

**INVESTIGATION OF FACTORS ASSOCIATED WITH INCOME FROM  
WORKING DONKEYS AMONG SMALLHOLDER FARMERS IN  
KIRINYAGA COUNTY, KENYA**

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AND ECONOMICS IN THE DEPARTMENT OF PUBLIC HEALTH  
PHARMACOLOGY AND TOXICOLOGY IN THE UNIVERSITY OF  
NAIROBI**

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## DECLARATION

This thesis is my original work and has not been presented for a degree in any other University.

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## **DEDICATION**

This thesis is dedicated to my late dad Mr Phares Gichure. May his soul rest in eternal peace. You constantly gave me the push to pursue this PhD and cheered me on until your demise.

A special dedication to my beloved family; husband Simon Maruga and children Leonel Mwangi and Megan Mumbi; mum Mrs Lucy Wanjiku and siblings James Maina, Zipporah Wairimu, Loice Njeri and Dr Josphat Njenga and to my supervisors, relatives, colleagues and all friends. You gave me the much needed support. We have done it. My children, nephews and nieces; be encouraged. Strive for excellence and you will achieve what you set out to do. Success has no limit.

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## **List of Abbreviations**

<b>ABW</b>	Animal biodiversity web
<b>AHA</b>	Animal health assistants
<b>CADP</b>	County annual development plan
<b>CBS</b>	Central bureau of statistics
<b>CIDP</b>	County Integrated Development Plan
<b>FAO</b>	Food and agriculture organization
<b>FAWAC</b>	Farm animal welfare advisory council
<b>FGDs</b>	Focused Group Discussions
<b>GDP</b>	Gross Domestic Product
<b>IGAD</b>	Intergovernmental Authority on Development
<b>KENDAT</b>	Kenya Network for dissemination of agricultural technologies
<b>KNBS</b>	Kenya National Bureau of statistics
<b>KES</b>	Kenyan Shillings
<b>LAHPs</b>	Local Animal Health Providers
<b>NGO</b>	Non- Governmental Organization
<b>OCS</b>	Officer Commanding a police Station
<b>OIE</b>	World Organization for Animal Health
<b>PE</b>	Participatory Epidemiology
<b>SNV</b>	Netherlands Development Organization
<b><i>Tuk tuks</i></b>	Motorized tricycles used to transport goods
<b>US \$</b>	United States Dollar

## ABSTRACT

Working donkeys in developing countries play an important role for smallholder farming households through provision of income mainly from draught power. Few studies have documented factors associated with income from these working donkeys within the context of a highland agro-ecosystem. This study was conducted from June to September 2018 in Kirinyaga County located within the central highland areas of Kenya. The objectives were to determine (1) the challenges and opportunities for working donkeys rearing under smallholder farming systems in Kirinyaga County, (2) farm level factors that are associated with household incomes for farms that keep donkeys within a smallholder farming system in central Kenya as well as (3) to assess phenotypic characteristics of donkeys and their suitability for work.

Data was collected using mixed methods including participatory epidemiological methods (PE): listing, pairwise ranking and probing during focus group discussions (FGDs) with 8-12 participants who were donkey owners across the thirteen donkey rearing locations; face to face interviews with 351 donkey owners and users across thirteen administrative units in the study area using a pre-tested semi-structured questionnaire; in-depth interviews with key informants who had kept or used donkeys for a long time (more than 20 years) in the County. Morphometric data on donkeys' age, sex, coat color, height at withers, body length and heart girth and body weight were collected on individual donkeys which were sampled from participating households.

The data from PE were analyzed using Kruskal-Wallis non-parametric method to test whether median ranks were significantly different from zero. Quantitative data from the questionnaires were analyzed using descriptive and inferential statistics, while qualitative data were presented as themes using narrative summaries.

The benefits obtained from keeping donkeys included incomes obtained from their use in transportation ( $Z= 5.80$ ) and manure production ( $Z= 3.47$ ). Men were more involved with working donkeys than women. They were often the donkey owners and care givers (92%). They were also the beneficiaries and controllers of the income generated through the use of the donkeys (95%). The identified challenges included theft for slaughter ( $Z = 5.99$ ), diseases ( $Z = 3.03$ ), road accidents ( $Z = 2.83$ ) and malicious cutting ( $Z = 2.32$ ); while commonly reported diseases were tetanus ( $Z = 5.35$ ), hoof problems ( $Z = 4.55$ ), worms ( $Z = 3.10$ ) and mange ( $Z = 2.24$ ) infestations. On average, households owned three donkeys with a ratio of male to female donkeys estimated at 2:1. Most (83%) of these donkeys were purchased into farms with a paltry (17%) being farm bred. Furthermore, most households (98%) relied on donkeys as their primary source of income. The monthly gross margin obtained through commercial transport of goods using donkeys was  $9,272 \pm 41.7$  KES per donkey; implying a gross profit of 62%. The mean daily gross margin from working donkeys was 300 KES per donkey, as compared to only  $100 \pm 23$  KES gross income obtained from cattle rearing. The farm level factors that were associated with level of household incomes included the number of working donkeys reared per farm ( $P < 0.001$ ), number of hours these donkey worked ( $P = 0.05$ ), savings from using own donkey transportations ( $P < 0.001$ ) and engaging in crops ( $P = 0.017$ ) and other livestock farming ( $P = 0.004$ ). Alternative household income could be earned through donkeys from the sale of donkey manure at a market price of  $430 \pm 26$  KES per bag for crop production, hiring out of donkeys for work at  $379 \pm 16$  KES per day as well as sale of adult donkeys or their foals at a market price of  $16,000 \pm 252$  KES and  $8,000 \pm 237$  KES respectively for use as replacement stock.

The average weight of the adult working donkey in the central highlands of Kenya was  $155.5\text{Kg} \pm 1.71$ ; height at withers was  $99.7\text{ cm} \pm 0.50$ ; heart girth of  $113.7\text{cm} \pm 0.43$  and a body length of  $113.2\text{ cm} \pm 0.58$ . All these body measurements varied significantly between sex and age groups of donkeys ( $P < 0.001$ ). Review of published studies reveal that apart from height at withers, donkeys raised in Kenya have larger sizes compared to other working donkeys in different parts of the world; an indication of genetic diversity for working donkeys locally and geographical location and husbandry practices. Majority of the donkeys in the central highlands of Kenya were in a state of good welfare with 86% having moderate to ideal body condition scores of 2.5 and 3 (range of 1-5), with 18% showing signs of lameness and only 5% showing lesions on the body.

The results calls for a shift in attention on donkey health and welfare, which for most part is ignored by livestock extension agents and policy makers in most farming systems across the developing world, where communities rely on donkeys for support of subsistence livelihood system. Furthermore, these findings provide opportunities for future research on reasons for phenotypic diversity between donkeys raised in Kenya and other parts of the world.

## CHAPTER ONE: INTRODUCTION

### 1.1 Background Information

Livestock contributes to the livelihoods and food security of approximately 1.7 billion people in the World, particularly the rural and poor communities living in the developing countries (FAO, 1996). Livestock's contribution to the Kenya's national GDP (Gross Domestic Product) is estimated at approximately 12% and 42% for the agricultural GDP (SNV, 2008). Income obtained through provision of draught power supports household in meeting the basic needs for survival such as food, clothing and shelter. However, provision of draught power has not been listed as a primary output for working equines (FAO, 1996), with contribution of working donkeys to the national GDP being under-represented by about 57% (IGAD, 2013).

The amount of work that a donkey is capable of doing is determined by the size of the donkey (Pearson *et al.*, 1999 and Batholomew *et al.*, 1993). Previous studies have documented that donkeys can carry packs of up to 50% of their body weight comfortably (Pal *et al.*, 2002) and pull loads of up to 2.7 times their body weight by cart (Gebresenbet *et al.*, 2016). The donkeys were able to perform better by either improving their husbandry and management or the efficiency of their working implements such as carts and harnesses (Pearson *et al.*, 1999).

In Kenya donkeys are found in all ecological zones (KNBS, 2019). They tend to be more concentrated in the peri-urban areas such as the outskirts of Nairobi and Kirinyaga Counties where they are used intensively for the transport of building materials, water and rice to and from milling factories. Donkeys are also found in the rural areas where they are used for mixed crop-livestock production in areas of Nyandarua, Kiambu and Meru counties where they are used by smallholder farmers for transport of farm inputs and outputs from farms to markets. In the semi-arid areas



of Kajiado, Kitui and Turkana counties, donkeys are used to ferry water, people and other kinds of goods to and from the homesteads.

The use of donkeys for draught has been particularly more for women farmers because they found donkeys more affordable to purchase and easier to work with than oxen. Donkeys reduced their domestic transport burden in the rural areas (Fernando and Starkey, 2004). When livestock are produced to generate income, men are often the owners, care givers, decision makers and beneficiaries of incomes received through them. Women on the other hand assist the men in performing the responsibilities of raising the animals (IFAD, 2009) although Mutua *et al.*, (2014) noted that gender roles varied between livestock species and from place to place. Understanding the involvement of women with working donkeys under smallholder farming setting will increase efficiency and therefore the income earned through the donkeys.

Several non-governmental organizations in Kenya are involved in improving the welfare and productivity of working donkeys. They include Brooke Hospital for animals and their partner organizations as well as the Donkey Sanctuary. Direct efforts by the Kenyan government towards donkey production are missing. In fact, a document search revealed that the name donkey was missing in key Kenyan legislation like Prevention of cruelty to animals act CAP 360 (2012) and the Rabies act CAP 356 (Brooke, 2007).

## **1.2 Problem statement**

Donkeys are raised in different agro-ecological systems in Kenya ranging from the arid and semi-arid areas and highland agro-ecological areas. It needs to be recognized that the benefits of keeping donkeys and associated production challenges inherent in these production system may vary across production systems. The current published

literature has generalized the benefits and associated challenges of working donkeys and may omit significant benefits and production challenges in other production areas. Although working donkeys contribute to both direct and indirect household incomes (Valette, 2015), they are not viewed as a critical element of people's livelihoods (Pearson *et al.*, 2000). The socio-economic benefits of working donkeys are often overlooked, incompletely understood or often underrepresented. Consequently, they become omitted in initiatives developed by government policy makers (Valette, 2015; IGAD, 2013). Mostly, they are perceived as single purpose animals (Hassan *et al.*, 2013; Smith and Pearson, 2005). Furthermore, the prestige of owning donkeys is low in most societies with their ownership being associated with communities living in poverty and state of marginalization (Fernando, 1997; Hassan *et al.*, 2013; Swai & Bwanga, 2008).

Previous studies that were conducted on donkeys focused on diseases which affect them; for example Karanja (1992) conducted a study to establish the type and severity of *Trypanosoma congolense* infection in donkeys, their clinical and pathological presentation. Kyeswa (1996) estimated the prevalence of gastro-intestinal nematodes, ecto-parasites and gross skin conditions in donkeys. Lewa *et al.* (1999) identified the internal parasites of donkeys, their seasonal prevalence and described the pathological lesions associated with internal parasites. Kirui *et al.* (2010) reviewed the types and responses to challenges of worm infestation of donkeys in Kenya while Gichure (2012) determined prevalence and risk factors for African horse sickness (AHS) in donkeys in Lari and Limuru divisions of Kiambu West District, Kenya.

To date there is no reliable source of information on the factors associated with the level of income from working donkeys raised by both by rural and peri-urban households in the central highlands of Kenya. A perusal through key planning

documents of Kirinyaga County like the Kirinyaga County integrated development plan 2013-2017 (2013), Household Baseline Survey Report (2014) and the Kirinyaga County finance bill (2014) reveals that the donkey is largely missing from the county's development plan and allocation of resources. This picture is also replicated in other counties in Kenya which have a high number of working donkeys despite many households dependent on them. Therefore, results from this report are useful in guiding national policy development for donkeys' health and welfare in the national planning and resource allocation framework, which would further provide a favorable working environment for donkeys and enhanced performance and productivity for donkey owners and users under similar production systems.

