02%) herds in Kajiado North Subcounty. The Galla breed was the most dominant goat breed in Kajiado North Subcounty (68%), and Nairobi City (57.59%). The Dorper breed was the most preferred among sheep breeds with 46.41% and 54.72% in Nairobi City Kajiado North Sub-County respectively. In both cases, the proportion of crossbreeds in the herd was highest in Nairobi City than in Kajiado North Subcounty. Whereas the breeding females (lactating and dry) formed the largest proportion of the herds, with 53.49% in Nairobi City and

64.41% in Kajiado North Subcounty, the non-breeding females (old dry-females) were the least,

comprising 7.48% and 2.93% in Nairobi City and Kajiado North Subcounty respectively.

Table 6: Composition and structure of livestock herds kept by pastoralists in Nairobi City and neighboring rural areas of Kajiado North Sub-County

Livestock category (species, breeds, and classes)	Proportion (%) of the household herd	
	Nairobi City (Urban and peri-urban)	Kajiado North Subcounty (Rural system)
Species		
Cattle	44.28	52.67
Goats	16.66	9.62
Sheep	39.07	37.71
Breeds		
East African Zebu Cattle	27.92	85.02
Boran Cattle	41.92	0
Sahiwal	23.42	0.09
Cattle Crossbreeds	14.89	6.70
Exotic breeds	0.04	0
Galla Goat	57.59	68.00
Small East African Goat	25.27	21.50
Goat Crossbreeds	17.14	10.50
Dorper Sheep	46.41	54.72
Red Maasai Sheep	29.74	31.38
Somali Sheep	19.56	11.86
Sheep Crossbreeds	4.28	2.04
Classes		
Male	20.53	17.60
Female	60.97	67.34
Immatures (calves/kids/lambs)	18.50	15.06
Adults	81.50	84.94
Breeding females (cows/does/ewes)	53.49	64.41
Old non-breeding females	7.48	2.93
Castrated males (steers)	12.46	12.60
Uncastrated males (bulls/bucks/rams)	8.07	5.00
Pure breeds	83.88	90.38
Crossbreeds	16.12	9.62

Source: A household survey *(n=178)*

4.3.2 Livestock breeds kept by pastoralists in Nairobi City and Kajiado North Subcounty

Livestock breeds kept by pastoralists in Nairobi City and Kajiado North Subcounty were predominantly local breeds (Table 4.1). Cattle pure breeds mainly included the East African Zebu, Boran, and Sahiwal. The main pure breeds of goats consisted of the Galla and Small East African goats, whereas those of sheep included the Dorper sheep, Red Maasai, and Somali Black-head. There was a significant difference in the average number of East African Zebu (p=0.00), Sahiwal (p=0.01), crosses of indigenous cattle (p=0.02), and crosses of native goat breeds among pastoralist herds in the city and Kajiado North Subcounty (Table 4.2). The FGD participants indicated that although native breeds dominated their stock, preference, and selection for crossbreeds was rising among herders in the city. Only one pastoralist owned pure exotic cattle breed (Jersey) among the *manyattas* in the city.

Table 4.7: Average number of various livestock breeds in the sampled pastoralist households

Species	Breed	Mean number of various livestock breeds per household in urban and peri-urban (Nairobi City), and rural (Kajiado North Subcounty)				
		Nairobi City Mean ± SD	Kajiado North Subcounty Mean ± SD	U-test	Z	p
Cattle	East African Zebu	15.41±11.79	35.81±12.01	240.00	-6.24	0.00*
	Boran	20.89±26.43	0	-	-	-
	Sahiwal	17.94±13.53	1	0.50	-1.68	0.01*
	Crosses	16.16±7.82	8.15±4.26	276.50	-2.28	0.02*
	Exotic (Jersey)	2	0	-	-	-
Goats	Galla-goat	18.85±10.96	17.00±8.12	230.00	-0.12	0.91
	Small East African	13.56±9.76	7.17±2.64	67.50	-1.46	0.15
	Crosses	8.95±5.82	4.20±3.83	45.00	-1.85	0.01*
Sheep	Dorper	21.67±13.88	23.83±10.50	731.00	-1.09	0.27
	Red Maasai	16.04±10.92	17.57±8.39	493.00	-0.97	0.33
	Somali Black-head	11.97±9.69	10.33±7.63	305.00	-0.41	0.68
	Crosses	6.09±5.39	3.20±1.64	68.50	-0.87	0.38

Significance level at 5%, (n=178)

4.3.3 Pastoral household livestock Classes in Nairobi City and Kajiado North Subcounty

The dominant livestock category consisted of the breeding females, while the least class was the uncastrated males (bulls, bucks, and rams) among pastoralists' herds in both study areas (Table 4.3). There was a significant difference between breeding cows (p=0.02), non-breeding cows (p=0.00), goat-kids (p=0.03), and rams (p=0.02) in Nairobi City and Kajiado North Sub-county. On average, pastoralists who had migrated to Nairobi City had more non-breeding cattle, goat-kids, and rams than their counterparts back in the rural Kajiado North Sub-county.

Table 4.8: Average number of various livestock classes in sampled pastoralist households

Species		Mean number of livestock classes per sampled household herd in Nairobi City (urban and peri-urban), and origin (rural areas)				
Class		Nairobi City Mean ± SD	Kajiado North Sub-County Mean ± SD	U-test	Z	p
Cattle	Calves	5.3±2.38	6.73±3.11	1322.00	-0.796	0.43
	Breeding cows	13.35±11.31	31.59±22.48	952.50	-2.351	0.02*
	Non-breeding cows	8.76±5.89	2.0±1.34	36.50	-4.489	0.00*
	Steers	7.53±7.25	6.16±3.15	1052.00	-0.075	0.94
	Bulls	3.81±3.62	2.15±0.78	1267.00	-1.181	0.24
Goats	Kids	7.23±4.39	3.43±1.27	112.00	-2.097	0.03*
	Breeding does	14.85±8.62	17.5±6.63	196.50	-1.123	0.26
	Non-breeding does	3.67±2.73	2.0±1.0	17.00	-1.299	0.19
	Steers	6.47±6.09	2.83±1.47	86.00	-1.557	0.12
	Bucks	2.67±1.69	1.63±0.92	146.00	-1.747	0.08
Sheep	Lambs	8.17±6.29	6.38±4.66	614.50	-1.054	0.29
	Breeding ewes	25.39±17.9	28.89±12.52	674.00	-1.692	0.09
	Non-breeding ewes	8.8±5.58	6.0±6.78	73.50	-1.522	0.13
	Steers	9.09±5.79	8.27±4.98	280.50	-0.551	0.58
	Rams	3.87±3.02	2.06±1.09	436.00	-3.069	0.00*

Significance level at 5%, (n=178)

In the two study areas, female animals were more than males; mature animals were more than immature/young stock (calves, kids, and lambs); and castrated males (steers) more than their uncastrated counterparts (bulls, bucks, and rams). Pastoralists who had migrated to Nairobi City

generally had a lower proportion of female animals, and the breeding ones in particular, and generally fewer adult animals in their herds than their counterparts in the neighboring rural areas of Kajiado North Subcounty (Figure 4.1). Whereas the proportion of pure breeds in household herds was highest in the neighboring rural Kajiado, crossbreeds of indigenous livestock were dominant among the city herds. (Figure 4.1).
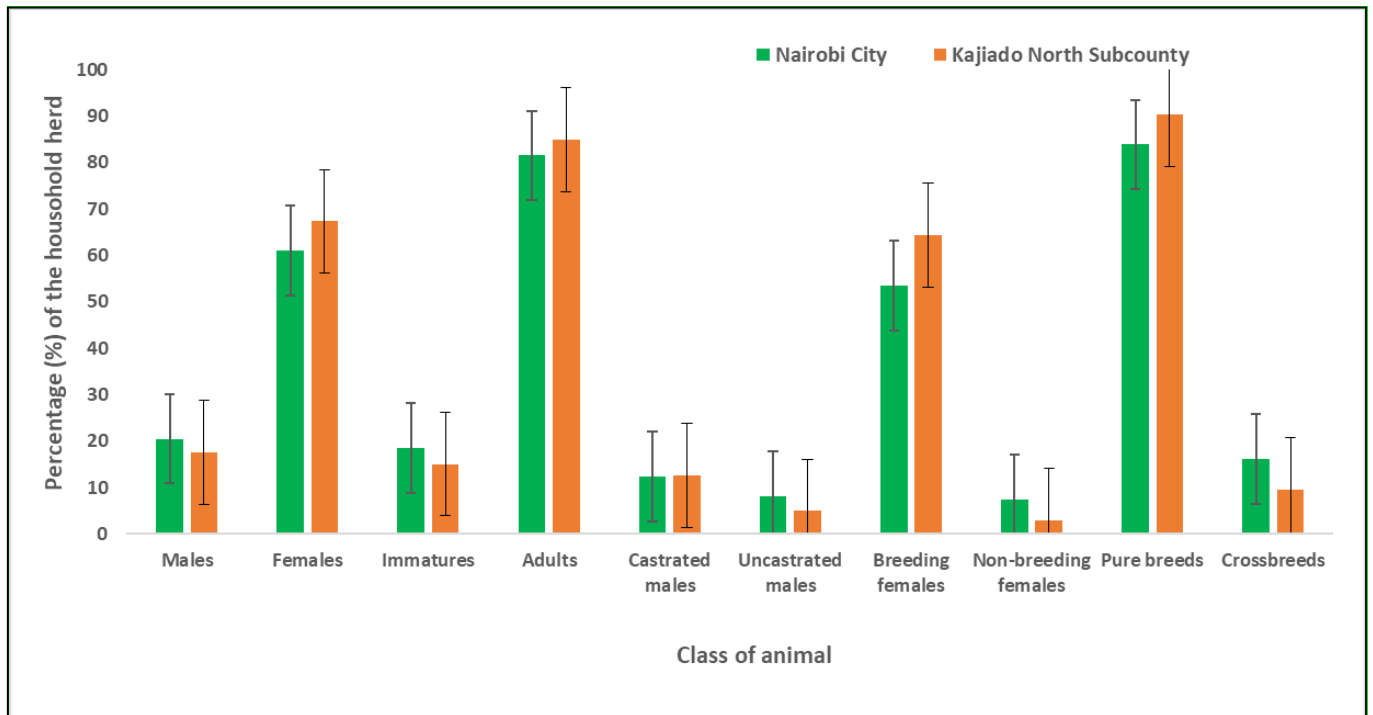
Figure 4.1: Herd structure (cattle, goats & sheep) in the sampled households