As elsewhere in the world, there is scanty literature on the genetic and phenotypic diversity of these donkeys (Blench, 2000) which has limited their optimal use (Pearson and Vall, 1998). Consequently, breeding for size improvement is hampered by lack of data. This data will help in determining appropriate load for the donkeys to carry or pull with minimal negative effects on their welfare.

### **1.3 Research questions**

The study was guided by the following research questions.

- i. What are the phenotypic characteristics of working donkeys in Kenya?
- ii. What are the role of gender in ownership and management of donkeys?
- iii. What are the main benefits of keeping donkeys in the central Kenyan highlands?
- iv. What are the challenges associated with working donkeys in the area?
- v. What are the estimated gross margins obtained by farms raising working donkeys?

- vi. What factors are associated with the level of profitability obtained from working donkeys?

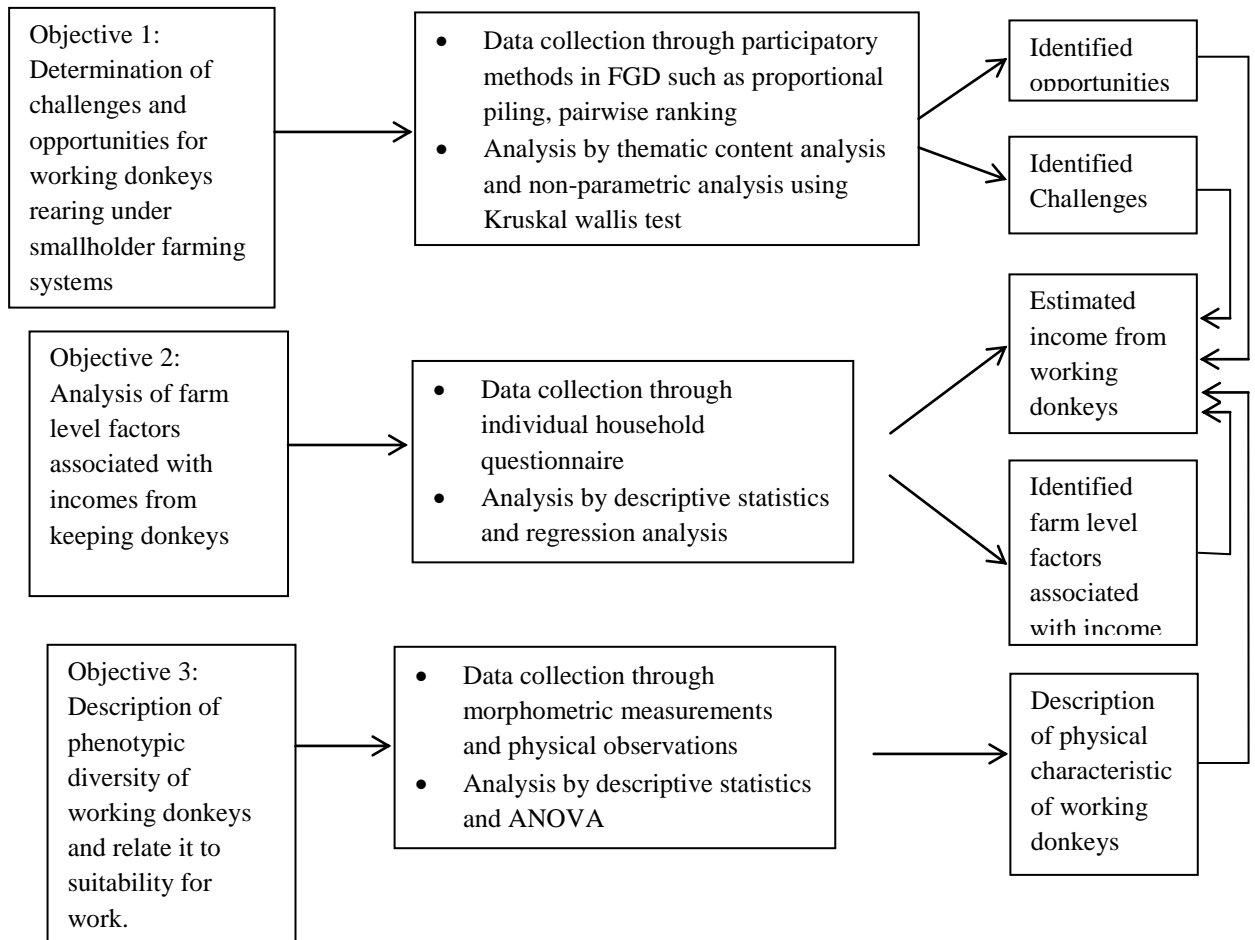
#### **1.4 Objectives of the study**

The overall objective of the study was to investigate factors associated with the level of profitability from working donkeys within the central highlands of Kenya.

The specific objectives of the study were:

- (a) To determine the challenges and opportunities for working donkeys rearing under smallholder farming systems in Kirinyaga County.
- (b) To analyze farm level factors which are associated with incomes from working donkeys within a smallholder farms in central Kenya.
- (c) To determine the phenotypic diversity of donkeys reared in the central highlands of Kenya and relate it to suitability for work.

Based on the objectives of the study, a conceptual framework presented in Figure 1 was developed and used to guide the research, incorporating the methods of data collection and analysis as well as the expected outcomes. The arrows from the objectives point to the methods that were used for data was collection and analysis. These further point to the expected outcomes from the study.



**Figure 1: Conceptual framework used to guide the research**

### 1.5 Study hypothesis

The hypothesis of the study was developed with reference to available literature on working donkeys in Kenya. The alternate hypothesis stated that the level of income obtained from working donkeys was associated with farm-level, animal, human and external factors. The null hypothesis stated that these farm-level, animal, human and external factors were not inter-related with each other. Another null hypothesis stated that there was no difference in the phenotypic characteristics of the working donkeys raised in Kenya with other working donkeys in the rest of the world.

## **1.6 Justification of the study**

The findings will contribute to new knowledge and literature within the scientific community by inter-relating the human, animal and farm level factors that are associated with income from working donkeys. A description of the size of the donkeys provide baseline data useful for explaining the genetic diversity of the donkeys raised in Kenya and can inform breeding strategies for size, physical strength and resilience. Additionally, an accurate estimation of their body weight will be useful to veterinary practitioners for correct dosing of drugs and will guide extension agents on the appropriate loads for the donkeys to bear with minimal effects on their welfare. The generated data will also be useful for policy makers, veterinary professionals, extension agents and donkey owners to intensify efforts to improve donkey health and welfare to ensure optimization of donkey use for the benefit of the households dependent on them for subsistence. Further, understanding the role of gender in working donkeys will identify and support women's roles as donkey owners and users; therefore strengthening their decision-making capabilities which are key aspects in promoting women's social and economic empowerment. This will consequently elevate the status of their families and communities and therefore contributing to millennium development goal 3 which is to promote gender equality and empower women.

## **1.7 Scope and limitations of the study**

The study was a cross-sectional study conducted in Kirinyaga County between the months of June to September 2018. Participatory methods were used to collect the data. This therefore meant that the results obtained were based on the donkey owners' perception and the present challenges at that point in time. Additionally, the study location was a smallholder farming system where donkeys were used intensively for

transport. The results, could be different for other geographical locations where donkeys were not used intensively in areas such as the pastoral systems.

### **1.8 Organization of the thesis**

This thesis is organized in a paper format. Chapter one contains the introduction of the study including the three specific objectives. Chapter two contains the literature review which provides an in-depth knowledge about donkeys. Chapter three contains the materials and methods. This involves a description of the study area as well as how the data was collected and analyzed. Chapter four contains a paper titled challenges and opportunities for working donkeys rearing under smallholder farming systems in Kirinyaga County. This chapter specifically provides an in-depth description of how objective one of the thesis was achieved. Chapter five contains a paper titled farm level factors associated with level of income from working under smallholder farming systems. This chapter provides a detailed description of how objective two of the thesis was achieved. Chapter six contains a paper titled phenotypic characteristics of donkeys reared in the central highlands of Kenya and their suitability for work. This chapter provides a conclusive description of how objective three of the thesis was achieved. Chapter seven contains a general discussion, conclusions and recommendations. This section describes how the three specific objectives interrelate to achieve the overall objective of the study as well as highlights the study conclusions and recommendations. Chapter eight is the references section while chapter nine is the appendices section to provide additional information required to enrich the thesis.

## **CHAPTER TWO: LITERATURE REVIEW**

### **2.1 Donkey population and ownership**

The estimated world population of working donkeys is 44 million with 13.7 million found in Africa (FAO, 1997) and 1.8 million donkeys in Kenya (CBS, 2009). A majority of working donkeys are owned by individuals as a source of income to sustain their livelihoods. Turkana County has the highest population (558,157) while Vihiga County the lowest population of 827 donkeys with 3,990 donkeys being raised in Kirinyaga County.

### **2.2 Donkey population growth**

Increased demand for draught power for households has resulted in a steady growth in the number of donkeys in sub-Saharan Africa, the northern parts of the Indian subcontinent as well as the tropical highlands of Latin America (Starkey and Starkey, 2004). The populations of working donkeys worldwide change in different reasons such as use of alternative motorized transport or climatic changes which affect weather patterns (Starkey, 2010). There has been a rapid growth of the population of donkeys raised within Kirinyaga County. For example, there were fewer donkeys in this region just about 30 years ago; which were primarily kept for transportation of farm produce to the urban market centers, but following the introduction of rice farming in Mwea region, and the increased businesses opportunities on ferrying of rice produce from farming fields to the milling centers, the use of donkeys has increased (L. Gachoki, personal communication, September 12 2018). This increase in the number of working donkeys raised within the country under similar production systems in the central highlands has been argued to have resulted from increased intercommunity linkages through associations along various value chains where donkeys play some critical role in transportation (Njenga, 1993). In the recent past,



donkey population sizes have declined due to increased incidences of donkey slaughter, and the competition from other means of transportation in these farming areas (Gichure *et al.*, 2019).

### **2.3 Donkey breeds worldwide**

The miniature donkey weighs less than 180 kg and measures up to 92 cm height at withers and on the other hand, the largest type of donkey, the mammoth stock, weighs up to 430 kg and may measure 143 cm height at withers (ADW, 2020). Physical description has been provided for working donkeys in different parts of the world such as Europe, Mexico, Ethiopia, Morocco, Zimbabwe and West Africa. The average weight of most adult working donkeys varies by breed and eco-geographical conditions ranging between 110 and 142 kgs. (Kugler *et al.*, 2008, Aluja *et al.*, 2005, Mustafa *et al.*, 2020, Pearson and Ouassat, 1996, Nengomasha *et al.*, 1999, Hassan *et al.*, 2013 and Nininahazwe *et al.*, 2017). Most of the donkeys kept in the tropical regions are considered underweight due to inadequate quantity and quality feeds (Pearson and Oussat, 1996).

There are three known donkey breeds present in the East African region. These include the East African, Maasai and Somalia donkey breeds. The East African breed has maximum withers height of 102 cm with a greyish brown or reddish brown color coat. Only the coat color of the Maasai breed of donkeys has been recorded although it is commonly reared by the Maasai community who are found in Kenya and Tanzania. The Somali breed, a wild donkey found in Somalia, Ethiopia and some parts of Kenya, has a grayish brown coat with prominent leg stripes but lacks the dorsal and transverse stripes. It is 142.25cm tall at the withers on average (Orhan *et al.*, 2012).