4.3.4 Purpose of livestock species kept by pastoral households in Nairobi City and the neighboring rural parts of Kajiado North Sub-County

Results show that most pastoralists in the City (86.1%) and Kajiado North Sub-County (95.7%) primarily kept livestock as an inherited cultural practice. A low proportion, 53.5%, of the interviewed households in Nairobi City, as compared to 70.4% in Kajiado North Subcounty reported livestock keeping as a reserve for emergencies. Most pastoralists in the city, unlike those in rural areas, kept livestock to target urban markets for live animals, milk, and manure,

while some were specifically involved in fattening and selling animals. However, 69.1% of herders in Kajiado North Sub-County kept livestock for meat, normally consumed at home compared to 21.8% in the city (Table 4.4).

Table 4.9: Pastoralists' reasons for keeping livestock in Nairobi City and Kajiado North Subcounty

The purpose of keeping livestock	Percentage (%) of respondents	
	Nairobi City	Kajiado North Sub-County
Inherited cultural practice	86.1	95.7
Reserve for emergencies	53.5	70.4
Livestock for sale	55.1	25.8
Milk for home consumption and sale	71.5	41.9
Manure for sale	66.7	36.2
Meat for home consumption	21.8	69.1
Fattening livestock for sale	42.4	8.4

Source: Household survey 2020 *(n=178)*

4.4 Discussion

4.4.1 Composition and structure of livestock species among pastoralist households

The results show a significant difference in livestock herd composition and structure between urban and peri-urban areas of Nairobi City and the neighboring rural areas of Kajiado North Sub-County. In addition, pastoralist households in Kajiado North Sub-County kept larger herd sizes than their counterparts in Nairobi City. This can be ascribed to the fact that small herds are easy to manage in the busy urban environment. Studies by Alarcon *et al.* (2017) in Nairobi City, and Dabasso *et al.* (2018) in Laikipia, Narok, and Taita Taveta, confirm that pastoralists keep flexible stock sizes that can be comfortably managed, as well as always try to match the numbers with grazing resources in space and time for sustainability.

Results indicate that the number of grazers (cattle and sheep) in household herds was higher than browsers (goats) in the two study areas. In addition to the fact that the Maasai are traditionally

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cattle and sheep keepers, this could be partly due to the nature of pasture in the city that favors grazers such as cattle and sheep. Further still, it may be difficult to herd goats in the busy city environment as they are likely to stray into farms and roads, and as such considered a potential source of conflict. However, studies by Makau (2017) in Machakos County and Matete and Shumba (2015) in Turkana County indicated that pastoralists keep more goats because they require small landholdings thus suitable for highly populated areas compared to sheep, they breed faster and require minimum investment making them profitable than other species in urban and rural areas.

4.4.2   Breed composition of pastoralist households' herds

Indigenous livestock breeds were predominant over the exotic types among pastoralists in the two study areas. This can be attributed to the fact that the local breeds are more adapted to droughts, tolerant to pests and diseases, can endure long-distance trekking in search of pasture and water, and are therefore easy to manage. The findings confirm the observations by Mgongo *et al*. (2014) in Tanzania, Mwangi *et al*. (2020) in Laikipia County, and Tura *et al*. (2011) in Marsabit, that pastoralists prefer keeping indigenous breeds since they have rich knowledge in their management, low-cost requirement and ability to withstand harsh environments where exotic breeds rarely survive.

The findings further indicated that pastoralists in Nairobi City kept diverse herds than their Kajiado North Sub-County counterparts. This may be due to the ease of acquiring other breeds as they interact with other communities from various parts of the country through trade in the City. Pastoralists in the city mainly preferred crossbreed animals, because, unlike purebreds, crossbreeds have dual traits such as fast growth rate, high milk production, pest and disease resistance, tolerance to drought, and fast weights gain that make them fetch higher prices than

the indigenous breed in urban livestock markets. These findings corroborate previous studies which showed that pastoralists selectively crossbreed their livestock for characteristics that improve production and returns from their herds (Dossa *et al*., 2015; Mgongo *et al*., 2014; Zonabend König *et al*., 2016)

4.4.3   Livestock classes kept by pastoralist households

The breeding females comprised the larger proportion of household herds in both study areas, while the uncastrated males (bulls, bucks, and rams) were the least category in the herds. This is because pastoralists traditionally keep a low bull to cow ratio to ensure efficient breeding and fast herd multiplication, as well as faster recovery following droughts. The findings support those of Mwanyumba *et al.* (2015) in Garissa County and Wanjala & Njehia (2014) in Western Kenya, which showed that a large number of breeding females among herders is a necessary long-term strategy for regeneration and maintenance of the livestock populations.

The results also reveal that castrated males (steers) in the herd were higher than their uncastrated counterparts (bulls, bucks, and rams). This is a result of the selective breeding process that ensures that fewer males with the desired traits are allowed to breed, whereas the rest are castrated and fattened for sale, and eventually slaughtered for beef. The results agree with those of Dabasso *et al.* (2018) in Laikipia, Narok and Taita Taveta, Dioli (2018) in Turkana, and Ducrotoy *et al*. (2016) in Nigeria, that castration is a common practice among pastoral herders as a way of controlling breeding, and fattening of steers for slaughter by butcheries or individuals in meat value chains.

4.4.4 Purposes of livestock kept by pastoralists in Nairobi City and the neighboring rural areas of Kajiado North Sub-County

Most of the pastoralist households who have migrated to Nairobi City, unlike their counterparts in Kajiado North Sub-County indicated their main reason for keeping livestock as trade in live animals, milk, and manure. The households seem to be market-oriented to take advantage of the ready market due to the high demand for livestock and their products in the urban and peri-urban parts of the city. Studies by Alarcon *et al*. (2017b) in Nairobi City, Nyariki & Amwata (2019) in Kenya, Tully & Shapiro (2014) in Kenya, and Roessler *et al*. (2016) in West Africa, reported the existence of high market opportunities for pastoralists' livestock and livestock products in urban areas. Fewer herders in Nairobi City kept livestock for meat home consumption as compared to their counterparts in Kajiado North Sub-County. This can be explained by the fact that the different social cultures and lifestyles in the city are likely to influence the dietary behavior of migrated pastoralist households', and given access to alternative foodstuff, they are unlikely to focus on rearing livestock for just subsistence, but rather to take advantage of the ready market for various livestock and livestock products in the city.

4.5 Conclusions

Pastoralists in the city, like their counterparts in the rural areas, keep mixed-species herds of cattle, sheep, and goats, predominantly of indigenous breed, which are tolerant to droughts, pests, and diseases, and endure long-distance treks in search of pasture and water. However, preference for crossbreeds is increasingly rising among pastoralist households in the city as compared to those in the neighboring rural areas of Kajiado County. The majority of pastoralists in the city mainly keep livestock to sell the live animals, milk, and manure, as opposed to the scenario in the rural areas, where livestock are kept mainly for meeting subsistence and socio-cultural obligations.

CHAPTER FIVE

CHANGING LAND USE AND LAND COVER IN AREAS UTILIZED BY PASTORALISTS FOR GRAZING IN NAIROBI CITY

ABSTRACT

Urban areas of the world are facing rapid land use and land cover changes (LULCC) mainly due to the rise in human population and growth occasioned by the expansion of industries, administrative institutions, transport infrastructure, and real estate to accommodate the settling communities, and commercial centers for economic development. Nairobi City, like many other cities in the world, is experiencing fast growth and expansion to its neighboring regions, thus leading to continuous land conversion, which has implications for other multiple uses, among them urban and peri-urban pastoralism. This study analyzed LULCC in the areas used by pastoralists in the city of Nairobi. Four Participatory GIS sessions and four focus group discussions (FGDs) were conducted to determine LULCC between the years 2000 and 2020 in *Oloropil, Darfur, Kimbo,* and *Karen Plains Manyattas,* where pastoralists reside in the city. The area under each land use and land cover (LULC) was analyzed using ArcGIS software to generate percentage change in the identified LULC classes. In all the study sites, there was significant LULCC ($p<0.05$) through expansion in the built-up area between 187.8% and 955.5%, and expansion in the bare land area between 402.8% and 865.9%. Generally, grassland areas declined between 28.2% and 39.6%, forestland reduced between 28.1% and 76.7%, while wetland areas had no significant change over the two decades. Despite serving as a critical watering refuge for pastoralists from the neighboring Narok and Kajiado Counties, Nairobi City is facing rapid expansion in built-up areas, especially in the main pastoralists' grazing areas. This trend is attributed to increased land privatization, restricted access to grazing resources, and

frequent displacement of pastoralists. There is a need for policy interventions that are cognizant of pastoralism as part of the urban and peri-urban agri-food systems.