## **2.4 Breeding of donkeys in Kenya**

There are no breeding programs or breeding farms for working donkeys. Selection of breeding animals is often not common. A mare on heat is often served by any available stallion within the community. The resultant foal may be sold to other donkey farmers as replacement stock. Free movement of animals across national borders and within the country provides an opportunity for cross-breeding the different donkey breeds through non-selective mating of the donkeys.

## **2.5 Benefits of working donkeys in developing countries**

Working donkeys are preferred to cattle in sub-Saharan Africa because they have a survival advantage in extreme weather and feed scarcity as well as consuming under-utilized forage on rangeland. They also have lower maintenance in terms of feed requirements due to their relative smaller body weight (Smith and Pearson, 2005).

### **2.5.1 Draught power**

Donkeys are versatile and reliable sources of draught power for smallholder farms in rural and urban areas (Hagmann and Prasad, 1995; Kaumbutho *et al.*, 1998; Biffa and Woldemeskel, 2006; Swann, 2006). Use of draught power enables farmers to increase agricultural production. Donkeys are preferred as a source of agricultural power in semi-arid areas when the cost of maintaining cattle is too high. Additionally, donkeys are easier to train and cheaper to purchase than cattle (Pearson and Vall, 1998; Fernando and Starkey, 2004).

### **2.5.2 Transport**

Historically, the main use of donkeys has been for transport (Fernando and Starkey, 2004). Donkeys transport a variety of items in all agro-ecological areas. Within the urban and peri-urban areas, they transport building materials and different kind of goods commercially while in the informal urban settings and rural areas they transport

water, farm produce, animal feeds and domestic items (Angara *et al.*, 2011). Donkeys are relied as a means of transport where road networks are poor or non-existent (Starkey and Starkey, 2004; Mukiria, 2010; Angara *et al.*, 2011). This reduces the domestic transport burden and enables small-holder farmers to take part in the market economy (Fernando and Starkey, 2004). Donkeys also play a role in urbanization process by transporting building materials within the urban and peri-urban areas as was observed by Angara *et al.*, (2011).

The price charged for donkey transport is affordable when compared to other means of transport and is often associated with low income earners (Valette, 2014). The demand for donkey transport is threatened by competition from other means of transport although the high transport fees and high prices of fuel continue to create demand for donkey carts, especially for poor dwellers (Angara *et al.*, 2011).

### **2.5.3 Income and employment opportunities**

Donkey transport provides an employment opportunity for donkey owners and users who are employed either partially or fully by the donkey business. Garden Veterinary services Ltd (2017) and Lumumba *et al.*, (2019) reported that the average daily income earned through working donkeys was 9,000-15,000 KES per month and 11,390 KES per month respectively. The income generated through transportation of goods at a fee was more profitable than other jobs (Angara, 2011). Income earned from working donkeys provided sustenance for a household comprising of 5-20 members (Valette, 2014), hence contributing to other development outcomes such as education and food security (Lumumba *et al.*, 2019). The income was higher than the minimum wage earned by government employees (Sisay and Tilahun, 2000) and enabled many households to live above the international poverty level of 1\$ a day (Sieber, 2000).

#### **2.5.4 Environmental sustainability**

Donkeys contribute positively to the environment through their excreta which is used as manure. Donkey manure significantly improved the composting process and the quality of resultant compost for use as manure in fields to improve the soil quality (Karanja *et al.*, 2019). The manure could either be sold to crop farmers or efficiently utilized in production of agricultural by-products such as bio-gas which could improve the returns of the donkey owners (Valette, 2015).

#### **2.5.5 Women empowerment**

Ownership of livestock increases women involvement in the livestock sector which is fundamental for increased household productivity and economic empowerment (Galiè *et al.*, 2019). Women empowerment is thought to be an invisible benefit of working donkeys by lessening women's burden through provision of labor for tasks which would have been done by them (Brooke, 2014). This gave them more time and opportunity for community involvement and engaging in alternative income generation activities. A study by (Fernando and Starkey, 2004) showed that using donkeys could save women up to 25 hours a week for other activities. When women had access to financial resources, they were empowered within their households and in their communities (Bradshaw, 2013). The income earned through donkeys reduced the reliance of women on other people consequently improving their self-esteem, independence and social status and therefore improving their quality of life (Greiger *et al.*, 2020).

#### **2.5.6 Emerging benefits**

There is an increasing demand for donkey skin in Asian countries for production of herbal medication known as *ejiao*. Donkeys are gazetted as food animals Meat control act CAP 356 (1977). Their meat is an accepted delicacy among the Turkana

community in Kenya (Rono *et al.*, 2018). Consumption of donkey meat is popular in China and the meat is highly prized (Gregory and Grandin, 2007). The meat is low in fat and cholesterol and rich in iron (Polidori, 2017). The consumption of donkey products re-emerged in the 21st century due to an interest in the use of donkeys as production animals for their skins, meat and milk (Donkey Sanctuary, 2017).

Milk from donkeys is used among the Maasai community in Kenya where it is fed immediately after milking, while still warm, to children to manage severe coughs or pneumonia or to prevent diseases such as the common cold among them (Fernando and Starkey, 2004). Donkey milk was reportedly fed to orphaned children in Paris in the nineteenth century (Salimei, 2011). Donkey milk has also been reported to be effective in the inactivation of certain viruses, bacteria and tumors due to the lysozyme enzymes present (Madhusudan *et al.*, 2017). Further studies should be conducted to assess the medicinal qualities of the milk and assess the risks associated with consumption of raw milk.

Optimal utilization of these donkey products such as skin, meat and milk could have an overall effect of intensifying donkey breeding to support their role as production animals.

Another benefit of donkeys involves participation in recreation activities such as donkey racing during cultural events in the Lamu archipelago in Kenya provides an opportunity for tourism (Mukiria *et al.*, 2010).

## **2.6 Challenges faced by working donkeys in Kenya**

Working donkeys are faced with challenges which include small donkey size, poor husbandry and management conditions, injurious working implements, mistreatment, diseases, and road accidents. All these challenges greatly affect their welfare and consequently their work output (Valette, 2015).

### **2.6.1 Donkey size**

The donkeys' body weight determines the amount of load it can bear or pull (Pearson *et al.*, 1999). The size of an animal is as a result of genetic make-up as well as the environment which mostly is the feeding. In the tropical regions, most donkeys were considered underweight due to inadequate quantity and quality of feeds (Pearson and Oussat, 1996). Various phenotypic characteristics and body measurements including the height at withers, body length, heart or umbilical length have been provided for working donkeys elsewhere in the world such as Ethiopia, Zimbabwe, West Africa and Morocco. Body weight is obtained using the weigh scale but where this is not available, weight estimation formulas which incorporate the heart girth circumference and body length measurements have been used to estimate the body weight. (Orhan *et al.*, 2012; Mustefa *et al.*, 2020; Nininahazwe *et al.*, 2017; Nengomasha *et al.*, 1999; Pearson and Ouassat, 1996). Literature about the body measurements and weight of the donkey raised in Kenya is missing.

### **2.6.2 Poor nutrition**

Feeding is an important aspect in the management of any farm animal. The level of nutrition determines the working capacity of donkeys (Ram *et al.*, 2004) therefore knowledge of their feeding behaviour and nutrient requirements is crucial to maximize their work potential and work output (Aganga *et al.*, 2000). Often working donkeys in the highlands graze on natural pasture or feed on crop residues. Naturally, donkeys are both grazers and browsers (Aganga *et al.*, 2000). In the semi-arid areas, they eat a variety of feeds ranging from grasses, shrubs and the bark of trees hence making them preferable to cattle in arid areas (Smith and Pearson, 2005). Availability of adequate and nutritious feeds affects the growth and work output of working donkeys in sub-Saharan Africa (Pearson and Vall, 1998).

### **2.6.3 Working implements**

Improper and often injurious working implements including improper harnesses and cart designs were associated with wounds in working donkeys (Pearson *et al.*, 1999; Biffa and Woldemeskel, 2006). Poor or inadequate traction equipment will lead to welfare problems for the animals including wounds. Efficiency of working donkeys could be enhanced through access to modern technological working implements (Valette, 2015).

### **2.6.4 Mistreatment of donkeys**

The increasing human population, demands for transport of goods to and from far, remote areas, and construction activities around the town make equines highly demanded animals. They are mistreated in the form of whipping and subjected to excessive work and overloading while being restrained poorly in the form of use of tight synthetic tether ropes often without adequate feed or health care. (Onyango, 2017; The Brooke, 2010; Biffa and Woldemeskel, 2006). These ill-practices are prohibited in the prevention of cruelty to animals act CAP 360 (2012) of the laws of Kenya and they compromise donkeys' welfare and consequently their work out put. Although the law (CAP 360, 2012) is present, efforts should be intensified towards enforcing these laws within the donkey owning communities. Lack of adequate feeds leaves them to scavenge in waste and predisposing them to colic through ingestion of foreign materials.

### **2.6.5 Diseases**

Diseases were highlighted as factor affecting performance of working donkeys (Pearson and Vall, 1998). Healthy and well cared for donkeys work more efficiently and remain active for longer. Donkeys suffer diseases such as Trypanosomiasis (Karanja, 1992, Mukiria *et al.*, 2010), skin conditions and ecto-parasites (Kyeswa,

1996), as well as gastro intestinal parasites (Mulwa *et al.*, 2020, Lewa, 1999, Kirui *et al.*, 2010; Gichure *et al.*, 2013; Kyeswa, 1996), and African Horse sickness (Gichure, 2012).

Tick borne diseases are important constraints to livestock production (Muhanguzi *et al.*, 2017). Trypanosomiasis affects all ages of donkeys but clinical disease was more among the young donkeys. The prevalence was 7.5% and 3.1% in the wet and dry season respectively and was mostly transmitted by the vector *Glossina* biologically and biting flies such as *Tabanus* and *Stomoxys* mechanically. The disease manifested by reduction in red blood cell count manifested as pale mucus membranes among other clinical signs. In Uganda, Muhanguzi *et al.*, (2017) reported a prevalence of 32.4%. The disease was often caused by *Trypanosoma congolense* (Mukiria *et al.*, 2010; Karanja, 1992; Muhanguzi *et al.*, 2017)

External parasites affected donkeys with a prevalence of 77%. Majority of the ectoparasites were ticks (74%) (Kyeswa, 1996). In Ethiopia, wounds were the most prevalent skin condition affecting donkeys (82.3%); followed by ectoparasites (22.1%). Lice (11.2%), ticks (10.4%) and mange mites (1.6%) were the identified ectoparasites in that study (Kasaye *et al.*, 2016). Wounds often resulted from injurious carts and harnesses as well as from excessive whipping. They were identified as a major health problem in working donkeys (Biffa and Woldemeskel, 2006)

The prevalence of gastrointestinal parasites was 71.6% with the most common helminth species being *Strongylus vulgaris* (52.8%). Other identified internal parasites included *Triodontophorus serratus*, *Anaplocephala magna*, *Habronema* species eggs (Mulwa *et al.*, 2020). Helminth infections were the most common cause of death in working donkeys. They were also associated with growth of retardation, decreased work output, pain and distress due to colic (Saul *et al.*, 1997)



African horse sickness in donkeys occurred mostly after the rainy season than in the dry season when the vector, *Culicoides*, was numerous in the environment. Its prevalence was 35% and 28% in the wet and dry season respectively. Clinically, the disease in donkeys manifests either as a mild form or a severe form characterized by difficulties in breathing, oedema of the head and respiratory tract. The disease may be fatal in donkeys but the mortality rate was 2%. Recovered cases often became blind (Gichure, 2012).