5.1 Introduction

Land use and land cover change (LULCC) involves a set of processes and complex interactions between the human, biological and physical components of the environment over time (Kiio & Odera, 2015; Maina *et al*., 2020), which globally affect peoples' livelihood. Previous studies have revealed that as a result of the LULCC, only a few parts of the earth's landscape, mainly in rural and protected areas still exist in the undisturbed state (Alawamy *et al*., 2020; Barnosky *et al*., 2012; Coulibaly & Li, 2020; Izakovičová *et al.*, 2017). Trends in LULCC are mainly ascribed to the adverse effects of climate change resulting in land degradation, and unsustainable human practices involving deforestation, poor agricultural practices, poor disposal of organic and inorganic wastes, and industrial emissions (Mulinge *et al*., 2016; Wangai *et al*., 2019).

Globally, LULCC is continuously impacting negatively on the supply of ecosystem goods and services and is an emerging human concern that requires a holistic approach to the conservation of the planet's environmental resources (WoldeYohannes *et al*., 2018). Changes in land use and land cover in urban and peri-urban areas are driven by the rapid rise in human population and accompanying land conversions to administrative offices, transport infrastructure, real estates, and factories (Cheruto *et al.,* 2016) Generally, conversion of agricultural land to other uses consequently reduces grazing land, increasing livestock competition for available pasture and water, thus leading to a reduction in food production, and revenue from both domestic and export trade (Kiio & Odera, 2015; Morara *et al*., 2014). The pastoral livestock production system, being

the major user of the world's rangeland ecosystem is equally expected to be negatively impacted by the LULCC (Van Zanten *et al.*, 2016).

Nairobi City, like many other fast-growing cities in Africa, is facing increased pressure from growth in human population, industrial and infrastructural expansions in tandem with the government's strategies to push the nation to a middle-income economy (UN-Habitat, 2016; Varshney, 2020). These transitions are not only leading to quick conversion of land into real-estates, institutional and commercial hubs but also expanding to the neighboring rural pastoralist territories (Mutisya & Yarime, 2011; Nkedianye *et al.*, 2020). These trends are likely to reduce grazing areas that were traditionally available for pastoralist herds in the urban and peri-urban areas of the city.

Although land conversions may be considered effective approaches for economic development, they similarly hold adverse implications on the general integrity and future sustainability of the Nairobi City's ecosystem. These consequences include loss of biodiversity, invasion by noxious plant species, increased land degradation, loss of land productivity, and increased human poverty (Alawamy *et al.*, 2020; Coulibaly & Li, 2020). In Kenya, approximately 61% of the total land is susceptible to land degradation due to frequent droughts, increased soil erosion, overgrazing, and deforestation (GoK, 2016). Studies project that in the next century, LULCC will be the key factor of concern, resulting in the loss of biological diversity and negatively impacting the well-being of all humanity (Maina *et al.*, 2020). It is therefore important for policymakers to formulate timely interventions to address the adverse effects of LULCC for a sustainable future.

Modern science and technology have been criticized for overlooking local people's knowledge of sustainable land use and natural resource management (Adhiambo *et al.*, 2017). This

prompted the conception and adoption of the Participatory-GIS (P-GIS) approach as a tool for integrating the perspectives of people at all levels of the society in planning and sustainable management of land resources (Chirenje *et al.*, 2013; Kathumo *et al*., 2015; Mbau *et al*., 2013; Norris, 2017). P-GIS is a powerful tool for gathering geospatial data on socio-economic and environmental dynamics, identifying key issues in resource management, and implementing solutions that reflect public concerns (Baaru & Gachene, 2016; Brown & Kyttä, 2014; Giuffrida *et al.*, 2019; Norris, 2017).

Despite several studies on LULCC, no studies have been done especially in the areas utilized by pastoralists within Nairobi City. For instance, Panek & Sobotová (2015) focused on mapping urban informal settlements in Nairobi City and their effects on economic development, Wangai *et al*. (2019) quantified land-use changes and potentials for regulating ecosystem services in parts of Nairobi and Kiambu Counties, while Oyugi *et al*. (2017) analyzed implications of LULC dynamics on the environmental quality of Nairobi City. This study builds on the previous studies by quantifying trends in land use and land cover changes in areas used for grazing by pastoralists in the city of Nairobi, to inform interventions for inclusive policy and regulatory frameworks, and sustainable utilization of urban and peri-urban resources.

5.2 Methodology

5.2.1   Description of the study area

The study was carried out in the urban and peri-urban areas utilized by pastoralists in Nairobi City. The city falls between latitude 1º 09′ and 1º 27′ South of the equator, longitude 35º 59′ and 37º 57′ East. It is located in the central highlands of Kenya, at an elevation of 1400 m towards the south-eastern side and 2200 m towards the north-western region (Njoroge *et al.*, 2011). The specific study sites included four pastoralist *Manyattas* (pastoralist settlements) namely;

Oloropil, Darfur, Kimbo, and *Karen Plains* located in Kasarani*,* Dagoretti, Lang'ata, and Embakasi Sub-counties of Nairobi City County respectively (Figure 5.1).
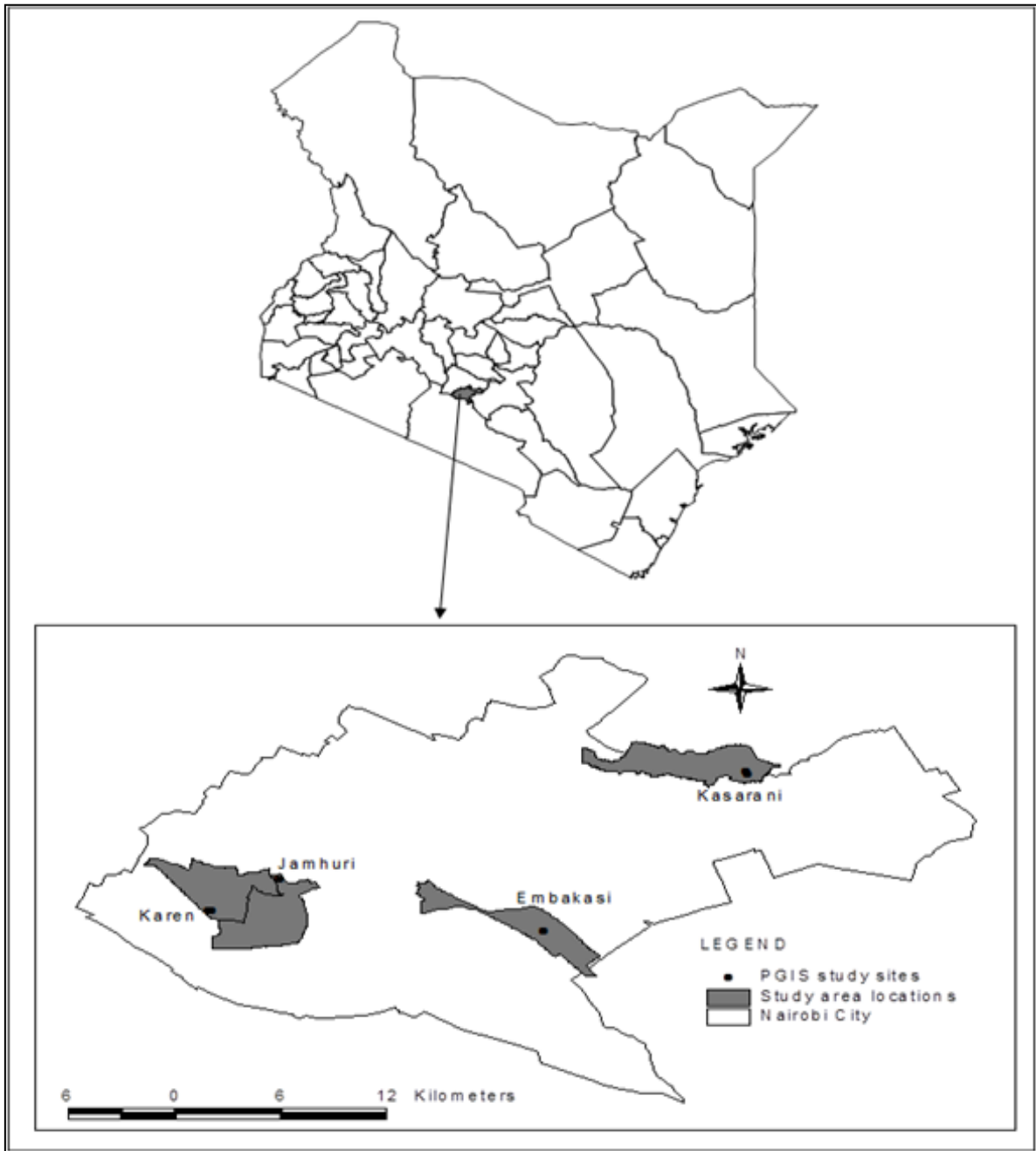
Figure 5.1: Study area (Pastoralists' *manyattas* **in Nairobi City)**

The major types of land use and land cover in Nairobi City include urban built-up areas (consisting of administration offices, public and private institutions, factories, commercial

centers, real estates, and settlement areas), wildlife conservation areas (Nairobi National Park), open recreational areas, transport area (airports, roads, railways), forestland, grasslands, and water bodies (Morara *et al.*, 2014; Njoroge *et al*., 2011). Land in the City is also used for urban agriculture, mainly for food and horticultural crop production, fish farming, poultry farming, and dairy farming (GoK, 2015).