#### **2.6.6 Road accidents**

The traffic act (CAP 403, 2013), donkey carts are classified under non-motorized transport. Although they are allowed on the road like other road users, they are exposed to multiple fast driven vehicles along the Embu-Makutano highway with the consequences of high traffic accidents. This leads to injuries or death of the donkeys as well as damaging their carts (Pearson et al., 1999). Various road safety campaigns have been conducted to address the challenge of road accidents though training donkey users about road safety, use of reflective jackets and placement of reflectors on carts, placement of road signage to warn motorists about donkey carts.

#### **2.6.7 Negative perceptions**

Donkeys work in a hostile environment within the community. They are viewed negatively when compared to other domestic animals. Different communities have different beliefs about donkeys; some of which reflect negative attitudes towards donkeys (Fernando and Starkey, 2004). This has contributed to a poor image of donkeys among the community members. Donkeys are perceived lesser when compared to other domestic animals. This then affects resolution of conflicts related to donkeys leading to malicious injuries, poisoning which could lead to death.

Peoples' attitudes and perceptions towards animals can determine how they treat animals (Perry, 2017)

### **2.6.8 Emerging challenges**

An emerging challenge in Kenya is theft and inhumane slaughter of donkeys by unscrupulous traders who are part of a larger international network of trade in donkey skin and meat (Donkey Sanctuary, 2017; Garden Veterinary Services Limited, 2017). If not properly checked, this practice will threaten the donkey population within the continent of Africa, and also globally (Lumumba *et al.*, 2019). Furthermore, these illicit activities of trade also presented welfare challenges for donkeys (Garden Veterinary Services Limited, 2017). Previously, donkeys were stolen and slaughtered without following humane procedures and their meat sold fraudulently as beef.

In order to prevent inhumane slaughter of donkeys, improve food safety and to encourage donkey production donkeys meat was legalized in 1999 (Kenya Legal Notice 144-146, 1999) (GoK, 2012). Four Chinese owned donkey export slaughterhouses in Kenya located in Baringo, Nakuru, Turkana and Machakos Counties were opened. Their main purpose was to export of donkey meat and skin whose demand was high in China (Khumalo, 2017). Thereafter, challenges about mistreatment of donkeys at the market yards and during transport to the slaughterhouses as well as the deplorable handling conditions within those slaughterhouses emerged. These challenges ranged from animal injuries (15%), lack of donkey welfare provisions within the slaughterhouse premises (71%) (such as lack of shelter, veterinary services, feed and water provision) to death (10%) (Garden Veterinary services Ltd, 2017). Additionally, these slaughterhouses required a constant flow of donkeys which are obtained from Kenya and other neighboring countries. With the decreasing donkey population and unintentional breeding is was

probable that unscrupulous businessmen turned to stealing donkeys from unaware owners or smuggling them from neighboring countries such as Ethiopia, Somalia and Tanzania. Donkey theft with lack of breeding programs threatens the population of donkey in the future. Lumumba *et al.*, (2019) recorded that 15% of the donkey population had been slaughtered in the export slaughterhouses within a three-year period. With the annual mean rate of donkeys slaughtered (5.1%) being five times higher than the annual donkey population growth rate (1.04%), there would be no donkeys in the next 3 years with all factors being held constant. In light of these challenges associated with donkey slaughter, a ban was placed on donkey slaughter by way of revoking the licenses of operation of the slaughterhouses through a gazette notice No. 50 of 20th April 2020 (Appendix 4).

## **2.7 The role of gender in working equines**

In rural areas of developing countries, men's and women's ownership, use and control of assets are strongly gendered; limiting women's ability to participate in profitable market-oriented agriculture (Quisumbing, 2015). Women are however faced with challenges such as lack of control over livestock income. This limits their decision making in the farms hence affecting their socio-economic empowerment.

Migration of men to the urban areas for non-farm occupation resulted in a shortage of labour on many smallholder farms. This together with separation and death of males increased number of female-headed households in many communities (Fernando and Starkey, 2004). Therefore, the use of donkeys for draft has been particularly more for women farmers. They found donkeys more affordable and easier to work with than oxen, therefore reduced their domestic transport burden in the rural areas (Fernando and Starkey, 2004).

Livestock activities are a daily occupation with all household members having access to livestock and being involved in production. Gender roles vary between livestock species and from place to place (Mutua *et al.*, 2014). When livestock are produced to generate income, men are often the owners, care givers, decision makers and beneficiaries of incomes received through them. Often, women assist the men in performing the responsibilities of raising the animals (IFAD, 2009). Women therefore provided unpaid labor force in their farms and are essential players in the socioeconomic development of their households as well as country in general (Roy *et al.*, 2017). Although womens' participation in other livestock duties has remained low, their involvement in donkey farming communities was high where they were primary care takers to donkeys (Brooke, 2014). Understanding the role of gender in working donkeys will increase efficiency and therefore the income earned through the donkeys.

## **CHAPTER THREE: MATERIALS AND METHODS**

### **3.1 Description of the study area**

The study was conducted in Kirinyaga County which lies within the central highlands of Kenya. The County borders Machakos County to the South, Murang'a County to the South West, Nyeri County to the North West and Embu County to the East. Administratively, the county is divided into five sub-counties namely; Kirinyaga East, Kirinyaga West, Mwea East, Mwea West and Kirinyaga Central; which are further subdivided to 12 wards, 30 locations and 81 sub-locations. Wang'uru town which is located in Tebere Location within the Mwea Rice Irrigation scheme is the most populated town in Kirinyaga County (Kirinyaga, 2013).

The County tapers from Mt. Kenya which is located on its Northern side and greatly influences its topography and climatic conditions. It is divided in three ecological zones; the highlands, midlands and lowlands. The highlands lie between 3400 - 5380 metres above sea level (asl) while the midlands lie between 2000-3400 metres asl and cover Kirinyaga West, Kirinyaga East and Kirinyaga Central sub-counties including the mountain area. The lowland areas which lie between 1158 to 2000 metres asl are characterized by gentle rolling plains, that cover most of Mwea East and Mwea west sub-counties. Donkeys are raised within the midland and lowland areas in thirteen locations within the whole Kirinyaga County where the Mwea irrigation scheme is located where donkeys are used as an alternative means of transport by farmers and local traders of agricultural products (CIDP, 2018).

Being within the tropical region, two rainfall seasons are experienced. They include the long rains receiving an average of 2,146 mms of rainfall annually and occurring between the months of March to May and the short rainfalls occurring in months of October and November receiving an average of 1,212 mms of rainfall annually. The

other months of the year are often classified as dry seasons. The average temperatures range from 8.1<sup>0</sup>C to 30.3<sup>0</sup>C. The study was conducted in 2018 between the months of June to September which are the dry months.

The county had a human population of 610,411 persons and covering an area of 1,478.3 km<sup>2</sup> (KNBS, 2019) with a donkey population of approximately 3,990 (CBS, 2010). Recent data on present donkey population were missing the numbers were thought to have significantly reduced due to donkeys slaughter (Lumumba *et al.*, 2019). The average land ownership in the county is one hectare for smallholder farmers (CIDP, 2018). Majority of the smallholder farmers' practice mixed crop and livestock farming. Farmers often lease land for a specific period of time from the National Irrigation Board which own most of the arable land in the lowland areas. However in the highlands, individual land ownership is predominant (Ndegwa, 2014). Approximately 18% of households in Kirinyaga County obtain their income from self-employment though trading of different items such as farm produce, rice, market and shop items. Other households obtain their incomes from salaries and wages through formal employment or casual work respectively (CIDP, 2018).

The mixed crop and livestock farming is the most important economic activity practiced in the county. Approximately 87% of the population derive their livelihood support from mixed farming; which accounts for 72% of household income (CIDP, 2018). The other types of livestock kept by farmers include poultry, cattle, donkeys, sheep, goats, rabbits and bees, while agricultural crops which are grown include rice, maize, beans, tea, coffee, as well as horticultural crops: bananas, tomatoes and mangoes (KNBS, 2019).

### **3.2 Selection of data collection sites**

Kirinyaga County was selected because it represented donkeys used intensively in a smallholder farming setting. Thirteen locations were purposively selected because of the presence of large number of donkeys raised. The locations selected from Mwea East sub-county were Tebere, Gathigiriri, Nyangati, Murinduko, Kiamanyeki and Kamuchege. In Mwea West sub-county, the sampled locations were Mutithi, Thiba, Wamumu and Sagana. Kutus location was sampled from Kirinyaga Central sub-county while Ngariama location was sampled from Kirinyaga East sub-county and Kagio location was sampled from Kirinyaga West sub-county (Figure 2).

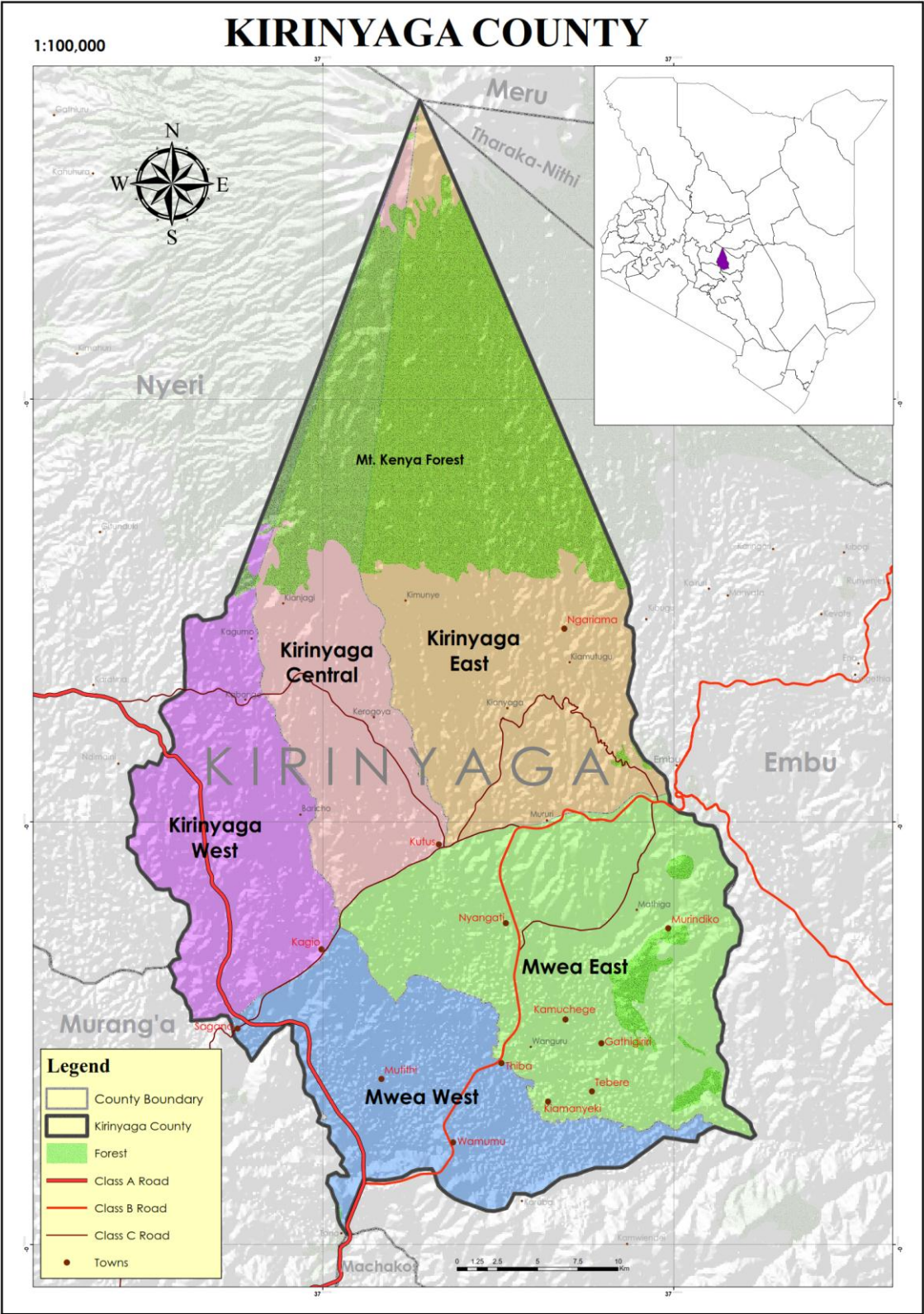


Figure 2: Selected locations (marked in red) where the study was carried out.

Source: Orbital geospatial services [www.orbital.co.ke](http://www.orbital.co.ke)



### **3.3 Study design and sample size determination**

This was a cross-sectional study conducted between the months of June to September 2018 in Kirinyaga County. The study units were donkeys within the donkey owning households. The required sample size of 351 was calculated based on a formula by Wayne and Chad (1999) where the population of donkeys was known.

$$n = (N \times X) / (X + N - 1).$$

Where,  $X = Z_{\alpha/2}^2 \times P \times (1-P) / p^2$ ,  $Z_{\alpha/2}$  is the critical value of the normal distribution at  $\alpha/2$  for a confidence level of 95%,  $\alpha$  is 0.05 and the critical value is 1.96,  $p$  is precision or margin of error,  $P$  is the sample proportion,  $N$  is the population size (3990) (CBS, 2010) and  $n$  is 351 donkey owning households whose owners were engaged in the individual interviews.

For data on phenotypic descriptions and body measurements, all the donkeys within the household were proposed to be sampled to avoid selection bias. However, most of the owners allowed only one donkey because body measurements took a lot of time. The total number of donkeys measured was 360.

### **3.4 Data collection**

Data was collected in five stages which included; preliminary visits to the selected locations and discussions with local authorities (chiefs) and leaders of donkey owner community groups in order to introduce the research and its objectives. Focused group discussions were then conducted in the thirteen locations rearing donkeys to identify the benefits and associated challenges of working donkeys. Individual questionnaire interviews were also conducted in donkey owning households to describe the characteristics of working donkeys and identify the farm level factors associated with working donkeys. Individual interviews were also held with key

informants who were donkey owners who had owned and worked with donkeys for more than 20 years to provide additional information concerning donkeys.

Data on the morphometric measurements including the heart girth, height at withers and body length were taken using a measuring tape. Body weight was estimated using a formula proposed by Pearson and Ouassat (1996) which incorporated the heart girth and body weight. These measurements were used to describe the physical characteristics of working donkeys and determine their suitability for work.

### **3.5 Data management and analysis**

The data from the focused group discussions, individual questionnaires and body measurements was first transcribed into a separate Microsoft Excel document and then exported to Genstat® (15<sup>th</sup> edition) statistical packages for analysis (VSN International, 2012). A description of the types of data as well as their analysis is described in Chapters four, five and six.

### **3.6 Ethical approvals and participant consent**

Ethical approval to conduct the study was granted by the University of Nairobi; Faculty of Veterinary Medicine Biosafety, animal use and ethics committee **REF: FVM BAUEC/2018/165** (Appendix 5). Permission to conduct the study was also obtained from the local administrators before commencement of the study within their localities. Furthermore, before conducting the focused discussions, administration of the questionnaires and taking the body measurements, the study objectives were explained to the participants and verbal consent to participate in the interviews was granted from all the participants. The participants were assured of privacy and protection of their information. No participant declined to give their consent in the study period. Consent for animals to be used in the study and for their photos to be taken was allowed by the donkeys' owners. Animal welfare guidelines were followed

such as using only healthy donkeys for the study, ensuring the donkeys were humanely handled and restrained. Minimum time was spent per donkey when taking measurements to prevent them from being stressed (FAWAK, 2004).

## **CHAPTER FOUR: CHALLENGES AND OPPORTUNITIES FOR WORKING DONKEYS REARING UNDER SMALLHOLDER FARMING SYSTEMS IN KIRINYAGA COUNTY**

### **4.1 Background information**

Livestock contribute to households both directly as a source of food and indirectly through income generated from the sale of animals and their products. For working animals, the draught power is an important output which enables them to earn income required for household subsistence. Working donkeys are faced with such challenges poor husbandry and management, donkey size, improper and often injurious working implements including improper harnesses and cart designs (Pearson *et al.*, 1999), mistreatment in the form of excessive whipping (Onyango, 2017) and diseases such as Trypanosomiasis (Karanja, 1992), gastro-intestinal nematodes, gross skin conditions and ecto-parasites (Kyeswa, 1996), internal parasites (Lewa 1999), worm infestations (Kirui *et al.*, 2010) and African Horse sickness (Gichure, 2012). All these challenges greatly affect their welfare.

Few studies have documented the benefits of working donkeys within the context of smallholder farming households in the central highlands of Kenya. Literature on the associated challenges is also scanty. This study was therefore conducted to describe the types of benefits and the associated production challenges of working donkeys within the context of smallholder farming systems within the peri-urban and rural areas in central highlands agro-ecosystems of Kenya. The generated data will be useful for policy makers for resource allocation to support donkey health and welfare practitioners in prioritizing benefits and production challenges of keeping donkeys and support for advocacy of donkey welfare within similar production systems.

## **4.2 Methodology of data collection**

Data was collected in thirteen focused group discussions in the 13 selected locations. One FGD was conducted per location. The focus groups comprised of 8-12 participants each from the different villages rearing donkeys to represent the entire location. The participants were selected during the preliminary visits to the selected study area where the chiefs and donkey owners were asked to nominate one person per village who would participate in the discussions. This selection of participants was done to identify people who could provide reliable data on types of benefits and challenges facing donkey keepers.

These participants were selected to represent the entire location. They consisted of donkey owners who were also donkey users. Additionally, they were 18 years old and above and a resident in the villages. The researcher was not involved with selection of the study participants. The group discussions were guided by a checklist of open-ended questions (Appendix 1). These responses were also open ended and further probing was done to provide detailed data on the topics being discussed as well as to ensure clearer understanding of the data obtained. Key questions addressed included benefits of keeping donkeys, the list of diseases affecting donkeys and the challenges facing the donkeys in the study areas. Additional questions asked included the types of transported materials, who transported the items and who made decisions regarding spending of income obtained from donkeys. The reasons for ranking for the identified and the proposed solutions for the identified production challenges were also sought. Data were collected by taking manual notes on flip charts based on the responses provided. Figure 3 shows a focused group discussion underway. Data on the benefits of keeping donkeys was also collected using individual farmer interviews (Appendix 2) to emphasize what was collected through the focused group discussions.



**Figure 3: Focus group discussion with donkey owners in Tebere location led by the author and a research assistant in Mwea East Sub-county**

Manual notes from the focus group discussion were taken. The focus group discussion guide questions were written in English. However, the discussions were conducted in Kiswahili language which was well understood by the participants. Additional notes were recorded on extra writing sheets attached to the questionnaire guides.

#### **4.3 Data Management and analysis**

The responses from the focused group discussions were first transcribed into separate templates created in Ms Word and Excel documents. These responses were firstly ranked and scored using simple ranking and then secondly by pair-wise ranking methods based on importance by the respondents. The scores and ranks were then converted to reciprocals to give weights to the obtained scores and ranks. The data was then exported to Genstat statistical package for analysis (VSN International 2015). The analysis was accomplished using the Kruskal-Wallis One way analysis of variance to test whether the median ranks for the various benefits and challenges were significantly greater than the median score. The responses were considered significant when the computed Z score was greater than the critical value of  $Z\alpha = 1.96$  value. Additional responses from the open-ended questions were presented in narrative summaries to support the ranks and scores obtained. Responses from the individual farmer interviews were analyzed using the Kruskal-Wallis One way analysis of variance.

## **4.4 Results**

### **4.4.1 Determination of benefits of keeping donkeys**

Donkeys kept in Kirinyaga County were used mainly as a means of transportation ( $Z = 5.80$ ) either for domestic transport or commercial transport which was a source of income. Donkeys were also kept by households for the purpose of manure production ( $Z = 3.47$ ). This manure from donkeys was often used as fertilizer for farmed crops such as rice which is produced by most families within the low laying areas of the County. Other benefits of keeping donkeys were for breeding (7/13) in order to obtain replacement stock; as savings in order to sell it times of money needs; for ploughing (6/13) where they substituted or complemented bulls; and for donkey milk (1/13) which as thought to have medicinal properties for people who had respiratory tract health infections and problems. Use of donkeys for domestic transport saved on labor charges for the household. The benefits of donkeys in the study area are indicated in Table 1.



**Table 1: Benefits of keeping donkeys according to smallholder farmers in Kirinyaga County**

Benefits of keeping donkeys	Median Rank	Z score
Transport	123.00	5.80*
As a source of manure	99.85	3.47*
For breeding purpose	72.58	0.71
For ploughing	64.85	-0.07
For sale	51.19	-1.44
Trading	51.19	-1.44
As a source of income/ to hire it out	50.08	-1.56
As a family asset	48.81	-1.68
As an identity	48.31	-1.73
As a pet	45.15	-2.05

\*Significant benefits

Donkeys therefore contributed as a source of income to the households either through charging of transport services they offer, or through their sale or sale of their products. Domestically, donkeys were used in order to avoid transport charges of fees that would be incurred by a household if farm labor was hired and hence this acted as savings for the household who used their own donkeys.

Rice was the most frequently transported farm produce (10/13 groups). It was transported at different stages including rice seedlings, harvested and milled rice. Water was also frequently transported to the households, followed by building materials, manure to farms, farm produce such as maize, vegetables and potatoes, as well as moving people (especially household items, sick people and during occasions like political campaigns and wedding ceremonies) and other animals.

#### **4.4.2 Gender roles in the use of donkeys**

The donkeys were mostly owned by men (92%) who worked with them more when compared to other household members. Few women (8%) also owned and worked with their donkeys while children neither owned or used donkeys. On some instances hired users worked with the donkeys all of whom were men. Men, women and children provided feeds to the donkeys on the farm as they did with other livestock reared in the farm. Men often made the decisions regarding animal health service provision as well as paid for the services offered to the donkeys. Men made decisions (95%) regarding the type of work to be done by the donkeys as well as the use of the income obtained through them even when these donkeys were owned by women.

#### **4.4.3 Determination of challenges experienced by working donkeys**

The challenges facing working donkeys in Kirinyaga County were theft and slaughter ( $Z = 5.99$ ), diseases ( $Z = 3.03$ ), road accidents ( $Z = 2.83$ ) and malicious cutting ( $Z = 2.32$ ) indicated in Table 2. They are sorted in descending order of significance.

**Table 2: Challenges experience by working donkeys in Kirinyaga County**

Challenge	Median rank	Z score
Theft and slaughter	214.00	5.99*
Diseases	163.15	3.03*
Road accidents	159.69	2.83*
Malicious cutting	150.88	2.32*
Competition by <i>tuk-tuks</i> and motorbikes	141.46	1.77
Lack of reliable vet services	110.69	-0.02
Poor image of donkeys	101.12	-0.57
Conflicts eg donkey detentions	93.58	-1.01
Lack of feeds	92.81	-1.06
Cost and availability of treatment	92.19	-1.09
Poor payment by customers ie debts	92.08	-1.10
Lack of housing	84.58	-1.54
Harassment by police	81.31	-1.73
Lack of unity among peers	76.46	-2.01
Poor roads	76.46	-2.01
Seasonality of work/ weather	75.38	-2.07

\*Significant challenges

Most of the respondents linked the challenge “donkey theft and slaughter” to the opening of export slaughter houses for donkeys in Turkana, Nakuru, Baringo and Machakos Counties which were in operation at the time when the study was conducted. Due to the threat in reduction of the numbers of donkeys raised in the country coupled with upcoming industrialization, most donkey owners had diversified to alternative means of transportation services such as motorized tricycles commonly known as *tuk-tuks* and motorbikes due to the changing customer needs for increased speed and transport of lighter loads.