5.2.2   Study Design and Data Collection

A purposive sampling procedure was employed in the selection of pastoralists' *manyattas* (settlement areas) and respondents from pastoralist households in Nairobi City. Four *manyattas* in Nairobi City namely; *Kimbo, Darfur, Oloropil,* and *Karen Plains Manyatta*; which are located in Dagoretti, Lang'ata, Embakasi, and Kasarani Subcounties respectively were selected for this study. Participatory resource mapping procedures followed by focus group discussions (FGDs) were used to gather the intended data for this study. Whereas the Participatory-GIS exercises entailed sketching mental maps of land use and land cover changes that have occurred over the past two decades within areas used by pastoralists for grazing, FGDs were used to gather information on how the observed LULCC has affected access to pasture and water among pastoralists in the city.

Participants of the participatory resource mapping comprised herders aged between 18 and 34 years (youth), men and women aged between 35 and 60 years, and the elderly men and women (above 60 years) who have lived in the study area for more than 20 years. Inclusion of the older generation was meant to ensure accurate capture of the current and past land-use systems. This is because elderly people above 60 years are usually the most conversant with the historical details on LULCC (Adhiambo *et al*., 2017; Kathumo *et al*., 2015). The youth were considered key in this study because they are involved in herding and therefore would be relied upon to provide

accurate information on grazing areas in the city. Four participatory resource mapping sessions and four FGDs were conducted with six to eight persons, which is considered to be a manageable and recommended sample size for gathering high-quality data (Lange, 2002; Rohrbach *et al*., 2015). The participants of the P-GIS and FGDs comprised at least two elderly persons, two mature men and women, and two youths at every study site.

During the resource mapping exercise, participants were requested to list the most important resources they depend on for livestock production in the city. The participants then ranked the top five most important land resources for pastoralists in the city (Table 5.1). Thereafter they were requested to sketch the location and extent of identified key resources using the agreed-upon symbols on manila papers for the three periods under study (2000, 2010, and 2020), starting from the most recent (2020). Materials for resource mapping included the PGIS guide tool, 3 manila papers for drawing, maker pens, a GPS device, a compass device, a notebook, pens, a camera, and a voice recorder.

Table 10: Description of land use and land cover types

LULC category	Description
Built-up area	Areas covered by pastoralists' m*anyattas* in the city, real estates, public and private institutions, commercial hubs, and industrial areas.
Grassland	Areas covered by grasses, herbs, and shrubs in open fields, along the roads, and private lands normally hired for grazing.
Wetland	Areas that are covered by dams, rivers, streams, and swamps.
Forestland	Areas with a continuous or discontinuous layer of trees and tree canopy.
Bare land	Completely non-vegetated areas including roads, railway lines, mining, and rocky grounds

A study period of 20 years with an interval of 10 years was considered sufficient to detect the transformations in land use and land cover in Nairobi City (Adhiambo *et al*., 2017). The

identified resources were drawn facing True-North, to facilitate alignment of the identified key resources to the geographic North-Pole, as well as to enhance precision during PGIS analysis. To facilitate geo-referencing of the PGIS maps, ground-truthing to take coordinates of the major features was conducted using a handheld GPS receiver with help of a guide from the pastoral community. In each of the selected study sites, participants discussed their own mentally drawn maps and the changes in key land resources over the three periods of study (Figure 5.2).

Participants in each FDG were requested to identify the major positive and negative effects of the observed LULCC on access to pasture and water resources by pastoralists in Nairobi City. In addition, participants were requested to suggest recommendations on mitigation of the undesirable effects of land use and land cover changes, and strategies for enhancing access to grazing resources among pastoralists in the city.

5.2.3   Data Analysis

Data was analyzed using the ArcGIS software version 10.8. Photographs of the mental resource maps were taken using a high resolutions camera, then georeferenced and digitized using the ArcGIS software to convert various land uses drawn by the locals into the exact locations of various features presented as points (built-up areas), lines (roads, rivers, and railway) and polygons (grassland, bare land, and forest), to visually present the changes that have occurred. ArcGIS was then used to calculate the area of each land use category per year in the study area. The data in the ArcGIS was exported to excel spreadsheets to enable calculation of the extent of LULCC observed between 2000-2010, 2010-2020, and 2000-2020. This entailed computation of the percentage cover of each land use and cover in the years 2000, 2010, and 2020, with 2000 as the reference (base) year. In addition, a Chi-square goodness of fit statistical test was conducted to detect whether the LULCC between 2000 and 2020 was statistically significant (Zar, 1996).
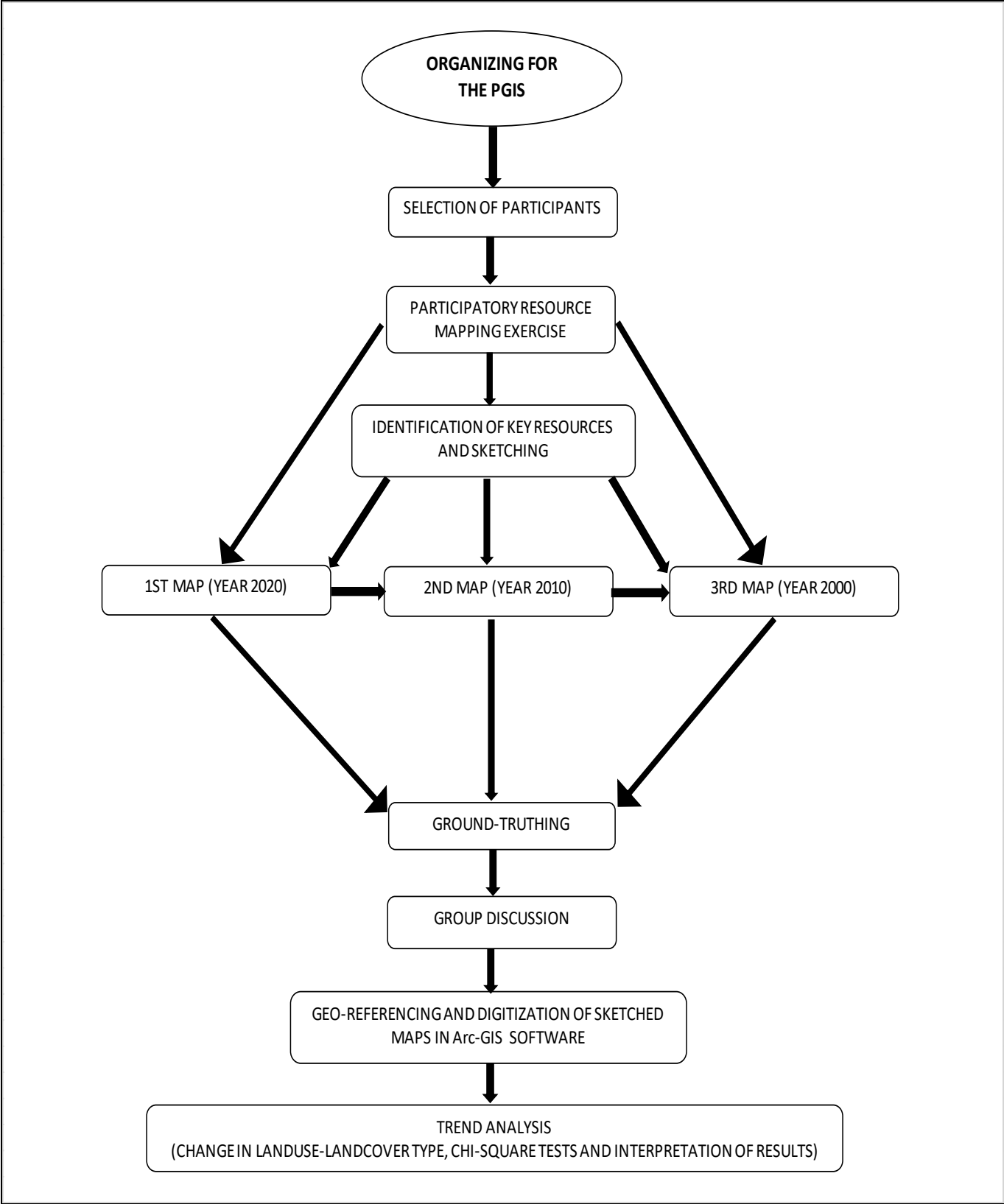
Figure 5.2: Participatory GIS methodology (*Source: Author's sketch*)

5.3 Results

5.3.1 Changes in land use and land cover in Nairobi City

Significant (p<0.05) LULCC was observed in the city, with a major increase in the built-up and bare land areas between 2000 and 2020. Across all the study sites, the wetland area had no significant change during the periods under study.

In *Oloropil Manyatta* located in Kasarani Sub-County (Figure 5.3 and Table 5.2), grassland was the major land cover, making up 55.1% of the entire area. Built-up area covered 12.8%, forestland 5%, and bare land 27.1% of the study area. Significant (p=0.006) expansion of built-up area was reported between 2000 and 2020 with an overall increase of 955.6% and bare land with an overall increase of 865.9% in the three periods of interest. Most (443.1%) of the increase in the built-up area took place in the first decade of the study (2000 and 2010). Overall, there was a significant (p=0.017) reduction (73.5%) of forestland in the periods under study.

The findings of LULC in *Darfur Manyatta* of Embakasi Sub-County (Figure 5.4 and Table 5.3), show that the grassland and bare land were the main types of land use and cover occupying 43% and 41.8% of the total land area respectively. The built-up area occupied 10%, forestland 3%, and wetland 2.1%. Significant (p=0.033) changes were reported under grassland, with a reduction of 39.6%, a decline of 76.7% (p=0.048) in forestland, and an increase of 763.7% (p=0.000) in bare land between the year 2000 and 2020. The highest (349.5%) increase in bare land was reported between 2000 and 2010.