The challenges were further probed in order for the donkey owners to propose solutions which are presented in Table 3. The solutions revolved around actions by the owner, administrators, law enforcers, animal health service providers and the government.

**Table 3: Narrative summaries for identified challenges and proposed solutions according to the respondents keeping donkeys in Kirinyaga County**

<b>Challenge</b>	<b>Proposed solution</b>
Theft and slaughter	Closure of slaughterhouses, placing a ban on donkey slaughter and trade on its products; legalizing donkey meat and donkey slaughter so that donkeys are sold willingly from owners; monitoring of movement and marketing of donkeys by transport and movement permits; Improvement of donkey housing and security; Prosecution of all perpetrators of illegal theft and slaughter
Diseases	Practicing disease prevention such as vaccination of animals and improvement of hygiene, practicing home based care, routine health checkups for the donkeys, Improvement of donkey husbandry; Early disease identification and reporting for veterinary treatment immediately; Improve the competency of existing animal health service providers on donkey diseases and conditions
Road accidents	Donkey users to be trained on traffic rules and road safety, motorists to be sensitized on animal road use by use of road signs and bumps, donkey owners to prevent roaming of their donkeys and always wear reflective jackets and carry a torch at night to improve visibility by other road users.
Malicious cutting	Donkey owners to prevent straying of their donkeys, Sensitize the community on humane and amicable solutions to donkey related conflicts, prosecution of the perpetrators of malicious cutting

<b>Challenge</b>	<b>Proposed solution</b>
Competition by <i>tuk-tuk</i>	Maintaining a good relationship with customers ie be trustworthy in work, charge reasonably; offer reasonable competitive charges for donkey transport services; Improvement of donkeys to increase their efficiency to improve their preference among customers; reducing dependence on donkey transport income by sale of donkey manure
Cost and lack of reliable vet services	Improving the competency of existing LAHPs to offer services to donkeys; subsidizing drugs used for donkey treatment in order to lower the cost of treatment; paying promptly for services offered to encourage service providers to work with donkeys, Budget wisely to include treatment costs; maintaining a good relationship with animal health service providers who can extend services even on credit
Conflicts eg donkey detentions	Owners to prevent their donkeys from straying, County government to provide land or owners to unite and buy some land as holding ground within the town area
Lack of feeds	Owners to preserve/store hay (feeds) while in plenty for use in scarcity and prevent their donkeys from roaming
Poor payment by customers ie debts	donkey owners to unite and set equal charging for the services offered, refusing to offer services to customers who don't pay,

#### 4.4.4 Disease conditions affecting donkeys

Donkeys raised in Kirinyaga County faced diseases such as tetanus ( $Z= 5.35$ ), hoof problems ( $Z= 4.55$ ), worms ( $Z= 3.10$ ), and mange ( $Z= 2.24$ ) among other diseases indicated in Table 4.

**Table 4: Identified disease conditions affecting donkeys in Kirinyaga County**

Disease/ Condition	Mean Rank	Z score
Tetanus	191.00	5.35*
Hoof problems	178.04	4.55*
Worms	154.58	3.10*
Mange	140.69	2.24*
Wounds	120.27	0.98
Rabies	113.42	0.55
Colic	100.08	-0.27
Respiratory problems	99.65	-0.30
Diarrhea	81.12	-1.45
Eye problems	79.15	-1.57
Trypanosomes	75.19	-1.81
Sarcoids	71.65	-2.03
Staggering/ gaits	67.38	-2.30
Abscess, Blisters	66.73	-2.34
Hypersalivation	66.73	-2.34
Allergies	66.31	-2.36

\*Significant diseases

Most donkey owners in Kirinyaga County who were organized into self-help groups had been trained on early disease reporting and home based care by a local NGO which had worked to improve donkey welfare for about 20 years from the time when the study was conducted. Those who did not know the diseases were probably owners who had acquired the donkeys in the last two years and women who had not received training on early disease identification. Additionally the disease which were identified as significant were those that were likely to cause death to the donkeys such as tetanus, rabies, colic, wounds; those that affected work output and therefore reduce income such as hoof problems, worms, respiratory problems; those which were expensive to treat and manage such as tetanus, worms, mange and wounds; those that were zoonotic and contagious such as rabies as well as those affecting appearance of the donkeys by affecting the coat hence reduces the price of a donkey during sale, also causes separation of donkeys by the owners and discourages potential clients from hiring the donkeys such as wounds and mange.

#### **4.5 Discussion**

Donkeys were used for transporting water, rice and building materials among other items. Water was transported to homes, schools, hotels, and construction sites. Transport of rice aided rice farmers to reach markets and obtain a higher return from their rice which would be traded, and hence enabling these farmers to participate in trade activities; a finding which concur with reports previously published by Valette (2014) and Fernando and Starkey (2004). The rice would be transported as seedlings, paddy, white rice and husks from the farms to the millers and consumers. While building materials were transported due to the growth of other town within Kirinyaga County.



Donkey manure was also used in Kirinyaga for sale and use in the farms. The manure was reported to improve the soil quality by reducing the occurrence of crop parasites in the soils and reducing the acidity levels in rice fields. Karanja *et al.*, (2019) had previously reported that donkey manure significantly improves the composting process and the quality of resultant compost for use as manure in the crop fields. Manure yield could be increased through accumulation enabled by enclosing or housing of donkeys to increase the volume of dung (Ndambi *et al.*, 2019)

Donkey meat was neither accepted nor consumed in the area. This confirmed a report by Rono *et al.*, (2018) who recorded that most communities in Kenya did not consume donkey meat except for the Turkana community who have been known to consume donkey meat. Unpublished reports indicated that donkey meat was sold fraudulently to consumers as beef by unscrupulous traders, who often had stolen donkeys, slaughtered them inhumanely under unhygienic conditions, which for most part was meant to obtain the donkey skin (Lumumba *et al.*, 2019). It was common to find donkey carcasses which had been deboned and the skin taken away (Khumalo, 2017). This observation was linked to the opening of four donkey abattoirs which had created a high demand for donkey skin for export to China to supply the ingredients for preparation of *ejiao*, which is a medicinal product used by the Chinese people, but had no commercial value for the skin and donkey meat has been reported in Africa (Donkey Sanctuary, 2017). The report further noted that with the decreasing donkey population and unintentional breeding challenges, unscrupulous businessmen turned to stealing donkeys which was reported in other parts of Kenya. The stolen donkeys were traced by the anti-stock theft unit to the donkey slaughterhouses which have been recently commissioned in Kenya (Donkey Sanctuary, 2017).

Men benefited more from donkeys as owners and users. This finding differed from a previous study by Fernando and Starkey, (2004) who recorded that women benefited more from donkeys. It appears that when there is income obtained from the working donkeys, the men become more involved. This confirms the conclusion by Garden veterinary services Ltd (2017) that men controlled incomes from donkeys even when the donkeys were owned by the women.

Donkey theft and uncontrolled slaughter of donkeys significantly reduces the population of donkeys in Kenya, and consequently affect the livelihoods of many donkey owning households who use them as a means of sustenance (Lumumba *et al.*, 2019). At the time when this report was written, Declaration of the export slaughter houses for donkeys had been revoked through a gazette notice No. 50 of 20th April 2020 (Appendix 4). This would prevent the theft of donkeys for slaughter and therefore reduce the threat of the diminishing donkey population.

Other proposed solutions according to the respondents included having a system of tracing donkeys from their source, properly restraining donkeys to prevent roaming and providing security in homes and communal holding grounds.

Another potential opportunity of rearing donkeys was for milk production. This was however not considered a benefit at the time when this study was conducted. Donkeys as a dairy species have been known since the Roman age not only for the nutritional value of their milk but also for its beneficial properties in skin care and in the late nineteenth century, donkey's milk was successfully used for feeding orphan infants in Paris (Salimei, 2011). Respondents in Kirinyaga County also consumed donkey milk which was thought to be a remedy for non-specific respiratory health problems (Fernando and Starkey, 2004) although they did not have documented evidence about the medicinal qualities of the milk which contained lysozyme that are effective in

inactivation of certain viruses, anti-microbial activity, angiogenic inhibition and anti-tumour (Madhusudan *et al.*, 2017).

Diseases were also identified as challenges affecting working donkeys in the central highlands. The identified diseases included tetanus, hoof problems which caused lameness, mange as well as endo-parasitic infections. Previous studies about the prevalence, presentation and management of tetanus in Kenya were missing although the number of reported cases was low (Dr Mulonzi C.N, sub-county veterinary officer personal communication April 20 2020). Donkeys' natural behavior of rolling on the ground (Reagan *et al.*, 2014) would predispose them to tetanus infection as compared to other domestic animals raised within the households. Tetanus was reported as the most significant disease ( $Z= 5.35$ ) among working donkeys in smallholder farms because its prognosis was guarded and it was mostly fatal for donkeys, but also presented a greater risk for infection to those who are in contact with the infected donkey. The disease can be prevented through vaccination to reduce the chances of infection (Khan, 2005). Helminthosis, was the most common endo-parasitic infection with a reported prevalence of 71.6% (Mulwa *et al.*, 2020). Helminth infestation reduced work output of donkeys and consequently the income obtained through donkeys (Ibrahim *et al.*, 2011). Lameness was an indicator a poor welfare status in animals (Reix *et al.*, 2014) and also affected the work output in donkeys (Pritchard *et al.*, 2005). The prevalence of lameness among working donkeys was 27% in Ethiopia (Assefa *et al.*, 2017). Similar prevalence studies have not been conducted in Kenya. According to the respondents, diseases had significant impacts based on their effects on work output for the donkeys, reduced productivity and often causing death. That could explain why the occurrence of wounds was not highlighted as a significant disease in the central highlands of Kenya, although its prevalence among working

donkeys was high at 82.3% (Ashinde *et al.*, 2017). The presence of wounds on donkeys indicated a poor welfare status in animals, and hence predisposing the donkeys to tetanus infections (Emmanuel *et al.*, 2020). The wounds would often result from friction caused by faulty carts and harnesses as well as by use of injurious whips and malicious cutting (Biffa and Woldemeskel, 2006). Whipping was common in Kirinyaga County as a method of directing donkeys on the road. Malicious cutting was highlighted as a significant challenge affecting working donkeys ( $Z=2.32$ ). Donkeys were often injured maliciously by the community members when donkeys stray into their farms and often destroying their property, and if the resulting conflict was not solved amicably by the warring community members. Malicious cutting often resulted to death of donkeys because the injuries were too severe to be managed. Mange was identified among the significant diseases affecting donkeys in Kirinyaga; because it affected the appearance and skin coat of the donkeys, which reduced the market price of a donkey during the point of sale. This would also be caused by the separation of donkeys by their owners and discouraged potential clients from hiring the donkeys for use to generate income. The respondents also thought that mange could be contagious and be spread to other donkeys through contact. Kyeswa (1996) in a study to estimate the prevalence of ectoparasites in Mwingi County, Kenya, did not identify mites in donkeys. The findings from this study showed that the above diseases were ranked highly on significance among respondents. Helminthosis was the only disease which was ranked to significantly impact on household incomes ( $Z=3.10$ ) and also had a high reported prevalence 71.6%.

#### **4.6 Conclusions and recommendations of the challenges and opportunities for working donkeys in Kirinyaga County**

In conclusion, the benefits of keeping donkeys in the central highlands of Kenya were for transportation of different kinds of goods as well as for the production of manure. Both of these benefits contributed to income. The income was obtained directly through payment for transport of goods by the donkeys and sale of donkey manure.

Working donkeys were faced by challenges such as rampant theft of donkeys for slaughter, road accidents, malicious injuries as well as diseases such as tetanus, worms, mange, and hoof problems. These challenges were ranked with significance based on their potential to affect work output, reduce the level of income earned by the households through donkeys or those that caused death. Addressing these challenges would optimize the opportunities of donkeys among smallholder farming systems in Kenya. This would however call for a collaborated effort among all stakeholders involved in the value chain of working donkeys.

This study only reports findings based on donkey owner knowledge of the benefits and identification of diseases that affected their donkeys, but future prospective studies should be conducted to determine the animal and herd level prevalence of the identified diseases which were ranked high by respondents. In chapter five, the farm level factors associated with levels of income from donkeys will be discussed.

## **CHAPTER FIVE: FARM-LEVEL FACTORS ASSOCIATED WITH LEVEL OF INCOME FROM WORKING DONKEYS UNDER SMALLHOLDER FARMING SYSTEMS**

### **5.1 Background information**

The contribution of livestock to Kenya's national GDP (Gross Domestic Product) is estimated at approximately 12% and 42% for the agricultural GDP (SNV, 2008). Income obtained through provision of draught power supports household in meeting the basic needs for survival such as food, clothing and shelter. However, provision of draught power has not been listed as a primary output for working equines (FAO, 1996). Although working donkeys contribute to both direct and indirect household incomes (Valette, 2015), they are not perceived as a critical element of people's livelihoods (Pearson *et al.*, 2000). Indeed, these working donkeys are often not considered with a lot of importance by policy makers, in part because they are perceived as single purpose animals (Hassan *et al.*, 2013). To date there is no reliable source of information on the factors associated with from working donkeys raised by both by rural and urban households in the central highlands of Kenya. Results from this report are useful in guiding national policy development for inclusion of donkeys' health and welfare in the national planning and resource allocation framework, which would further provide a favorable working environment for donkeys and enhanced performance and productivity for donkey owners and users under similar production systems.

### **5.2 Methodology of data collection**

A total of 354 smallholder farming households keeping donkeys were interviewed using a semi-structured questionnaire with open and closed ended questions (Appendix 2). The questionnaires were first pre-tested in all the locations within the

study site. All the sub-counties were sampled proportionally based on the population of donkeys raised in each. Multistage sampling technique was employed to select the study units; first by selecting thirteen locations where donkeys were raised in the county and second by selecting the donkey owning households through systematic random sampling method by selecting every third household along a transect route. If a donkey was not found in the next selected household, then the next household was automatically selected for the study until a household with a donkey was found. The households were identified with the help of key informants who were well known members of the communities who also owned donkeys. They introduced the researcher to the household head and requested for consent to participate in the interviews. During the questionnaire survey, respondents were asked about; their age, land ownership, livestock numbers, donkey herd structure including the sex ratio, sources of household income, reasons for keeping donkeys, donkey working practices such as number of hours the donkey worked per day and the number of days donkey worked per week, hiring out of donkeys for a fee, considerations for working donkeys, husbandry and management practices and prices for various inputs used in donkey management, as well as alternative income generating activities. The questions were open ended to allow a variety of responses from the participants. The respondents were asked to rank their responses based on importance. The ranks were categorized from 1- 3 where 1 was the most important response. The questions were translated to Kiswahili language which was well understood in the study area.

In-depth interviews were also done with the key informants to provide additional information concerning the population of donkeys in Kirinyaga County as well as highlight any emerging issues affecting donkeys. Inclusion of the key informants into the study was based on their willingness to participate in the research. The key

informants who were used in the study were donkey owners who had worked with donkeys for 30 years from the time the research was conducted

### **5.3 Data management and analysis**

Quantitative data was analyzed using descriptive statistical measures including mean, range and percentages. The quantitative variables included the age group of the respondents, land ownership, herd sizes and herd structure, donkey working period in hours, number of working days per week, amount of daily income obtained from donkeys compared with other livestock, market prices for young and mature donkeys as well as market prices of various inputs and outputs incurred while working with donkeys.

The profitability of working donkeys were analyzed by calculating the gross margins and later presented as a percentage of gross income per household as profit margins. The gross margin was calculated using the equation proposed by Hook, 2006. Gross margin = Output – Variable costs. While the profit margin was calculated using the formula recommended by Moran, (2009)

$$\text{Profit margin (\%)} = \frac{\text{Gross margin}}{\text{Gross farm income}} \times 100$$

Univariable general linear regression model was fitted to analyze farm level factors which were associated with level of income obtained from working donkeys in farms. The daily income obtained from donkeys was regressed against factors such as: Number of donkeys reared per household, number of hours these donkeys worked per day, number of days donkeys worked per week, source of replacement stock for donkeys, land ownership, types of items transported, factors considered when costing for work done by donkeys as well as other alternative businesses farmers were involved in. The variables which were significant at ( $P < 0.2$ ) were further analyzed



using multivariable regression analysis, and for all cases a 5% significance level was applied.

## **5.4 Results**

### **5.4.1 Determination of respondent and livestock characteristics**

Majority of the donkey owners and users were young people aged between 20-35 years (55%) followed by those between 36-50 years (40%). Few respondents were either below 20 years old (2%) or above 50 years old (3%). All the respondents from the selected households owned donkeys.

The total number of donkeys owned by the respondents was 1,040. The majority were adult males (65%), followed by adult females (23%) and foals (12%). Many smallholder farming household owned 3 donkeys with a sex ratio of male to female donkey estimated at 2.1. The livestock species kept in addition to donkeys included cattle (34%), chicken (11%), sheep and goats (12%) as well as pigs (2%).

Majority (83%) of the donkeys were purchased into farms (294/354); while the other farmers (17%) either obtained their donkeys through farm breeding (32/354; 9%) or through both farm breeding and purchasing (28/354; 8%). The average market price for adult donkeys was 16,000 ± 252 KES. Adult female donkeys were bought at 16,551 ± 304 KES; which made them slightly more expensive than adult male donkeys whose buying price was 16,163 ± 200 KES. The average market price of foals was 8,000 ± 237 KES. Female foals were also slightly more expensive (8,529 ± 232 KES) when compared to male foals (KES 8,160 ± 242 KES).

### **5.4.2 Determination of reasons for keeping donkeys by households**

The respondents considered donkeys as the most important livestock species (348/354; 98%) followed by cattle (6/354; 1.7%). This was because commercial donkey transport was a vital source of income for households (93%). The donkeys

were also used for domestic transport, and as a source of manure, for supporting business activities, as a source of labor for farm work and to complement and assist in cattle farming. Donkeys were also kept because they had low cost of maintenance as compared to other livestock, and were also considered easy to work with and as pets (Table 5). The daily income obtained from working donkeys was estimated at  $500 \pm 42$  KES compared to only  $100 \pm 23$  KES obtained from cattle. Cattle were used both for their milk production and for ploughing.

The manure from donkeys was sold at an average market price of  $430 \pm 26$  KES per cart (estimated at 200 Kgs) which was equal to that of sheep and goats; but more expensive compared to manure obtained from cattle which was sold at  $400 \pm 85$  KES per cart. And, the manure obtained from donkeys was used by 79% of all the respondents both for sale and for farm use.

**Table 5: Percentage scores for reasons of keeping donkeys according to farmers in Kirinyaga County**

Reasons for keeping donkeys	Rank 1	Rank 2	Rank 3
Source of income	92.7	8.1	14.3
Domestic transportation	6.5	52.5	33.9
Manure production	0.0	16.7	23.2
Little cost of maintenance	0.0	13.1	12.5
For sale (breeding of resale)	0.3	2.0	8.9
Support for farming activities	0.1	7.6	3.6
Raised as a pet	0.0	0.0	3.6

The categories of donkeys that were allowed to work were the mature males (99%), mature females (62%) and foals (4%). A few pregnant animals were also allowed to work until they were either 7 months pregnant or were physically not able to work. The donkeys worked for an average of about 4 hours in a day (ranging from 1 hour to 10 hours) depending on the availability of work.

All donkeys were used for transportation of goods by pulling a cart. About 89% of donkeys worked in the dry season, 4% in the rainy season and 7% in both seasons. Different kinds of goods were transported such as water, rice, farm inputs and outputs, building materials, farm animal feeds and firewood.

The respondents considered the donkeys' ability to fit into a cart and being strong enough to pull the cart as important criteria to determine their suitability for work. The strength was determined by both body size (63%) and age (37%). Majority of the respondents however could not estimate the weight of donkeys. Since most donkeys were bought in, average sized adult donkeys weighing approximately 150 Kgs were

preferred because they could be trained and then worked immediately upon acquisition.

When the donkeys were not working, majority were found grazing in communal land (74%) during the day. At night, some were left in the communal grazing areas overnight (21%) while others were either tethered in their homesteads (23%) or housed under unroofed (23%) or roofed (6%) enclosures. Others were untethered within the homesteads (19%) while a few (8%) roamed freely around the urban centers. Majority 57% (202/354) of the donkey owners leased land. Others used their parents land (24%) while a few rented land (19%). Majority (91%) of the tethered donkeys within the homesteads were allocated a space of between 10 to 15 feet radius. The space allocated for the enclosures was about 10 feet by 25 feet. These enclosures were shared among donkeys and cattle.

Majority of the owners did not incur labor charges since most of the respondents (90%) worked with their own donkeys. Those who hired labor paid the laborers a fraction of the income obtained. This ranged from a third of the gross income obtained (30%), a quarter (6%) and a half (16%) of the money earned from donkey transport. Other households paid between 200 KES and 500 KES as labor charges per day.

#### **5.4.3 Description of sources of household income**

Livestock farming was an important income generating activity among smallholder farmers in the highland areas of central Kenya. Commercial donkey transport was a source of income for 98% of households. Other alternative sources of household income for the smallholder farmers included mixed crop-livestock farming involving cattle, sheep, goats, poultry, pigs and food crops. Income was also obtained through motorbike transport, salaries and wages through formal employment or casual work

(Table 6). The daily income obtained by households through commercial transport services using donkeys was 500 KES (range of 0 KES to 3,000 KES). This was higher than the average income obtained from other livestock such as cattle, sheep, goats and chicken ( $100 \pm 23$  KES). While the average daily income obtained from crop farming was only estimated at  $250 \pm 16$  KES. The highest source of daily household income was through salaries and wages ( $1,500 \pm 65$  KES) although very few (1.4%; 5/354) smallholder farmers were employed. The daily costs incurred during working with donkeys included feeding cost ( $87 \pm 9$  KES), watering charges ( $22 \pm 2$  KES) and treatment charges ( $19 \pm 2$  KES). Therefore, the net daily income obtained through commercial transportation of goods using donkeys was therefore 300 KES.

**Table 6: Percentage sources of household income according to farmers in Kirinyaga County**

<b>Household income</b>	<b>Rank 1</b>	<b>Rank 2</b>	<b>Rank 3</b>
Use of donkeys for transportation	98.3	1.8	1.1
Other livestock farming	0.3	84.5	74.8
Crop farming	1.4	3.0	20.0
Salary and Wages	0.0	7.8	3.2
Motor Bike transportation	0.0	1.8	1.1

#### **5.4.4 Determination of profitability from working donkey**

The output was the monthly gross income obtained through commercial transportation of goods using donkeys 15,000 KES (500×30). The types and costs of variable inputs incurred included purchase of feeds and feeding (2,618 ± 264 KES), water (652 ±63 KES), charges for communal grazing at night (600 ±64 KES), treatment of diseases (583 ± 56 KES), maintenance of the cart (896 ± 89 KES) and hiring charges where applicable (379 ±16 KES). Based on these costs and outputs from donkey rearing, the estimated monthly gross margin was 9,272 ±42 KES (approximately 300 KES per day); which was about 62% of the gross income from working donkeys.