In *Kimbo Manyatta* located in Dagoretti Sub-County (Figure 5.5 and Table 5.4), the mainland uses and cover types were grassland covering about 29.4%, and forestland, occupying 26.5% of the land area. Other LULC types included built-up area (24.1%), wetland (1.3%), and bare land (18.7%). Significant (p=0.011) LULCC occurred in the built-up area, with an increase of

243.2%, and a 402.8% (p=0.003) increase in bare land during the study period. Most (149.4%) of the expansion in the built area was experienced between 2000 and 2010.

Results of LULCC in *Karen Plains Manyatta* located in Lang'ata Sub-County (Figure 5.6 and Table 5.5) showed that grassland was the major land use covering 44.8% of the total area. Built-up area occupied 23.9%, forestland 17.6%, wetland 2.2% and bare land 11.5%. Significant (p=0.014) changes were reported in the built-up area, with an increase of 187.8%, and an expansion of 601.3% (p=0.040) in bare land. Most (258.6%) increase in bare land area was reported between 2000 and 2010.
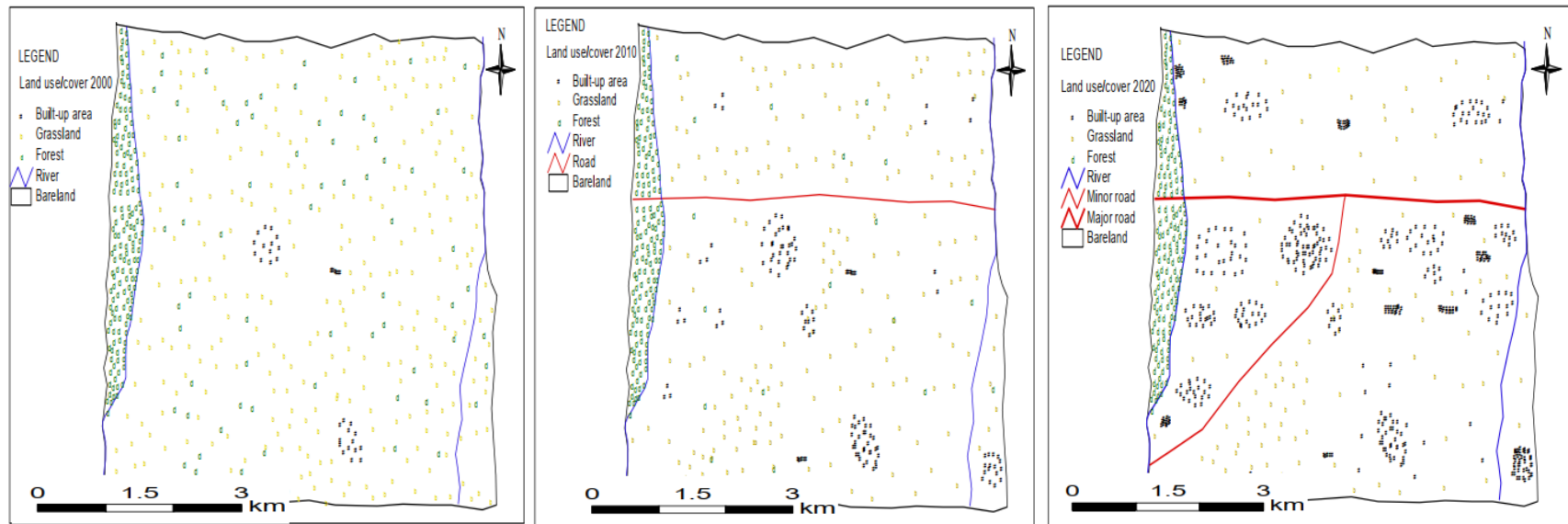
Figure 5.3: Land use and land cover changes in *Oloropil Manyatta* for the period 2000, 2010 and 2020

Table 11: Land use and land cover changes in *Oloropil Manyatta* between 2000 and 2020

Land use/cover category	Area in km² (percent coverage)			Change (%)		Overall Change (%)	Chi-square		
	2000	2010	2020	2000-2010	2010-2020	2000-2020	χ^2	df	p
Built-up area	0.248(1.2)	1.347(6.6)	2.618(12.8)	443.1	94.4	955.6	10.286	2	0.006
Grassland	15.753(77.1)	14.931(73)	11.255(55.1)	-5.2	-24.6	-28.6	4.020	2	0.134
Forestland	3.868(18.9)	2.432(11.9)	1.026(5.0)	-37.1	-57.8	-73.5	8.167	2	0.017
Bare land	0.574(2.8)	1.733(8.5)	5.544(27.1)	201.9	219.9	865.9	25.316	2	0.000
Total	20.443(100)	20.443(100)	20.443(100)	-	-	-	-	-	-

Figure 5.4: Land use and land cover changes in *Darfur Manyatta* for the period 2000, 2010 and 2020

Table 12: Land use and land cover changes in *Darfur Manyatta* between 2000 and 2020

Land use/cover category	Area in km² (percent coverage)			Change (%)		Overall Change (%)	Chi-square		
	2000	2010	2020	2000-2010	2010-2020	2000-2020	χ^2	df	p
Built-up area	1.134(2.8)	2.151(5.3)	4.044(10.0)	89.7	88.0	256.6	4.333	2	0.115
Grassland	28.774(73.1)	23.493(58.2)	17.373(43.0)	-18.4	-26.1	-39.6	6.849	2	0.033
Forestland	5.143(12.7)	3.961(9.8)	1.197(3.0)	-23.0	-69.8	-76.7	6.077	2	0.048
Wetland	3.367(8.3)	1.976(4.9)	0.868(2.1)	-41.3	-56.1	-74.2	3.600	2	0.165
Bare land	1.956(4.8)	8.793(21.8)	16.893(41.8)	349.5	92.1	763.7	29.826	2	0.000
Total	40.374(100)	40.374(100)	40.374(100)	-	-	-	-	-	-
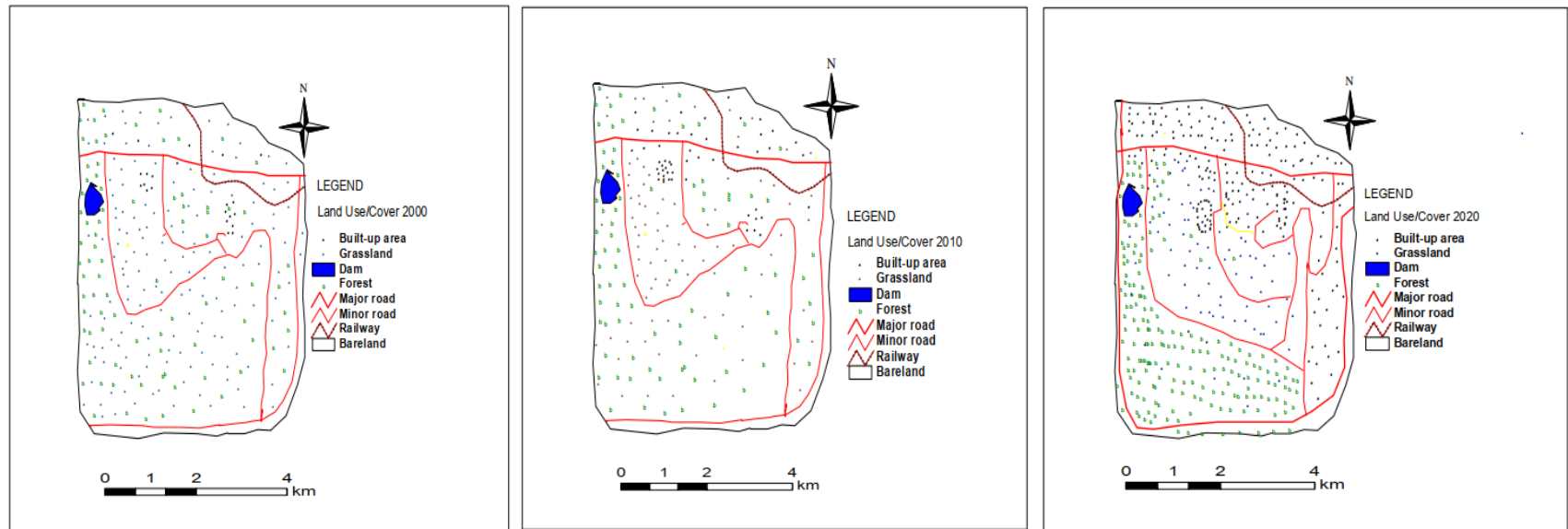
Figure 5.5: Land use and land cover changes in *Kimbo Manyatta* for the period 2000, 2010 and 2020

Table 13: Land use and land cover changes in *Kimbo Manyatta* between 2000 and 2020

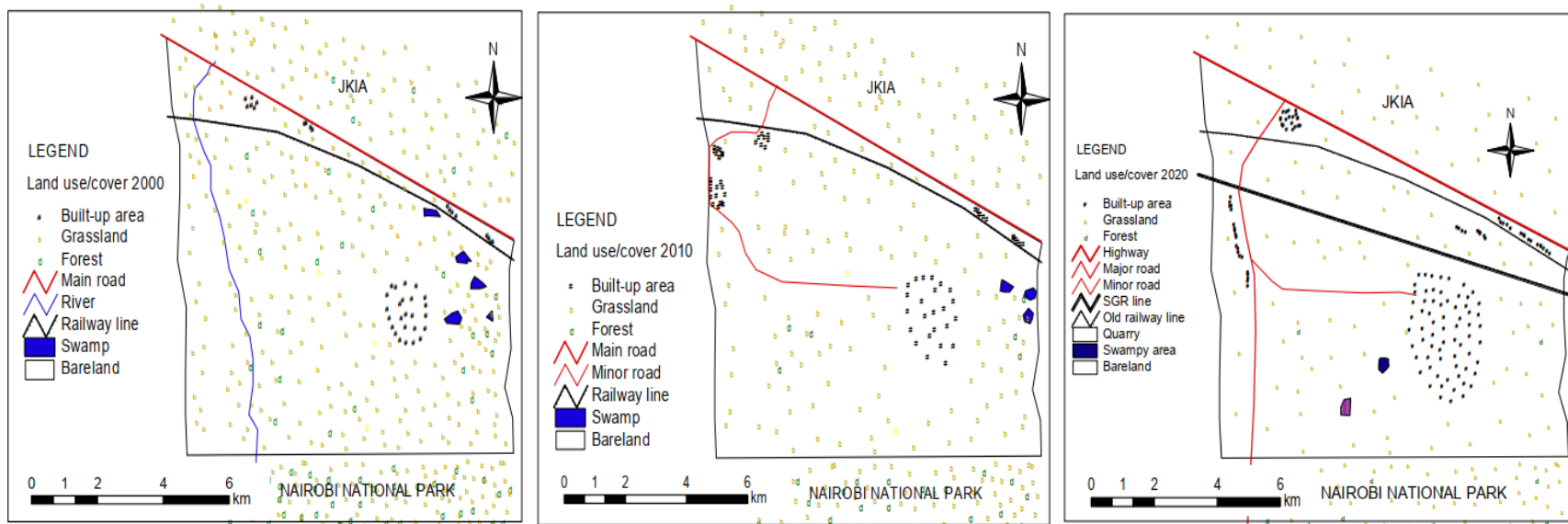| Land use/cover category	Area in km² (percent coverage)			Change (%)		Overall Change (%)	Chi-square		
	2000	2010	2020	2000-2010	2010-2020	2000-2020	χ^2	df	p
Built-up area	1.496(7.0)	3.731(17.5)	5.135(24.1)	149.4	37.6	243.2	9.102	2	0.011
Grassland	10.042(47.2)	8.287(38.9)	6.251(29.4)	-17.5	-24.6	-37.8	4.243	2	0.120
Forest land	8.634(40.6)	7.28(34.2)	5.637(26.5)	-15.7	-22.6	-34.7	3.347	2	0.188
Wetland	0.317(1.5)	0.292(1.4)	0.276(1.3)	-7.9	-5.5	-12.9	-	2	-
Bare land	0.792(3.7)	1.691(7.9)	3.982(18.7)	113.5	135.5	402.8	11.677	2	0.003
Total	21.281(100)	21.281(100)	21.281(100)	-	-	-	-	-	-
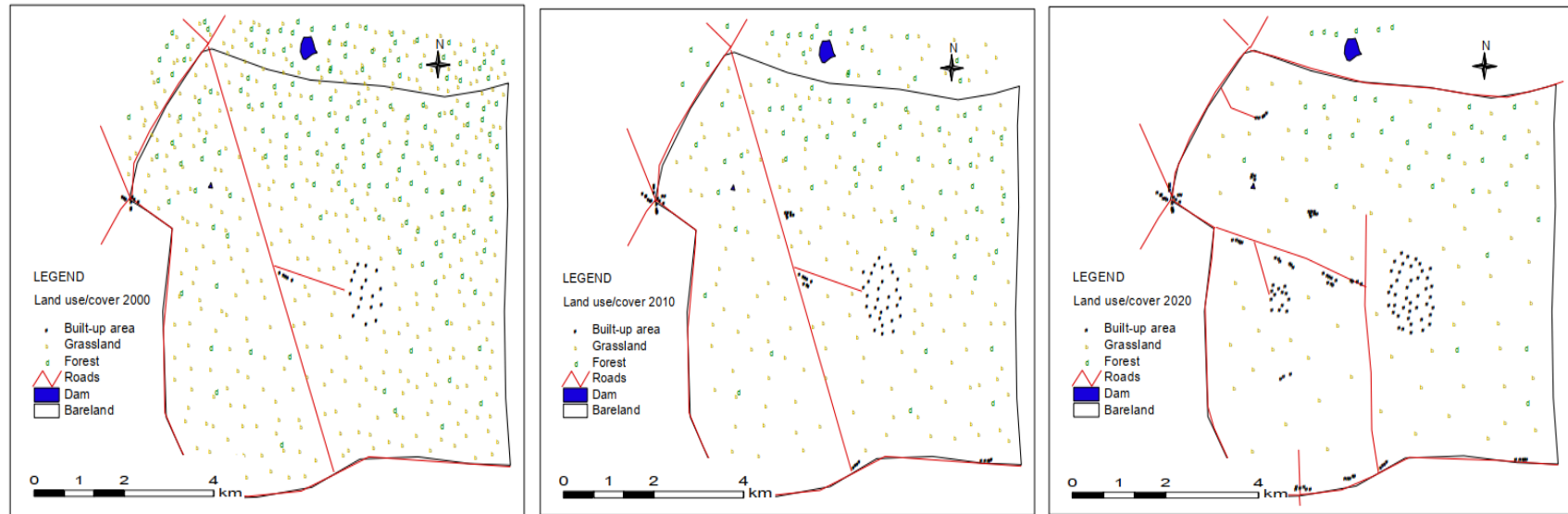
Figure 5.6: Land use and land cover changes in *Karen Plains Manyatta* for the period 2000, 2010 and 2020

Table 14: Land use and land cover changes in *Karen Plains Manyatta* between 2000 and 2020

Land use/cover category	Area in km² (percent coverage)			Change (%)		Overall Change (%)	Chi-square test		
	2000	2010	2020	2000-2010	2010-2020	2000-2020	χ^2	df	p
Built-up area	1.214(8.3)	2.075(14.2)	3.494(23.9)	70.9	68.4	187.8	8.522	2	0.014
Grassland	9.112(62.3)	8.387(57.4)	6.546(44.8)	-8.0	-22.0	-28.2	2.793	2	0.248
Forest land	3.588(24.5)	2.931(20.0)	2.579(17.6)	-18.3	-12.0	-28.1	1.238	2	0.538
Wetland	0.469(3.2)	0.372(2.5)	0.327(2.2)	-20.7	-12.1	-30.3	0.250	2	0.882
Bare land	0.239(1.6)	0.857(5.9)	1.676(11.5)	258.6	95.6	601.3	6.421	2	0.040
Total	14.622(100)	14.622(100)	14.622(100)	-	-	-	-	-	-

5.3.2 Effects of land use and land cover changes on access to grazing resources by pastoralists in Nairobi City

Participants of the focus group discussions (FGDs) noted that the key effects of LULCC on pastoralists' access to grazing and water resources in Nairobi City were undesirable, and similar across all the pastoralist *manyattas* (Table 5.6). These negative effects included a reduction in grazing land over time as a result of increased fencing of former grazing lands leading to restricted access to pasture, frequent displacements of pastoralists by private land developers, increased land privatization and conversion to built-up areas, as well as increased grabbing of public spaces previously used for grazing.

Table 15: Effects of LULCC on access to pasture and water in Nairobi City

| Effect of LULCC | Impact on pastoralist *manyatta* | | | |
	Oloropil	*Darfur*	*Kimbo*	*Karen Plains*
Reduction in grazing land	low	high	high	high
Increased fencing and restrictions on pasture	high	high	high	high
Frequent pastoralist displacements	low	high	high	low
Increased land privatization and conversion to built-up areas	high	high	high	high
Increased grabbing of public spaces	high	high	low	low

5.4 Discussion

5.4.1 Land use and land cover dynamics in areas used by pastoralists in Nairobi City between 2000 and 2020

The findings of this study show that the major changes in land use and land cover in the city between 2000 and 2020 included expansion in built-up and bare land areas, as well as a reduction in both grassland and forest area. This may be attributed to increased population, and infrastructural developments, subsequently leading to conversion in LULC types. Studies in the

metropolitan of Nairobi City by Wangai *et al*. (2019), and Muiruri & Odera (2018), showed that infrastructure development goes hand-in-hand with increased LULCC over time.

The continuous increase in the built-up area is probably because of the increased human population over time and the need for increased investment in Nairobi City, including real estate development to meet housing demand, transport sector, commercial centers, and industries for economic development. Abuya *et al*. (2019), Kathumo *et al*. (2015), and Turok & McGranahan (2013) showed that urbanization is highly correlated with policies supporting increased infrastructural investments, subsequently leading to fast conversion of the formerly unbuilt environments. The observed decline in grassland area in the current study can be linked to increased expansion of the built-up area, leading to conversion of the previously untenanted grazing areas.

Tree logging and clearing of vegetation in favor of infrastructural development that accompanies growth in urban centers (Gachene *et al*., 2015; Izakovičová *et al*. 2017; Kathumo *et al*., 2015; Wangai *et al.*, 2019) could have led to the observed decrease in forestland between 2000 and 2020 in *Kimbo* and *Karen Plains Manyattas*. The decline was however not significant given the proximity of these areas to the Ngong Forest, which is managed and protected by the Kenya Forest Service.

The significant increase in bare land in all the study sites, with *Darfur Manyatta,* experiencing the highest increase can be ascribed to the increased human population and sprawling city developments accompanied by unsustainable practices, among them, continuous destruction of vegetation, and poor rehabilitation of the mining and construction sites. These practices further

expose bare land to agents of soil erosion, therefore resulting in further deterioration of land and loss of vegetation (Muiruri & Odera, 2018; Li *et al*., 2017)

5.4.2   Effects of land use and land cover changes on access to pasture and water

The findings reveal that LULCC has adversely affected pastoralists' access to pasture and water in the city. This has been attributed to increased fencing that restricts access to pasture, increased land privatization, expansion of built-up areas, grabbing of public spaces formerly used for grazing, as well as frequent displacement of pastoralists from settled areas to pave way for urban infrastructural developments. Studies by Morara *et al*. (2014) in Kajiado County and Oyugi *et al*. (2017) in Nairobi City, confirmed the increased conversion of grazing lands in favor of residential, commercial, and industrial centers, thus restricting access to pasture and water as a result of sprawling urbanized areas.

5.5 Conclusions

The LULCC analysis shows expansion in the built-up area and bare land, and a corresponding reduction in grassland and forestland areas in the city over the last twenty years. Accompanying these changes are increased land privatization, frequent displacement of pastoralists from settled areas, and conversion of grazing lands to urban infrastructure, which limit pastoralists' access to grazing and water resources in the city. Since these transitions in land use and land cover in the city are inevitable, there is a need for more inclusive land-use policies and regulatory frameworks that recognize pastoralism as one of the critical food systems in urban and peri-urban areas.

CHAPTER SIX

GENERAL CONCLUSIONS AND RECOMMENDATIONS

This thesis provides an understanding of the drivers of pastoralists' migration and settlement in urban and peri-urban areas of Nairobi City, the composition and structure of their herds, and land use and land cover changes within the grazing areas in the city over the past 20 years. Several conclusions and recommendations arise from the findings of this study.

6.1 Conclusions

Pastoralists are migrating and settling in urban and peri-urban areas of Nairobi City mainly to track pasture and water resources, and in search of complementary livelihoods mainly through trade in live animals, milk, manure, leather commodities, beadwork, traditional medicine, and wild honey. Educated herders are among the majority of herders who permanently relocate to the city to seek wage employment.

Despite the economic opportunities and benefits, herders in the city encounter several challenges, primarily frequent road accidents involving livestock, and displacement from settled areas to pave way for the development of real estate and general urban infrastructure.

Crosses of native cattle and goats, herds in the city are similar in composition to those in the rural areas of Kajiado North Sub-county, primarily comprising indigenous cattle, sheep, and goats, with more females than males, and more castrated than uncastrated males. Preference for crossbreeds for their dual-purpose traits is growing among herders in the city due to their fast growth, high milk production, pest and disease resistance, tolerance to drought, and fast weight gain that make them fetch better prices than the indigenous breeds.

Real estate development and conversion of grazing areas in the city have increased over the past 20 years, therefore making unavailable the grasslands and forestland formerly used for grazing by pastoral herds. The increased privatization of urban land and conversion of former grazing land to real estate and infrastructure is to blame for the diminishing access to grazing resources and displacement of pastoralists in the city.

6.2 Recommendations

There is a need for policy and regulatory frameworks to recognize and integrate pastoralism with other forms of urban and peri-urban farming systems, to enhance returns in the pastoral production system.

It is necessary to conduct an in-depth investigation of the viability of complementary livelihood options pursued by pastoralist households in the urban and peri-urban areas to inform strategies aimed at enhancing the sustainability of pastoral production in such areas.

There is a need for measures aimed at improving access to fodder in Nairobi City given the rapid changes in land use and land tenure in urban spaces, which implies that pastoralists have to rely on commercial fodder to sustain their herds, especially during extreme droughts.

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APPENDICES

Appendix 1: Questionnaire for herders

Section 1: Social demographics

1.1 Respondent information

1.1.1   Name of Respondent (Optional):
1.1.2   Gender: 1) male 2) female
1.1.3   Age: ___ years
1.1.4   Are you married? 1☐Yes 2☐No
1.1.5   Respondent family size: No. of Wives___ No. of Children__ No. of other dependents
          (specify) _____
1.1.6   Number of school-going children _____
1.1.7   Indicate the level: 1) Primary 2) Secondary 3) Tertiary
1.1.8   Relationship of the respondent to the family ___
          (Select from the codes 1.1.8)

> *Codes1.1.8 Relationship to Family.*
> 1. Household-head 2. Spouse of head
> 3. Son   4. Daughter 5. Family relative
> 6. Employed worker   7. Other (specify)

1.1.9   How long have you been in Nairobi? 1)1-10yrs   2)11-20 yrs.   3)21-30yrs   4)31-
          40yrs   5)41-50yrs 6) over 50 yrs.
1.1.10 Highest education level of respondent: 1) Primary 2) Secondary   3) Tertiary 4) None
1.1.11 Does this livestock belong to you or someone else? 1. ☐Belong to me 2. ☐ Do not
          belong to me.
1.1.12 If not, who is the owner?
1.1.13 Where does the owner stay?
1.1.14 Is the owner employed elsewhere? 1☐Yes 2☐No
1.1.15 If yes, state the occupation of the herd owner:
1.1.16 How much does the herd owner pay you per month for herding? KShs.
1.1.17 How often do you communicate with the owner?
1.1.18 And what do you talk about when he/she calls?
1.1.19 How often does the owner visit the herds?

1.2 Livestock *Boma/Manyatta* information

1.2.1   Name of the *boma/manyatta* _____
1.2.2   How old is the *boma/manyatta* _____years?
1.2.3   How many household members are there? _____
1.2.4   How many herds are in the boma? _____
1.2.5   What other things do members engage in? _____
1.2.6   Is the *boma/manyatta* a permanent or satellite camp?
             Give reasons for your answer above

Section 2: Herd characteristics

2.1 Types and Classes of Livestock

Species	Breed *(Tick appropriately)*	Calves / kids	Breeding females	Old females *(no longer calving)*	Steers *(castrated males)*	Bulls *(Mature males)*	Total TLU
		Class of animals					
1. Cattle	1.East African Zebu						
	2.Borana						
	3.Sahiwal						
	4. Cattle Crosses						
	5.Others (specify)						
2. Goats	1.Galla goat						
	2.Small East African						
	3. Crosses of goats						
	4. Others (specify)						
3. Sheep	1. Dorper Sheep.						
	2. Red Maasai.						
	3. Somali sheep						
	4. Crosses of sheep						
	5. Others (specify)						
4. Donkey	Masai breed						
	Somali breed						
	Other (*specify*)						
5. Other(s)	*(Kindly specify)*						

2.1.1   How long have these herds been in Nairobi?

2.1.2   Give reasons why you moved with your herds to Nairobi County?

2.1.3   Where exactly is your home/home of the herd owner? (County/Constituency/Location)

2.1.4   Do you own land there? 1☐Yes 2☐No

2.1.5   What is the size of the land in ha?

2.1.6   When do you go back to graze there?

2.1.7   Explain the answer above

2.1.8   State the main reasons why you left your original homeland *(codes 2.1.8)*

2.1.9   Where do you intend to go next with the herds? Explain why

2.1.10 Are these herd species the same as those other herds left at their original ho
      1☐Yes 2☐ No. If not, explain.

2.1.11 Which characteristics do you consider in the selection of animals you
      keep in the urban area?

> **_Codes for 2.1.8 –
> Reasons why you left
> homeland_**
> 1. Land pressure
> 2. Livestock diseases/pests
> 3. Search for pasture
> 4. Search for water
> 5. Droughts
> 6. Escape for security
> 7. War/Conflicts
> 8. Search for market

2.1.12 Do various herders in Nairobi know each other? 1☐Yes 2☐No
2.1.13 Are you related to any of the herders? 1☐Yes 2☐No If yes, how?
2.1.14 Do they share information among themselves? 1☐Yes 2☐No
2.1.15 What type of information?
2.1.16 Do they assist one another? 1☐Yes 2☐No
2.1.17 Under what circumstance do they assist each other?
2.1.18 How often do they go back home to see their families?

2.2 Income from livestock sales, milk, manure sales

2.2.1   Do you sell these animals? 1☐Yes 2☐No
2.2.2   Where do you sell them? _____
2.2.3   Indicate the price Kshs. per animal: Cow: _____ Bull: _____ Heifer _____
     Sheep: _____Goats: _____ Other (Specify) _____
2.2.4   In the last year how many have you sold?
2.2.5   Do you sell milk? 1☐Yes 2☐No
2.2.6   How much do you produce per day? _____liters *Consume at home*____ (liters)
     Sold _____(liters)
2.2.7   What is the price per liter? Kshs. _____
2.2.8   How many months do you produce milk in a year? _____
2.2.9   Which months do you get more milk?
2.2.10   Do you sell manure? 1☐Yes 2☐No
2.2.11   How do you measure manure when selling? *(Tick codes 2.2.11)*
2.2.12   Indicate the price in Kshs. per unit _____
2.2.13   Whom do you sell to? _____
2.2.14   How many times have you sold manure in the last year? (frequency)
2.2.15   Are there other ways you use manure? 1☐Yes 2☐No. If yes, how?

Codes for 2.2.11– Sale of manure
1. 90 Kg bag
2. Per lorry (5-8 tonne)
3. Pickup (0.5-1 tonne)
4. Other (specify)

2.3 Complementary economic activities

2.3.1   Do you involve in other business activities? 1☐Yes 2☐No
2.3.2   If yes, specify these business activities *(Tick on the codes 2.3.2 below).*
2.3.3   Why did you choose the activity (activities) above?
2.3.4   How much do earn from them per month? Kshs.

Codes for 2.3.2 – Income source
1 Sale of leather products
2 Sale of honey
3 Sale traditional medicines
4 Sale knives/clubs/*rungus*
5 Sale of bead-work
6 Sale of *shukas*
7 Others (specify)

Section 3: Grazing, watering, and feeding strategies in Nairobi City

3.1 Apart from natural grass, do you purchase feeds for your livestock? 1☐Yes 2☐No

3.2 If yes, indicate the type of feeds *(Tick codes 3.2)*.

3.3 Where do you buy the feeds?

3.4 How much do you spend on feed purchase in a month (KShs) during a) Dry season _____ b) Wet season _____?

3.5 Under what circumstances or when do you opt to feed as opposed to grazing the animals?

3.6 During which periods do you purchase livestock feeds?

3.7 At what price are they sold? KShs.

3.8 Which areas do you graze your livestock on daily basis within the city?

3.9 Do these areas vary with the season?

3.10 If yes, where do you graze dry seasons _____Wet season_____

3.11 What determines your pattern of movement in these areas?

3.12 What are the grazing problems you face within the Nairobi area?

3.13 Where do you obtain water for your herds?

3.14 Do you pay for the water you use 1☐Yes 2☐No How much do you spend in a month for watering (Ksh)

3.15 Do you experience watering conflicts among yourselves and other city residents?1☐Yes 2☐No

3.16 Explain the conflict types

3.17 Do you experience watering challenges in Nairobi city? 1☐Yes 2☐No (Explain.)

3.18 How do you address these challenges?

> **Codes for 3.2 -Type of purchased feed**
> 1. *Unga* dairy meal
> 2. Hay
> 3. Crop residues
> 4. Mineral salts
> 5. Others (*Specify*)

Section 4: Nairobi City County environment

4.1 Does the Nairobi environment provide sufficient access to pasture and water? 1☐ Yes 2☐No. Please explain

4.2 Are there specific challenges to livestock herding in Nairobi County? 1☐ Yes 2☐No

4.3 Select and rank the top five challenges facing livestock rearing/herding in Nairobi area?

> **Codes for 4.3.4 – By whom**
> 1. Pastoralists
> 2. County government
> 3. National government
> 4. Private land owners
> 5. Others –(*specify*)

Tick	Challenge on Pastoralism in Nairobi	4.3.1 Rank (*i.e 1, 2,3*)	4.3.2 Describe the problem /challenge	4.3.3 Possible solutions	4.3.4 By whom? (Codes)
1.	Water scarcity				
2.	Conflicts				
3.	Drought and climate hazards				
4.	Landlessness				
5.	Resource competition				
6.	Environmental pollution				
7.	Unfavorable government policies				
8.	Theft/Insecurity				
9.	Livestock diseases *(Codes below)*				
10.	Frequent animal road accidents				
11.	Wildlife menace				
12.	Other (specify)				

4.4 Do you think the climate is changing? 1☐ Yes 2☐No
4.5 If yes, what are the changes you have observed in recent years?

    (i)   Rainfall becoming scarce

    (ii)   Frequent droughts

    (iii)   Frequent floods

    (iv)   Unreliable rainfall/seasons

    (v)   Increasing variability between seasons and years

    (vi)   A declining number of rain days

    (vii)   Heavy and destructive rains

    (viii)   Increasing temperatures

    (ix)   Others *(please specify)*

> *Codes for Livestock diseases*
> 1. FMD
> 2. RVF
> 3. Coenuruses
> 4. ECF
> 5. CCPP
> 6. CBPP
> 7. Trypanosomiasis
> 8. Other

4.6 Are there a group of people (e.g., women, men, girls, boys, disabled and elderly, poor) who are affected more than others? 1☐ Yes 2☐No.

4.7 If yes, specify the group and explain

4.8 How are you trying to cope with these changes?

4.9 State the factors affecting mitigation of these challenges/changes

Appendix 2: Key Informant Interview guide

1. What do you know about pastoralists in Nairobi City County?
2. Are you aware of the activities around the pastoral herding system in Nairobi City County? 1☐Yes 2☐No Explain
3. Which areas are pastoralists found in Nairobi County?
4. Does the Nairobi City County government provide any services to these pastoralists in the city? 1☐Yes 2☐No Please explain

5. Does Nairobi City County government get any revenue from urban pastoralism? 1☐Yes 2☐No Please explain

6. Are you aware of any economic activity these pastoralists are involved in within the city? 1☐Yes 2☐No If yes, please explain
7. What are the benefits that the Nairobi city government and city dwellers get from the pastoralists and their herds?
8. Do these herders pay some taxes or fees to reside or graze in the city? 1☐Yes 2☐No If yes, how much?
9. Are there any conflicts associated with the presence of these herds in the city? 1☐Yes 2☐No If yes, explain
10. Have you ever received any complaints about the pastoralists in Nairobi? 1☐Yes 2☐No Explain
11. What do you think would have been the cause of these complaints?
12. What are pastoralists doing to address these issues?
13. Is the county/national government assisting to address these issues? 1☐Yes 2☐No Explain
14. Which interventions do you think are appropriate?

15. Are there potential opportunities for pastoral production in Nairobi City County? 1☐Yes 2☐No Explain
16. What are the main challenges facing these pastoralists in the city?
17. In your opinion, do you consider pastoralism in Nairobi County a sustainable livelihood option? 1☐Yes2☐No Explain
18. Would you advocate for pastoralism within an urban/peri-urban environment? 1☐Yes2☐No Explain
19. Are there any plans for these herders to ensure they go about their business in harmony with the city residents? 1☐Yes2☐No Explain
20. Do we have laws supporting or prohibiting pastoralism in the city? 1☐Yes2☐No Explain
21. Based on the view of fast urbanization and infrastructure development, do you think pastoralism has a future in Nairobi City County? 1☐Yes2☐No Explain your answer

Appendix 3: Focus Group Discussion guide

Part 1: Questions
1. Characteristics of livestock kept by pastoralists in Nairobi City County
   a) Which type of livestock species are kept by pastoralists?
   b) Average herd size owned per household
   c) Herd structure (class and composition)
   d) Have they changed from the herds previously kept or those in their original homeland? How?
   e) Selection criteria of livestock species/determining traits
   f) Purpose/uses of the species
   g) Herd structure e.g., different classes of animals such as bulls, heifers, cows, calves
2. Livestock feeding strategies and grazing patterns
   i   Type of feeds/pasture resources relied on (dominant grass species at the bomas)
   ii   Sources of the feeds
   iii Seasonal variability
   iv   Do you also buy feeds? Which ones? From who? Price, stability in supply.
   v   Does grazing change with seasons?
   vi   Seasonal movement schedules and periods in Nairobi County and outside-drivers, rationale
   vii Do you pay to graze in some areas? To who and how much?
   viii Do you also pay for the security of their herds in urban areas?
   ix   Challenges facing feeding strategies and grazing patterns employed –conflicts, fences
   x   Solutions to address these challenges
   xi   Parties involved.
3. Water accessibility by pastoralists
   i   Watering locations/areas
   ii   Type of water sources
   iii Seasonality of these sources and trends in supply
   iv   Quality and quantity of the water supplied.
   v   Do you pay for the water? How much and to who?
   vi   Challenges faced in water availability/use

vii Possible solutions to problems encountered.
4. Emerging challenges in urban and peri-urban parts of Nairobi City
    i Livestock nutrition
    ii Livestock health –poisoning from wastes, diseases, death problems, veterinary services
    iii Insecurity –theft, wildlife menace
    iv Accidents –road accident frequencies are you compensated?
    v Conflicts –among pastoralists, other residents, city authorities, security guards
    vi Climate-related issues-floods, droughts-effects.
    vii Population trend/ urbanization
    viii Landlessness, areas formerly settled getting lost.
    ix Livestock Security and conflicts
5. Solutions to these challenges
    a)   Which solutions have been in place? Are they sufficient?
    b)   Suggest alternative solutions to these challenges
    c)   How will they be solved?
    d)   When? (Implantation time-frame)
    e)   By whom? (Parties involved?)
6. Economic opportunities by herders in urban and peri-urban Nairobi city
    a) Which economic activities do herders engage in? Sale of livestock, milk, manure, plant/traditional medicine, *shukas*, sandals, leather products, beadworks, casual labor, and security.
    b) Are there new market opportunities in Nairobi City? state them
    c) State the factors curtailing the pursuit of these opportunities
    d) What are the strategies and suggestions to help tap these potentials?
    e) How will the potential be attained and when?
    f) How will they benefit/affected the pastoral adaptation and future of pastoralism in urban areas?

Appendix 4: PGIS tool guide

The PGIS maps have to be drawn each facing the TRUE-NORTH direction.

1. Important resources starting with the most important

a) Grassland area
b) Water resources (dams, rivers, boreholes, piped water)
c) Forest resource
d) Trading and shopping centers
e) Urban/built area/settlements
f) Road-network
g) migratory areas
h) Others (*please specify*)

2. Observed changes in the land resources on the PGIS maps

Land use/cover	Observed change(s) by the community (*Increased, decreased, no change*)
Grassland	
Waterbody	
Forestland	
Market resource	
Settlement/built-up area	
Cropland	
Swampy area	
Rocky areas/Bare land,	
Others (*please specify*)	

4. Benefits associated with the changes

1. _____
2. _____
3. _____
4. _____
5. _____

5. Negative effects of the changes

1. _____
2. _____
3. _____
4. _____
5. _____

6. Community recommendations/Solutions to the undesirable effects

Effect	Solutions /Interventions
1.	
2.	
3.	
4.	
5.	

7. Challenges facing the intervention efforts

1. _____
2. _____
3. _____
4. _____
5. _____