#### **5.4.5 Analysis of factors associated with level of income for working donkeys**

Results from univariate analysis using Genstat generalized linear regression conducted on various household factors that affect donkey income are represented in the Table 7. Parameters (factors) with a probability of 20% under univariable model were considered significant. These included the total number of donkeys reared per farm, the number of hours these donkeys worked, hiring out of donkeys, savings from using own donkey transportation as well as engaging in mixed farming though farming in crops and other animals. Other factors which were significant although negatively included purchasing donkeys into farms, transportation of water and charging lower than peers. The factors are presented in table 7.

**Table 7: Univariable analysis for factors associated with level of income from working donkey**

<b>Parameter</b>	<b>Estimate</b>	<b>S.E</b>	<b>t</b>	<b>P</b>
Total number of working donkeys per household	90.3	17.2	5.26	<0.001
Number of hours that donkeys work in a day	38.6	12.5	3.09	0.002
Use of parents' land to rear donkeys	80.7	51.7	-1.56	0.120
Use of own land to rear donkeys	-51.9	56.4	-0.92	0.358
Source of donkeys: purchased	-166.3	81	-2.04	0.042
Source of donkeys: farm bred	-153	106	-1.45	0.149
Hiring out of idle donkeys	102.3	73	1.4	0.162
Charging lower fees than peers (caused a decrease in income)	-241.0	154.	-1.57	0.118
Alternative Sources of income such as;				
- Domestic transport	368.	108.	3.41	<.001
- Other livestock farming	571.	163.	3.51	<.001
- Crop Farming	192.7	59.6	3.24	0.001
- Casual work	155.7	81.0	1.92	0.055



The factors that were considered significant at 20% on univariable analysis were further analyzed on multivariable regression model in order to identify factors which were associated with level of income from working donkeys in households. The only factors that were associated with level of income in these households included the number of working donkeys reared per farm, number of hours these donkey worked as well as engaging in alternative sources of income generating activities such as casual work, mixed agriculture and livestock farming as well as savings from using own donkey transportation (Table 8).

**Table 8: Multivariable analysis for factors associated with level of income from working donkey**

<b>Parameter</b>	<b>Estimate</b>	<b>S.E.</b>	<b>t(318)</b>	<b>P</b>
<i>Constant</i>	153.4	75.4	2.04	0.043
Number of working donkeys	93.7	17.9	5.24	<.001
Number of hours the donkey works	23.7	12.5	1.89	0.050
Alternative sources of income				
- Savings from own donkey transportation	412.	112.	3.67	<.001
- Mixed crop-livestock farming	263.	98.8	2.56	0.012

## 5.5 Discussion

In the central highlands of Kenya, smallholder farmers kept more male working donkeys compared to the females in a male to female ratio of 2:1. This could be due to the perception that they were physically stronger than females as observed in Bostwana. Further, the female donkeys were more disadvantaged because of the lost working days during the peri-parturient period (Greiger and Hovorka, 2015).

On average, 3 donkeys were raised per household in the present. This ownership level was higher than Ethiopia which had an ownership of 2.39 donkeys per household (Melkam, 2017) in a similar smallholder farming setting. This could be influenced by the type of cart used in Kirinyaga County that was designed for 3 donkeys. The smallholder farmers kept donkeys as important livestock in their farms for their contribution to household income. The surveyed respondents preferred to keep donkeys rather than cattle because donkeys were cheaper to buy from the markets. Donkeys were also cheaper to maintain in terms of lesser feed, water, grazing area and treatment requirements. Handling and restraint of donkeys was also easier compared to cattle. This scenario was the same as for other areas where mixed livestock farming was practiced (Hassan *et al.*, 2013; Smith and Pearson, 2005). The responses could however be biased since only donkey owning households were selected for the study.

Farmers often purchased animals older than 3 years which were ready for use by pulling carts (Nininahazwe *et al.*, 2017) as opposed to breeding them within the farms. This was evidenced by the few foals present at the time of the study. This threatened donkey herd continuity in light of the present challenge of donkey theft in Kenya.

Majority of the respondents worked with their donkeys themselves (90%). In the past neighbours' donkeys were freely accessible in areas such as Ethiopia and Limuru (Kenya) (Njenga, 1993). In the present study, donkeys were hired out at a fee. Many of the respondents stated that hired donkeys' were often returned in a poor welfare state, having user inflicted wounds and injuries, and necessitating owners to incur treatment costs thereby reducing the net profits earned. The welfare compromise appears universal as previous reports recommended studies on welfare of hired out

donkeys (Valette, 2015). Those who hired out their donkeys within the study are did so to responsible users who spared the whip and were keen to observe early signs of diseases. A proper hiring system would encourage smallholder farmers to own more donkeys due to the alternative income earned through hiring of donkeys. Those who hired out their idle` donkeys earned two-thirds of average daily income. In other parts of Africa such as Botswana, hiring fees depended on the distance covered by the donkeys when working (Aganga and Maphorisa, 1994).

When donkeys were not working, they were found grazing in communal grounds (74%) often with other livestock. This provided a good opportunity for social interaction (Moyo *et al.*, 2008). Untethered donkeys were often found roaming within the urban centers; which posed the risk of theft and road accidents. An enclosed communal grazing area with adequate feed and water was therefore proposed though collective efforts by smallholder farmers to ensure their donkeys were safe within the urban areas. Within the farms, mostly at night, donkeys were tethered within a radius of between 10 and 15 feet. The space allocated for the enclosures occupied an area of approximately 10 feet by 25 feet depending on the number of donkeys owned. Donkeys were mostly housed together with cattle within the enclosures. This space allocation was relatively small due to the small farm sizes of 1 Ha for smallholder farmers in central highlands of Kenya (CIDP, 2018).

Land ownership as a farm level factor was not associated with income from working donkeys in the present study. In Nigeria, under a similar smallholder setting, land ownership was negatively associated with income from donkeys (Hassan *et al.*, 2013). Land was therefore not a necessary factor of production in donkey farming. Indeed, 19% of landless smallholder donkey had migrated to the region to provide commercial transport services using donkeys due to urbanization in Kirinyaga County

(Gachoki, 2018; Personal interview). They either left their donkeys to graze within the communal land or released their donkeys to roam around the urban centers at night. Majority (81%) of the others who either purchased their land or used their ancestral land controlled their donkeys within the homestead at night either by tethering or enclosing them; although a few still left the donkeys in the communal grazing areas. A study by Fielding and Krause (1998) showed that one pack donkey could safely carry one-third to one-half of its own weight over several hours if it is in reasonable welfare. On the other hand, one donkey pulling goods by cart could pull about 2.7 times of their live weight (Gebresenbet *et al.*, 2016). Given that the household ownership of donkeys is three, more weight could be pulled by the donkeys in the cart per trip without compromising on their welfare.

Most donkeys in Kirinyaga County worked for an average of 4 hours per day. Longer working hours of 6 hours have been recorded by Gebresenbet *et al.*, (2016), but with lighter load weights. The number of hours the donkeys worked was a significant farm level factor associated with income earned from working donkeys in the present study ( $P = 0.05$ ) and in a previous study by Hassan *et al.*, (2013). The donkey owners had adequate time to engage in additional income generating activities such as crop farming, motorbike transport and casual work while the donkeys had ample time to feed and increase their weight and body condition.

Healthy and well cared for donkeys work more efficiently and remain active for longer which translates to sustainable household incomes (Valette, 2015). Diseases were listed as a challenge affecting working donkeys; and their management reduced the level of income earned through them. The average cost of health care was estimated at  $583 \pm 56$  KES per donkey per month ( $19 \pm 2$  KES per donkey per day). Health care was provided by Local Animal Health Providers (LAHPs) who were

preferred because they had improved competencies in treatment and management of donkey diseases and conditions (Gichure *et al.*, 2019; Onono, 2017).

The gross daily income of 500 ±42 KES (with a gross margin of 300KES) per donkey was sufficient to support farming households. This was above the international poverty line which was US\$1.9 (194 KES) (1US \$ =102.6 KES) (World development report, 2019). The monthly gross margin of 9,272 KES was comparable to wages of many informal full-time jobs in Kenya (KNBS, 2019). Income from the working donkeys was adequate for households in the study area. The finding is in agreement with Sieber, (2000); Sisay and Tilahun, (2000) in Tanzania and Ethiopia respectively who concluded that income earned through working donkeys was higher than the minimum wage for public servants and would enable households to live above the international poverty line. However, changes that could reduce the population of donkeys within the central highlands of Kenya, such as theft of donkeys, could affect the incomes and hence survival of these smallholder farming households.

In addition to income from transport of goods, gross income from working donkeys could be increased through hiring out of donkeys ( $2/3 \times 500 = 360$  KES), sale of manure from donkeys (at 430 ± 26 KES per bag), and sale of foals or adult donkeys (at a market price of 8,000 ± 237 KES and 16,000 ± 252 KES) as replacement stock. Female donkeys were more expensive than the males due to their additional use as breeding animals besides provision of draught power. The prices of working donkeys recorded in this study were much higher than the donkeys meant for slaughter (Garden Veterinary, 2017) where the selling price was 4,500 KES for donkeys meant for disposal of the weak and sick.

This study presents the first findings that describe the characteristics of working donkeys, their benefits and associated challenges as well as the farm level factors

associated with generation of income from working donkeys under smallholder farming systems in the central highlands of Kenya. The study has demonstrated the crucial socio-economic roles played by donkeys among smallholder farmers in Kenya as in North West Nigeria (Hassan *et al.*, 2013), where donkeys earn income for households and create employment opportunities. Mixed or sole smallholder donkey farming can therefore realize sufficient income for farming households in Kenya as reported to do in Australia (Corowa, 2016). The importance of the working donkey cannot be overstated (Donkey Sanctuary, 2017). Their valuable contribution to rural livelihoods is increasingly recognized by international bodies such as the OIE (2016).

#### **5.6 Conclusions and recommendations for the factors associated with the level of income from working donkeys under small holder farming systems**

The farm level factors that were associated with level of household incomes included the number of working donkeys reared per farm, number of hours these donkey worked and savings from using own donkey transportations. The estimated daily gross margins obtained through working donkeys was 300KSH implying a gross profit of 62%. Alternative household income could be earned through donkeys from the sale of donkey manure, hiring out of donkeys for work as well as sale of adult donkeys or their foals as replacement stock.

The health and welfare of the working donkeys should be improved through collaborative efforts by policy makers, extension agents, animal health practitioners and donkey owners in order to improve the living standards of the livelihoods of the 98% of the small holder donkey farmers who depend on donkeys as a source of household income. In chapter six, the morphological characteristics of the working donkeys raised in the central highlands of Kenya need to be understood and compared with other working donkeys in the world to determine their suitability for work.

**CHAPTER SIX: PHENOTYPIC CHARACTERISTICS OF DONKEYS  
REARED IN KIRINYAGA COUNTY OF KENYA AND THEIR SUITABILITY  
FOR WORK**

**6.1 Background information**

The amount of work done by donkeys is determined by their size (Batholomew *et al.*, 1993 and Pearson *et al.*, 1999). Work performance is enhanced by improving their husbandry and management or the efficiency of their working implements such as carts and harnesses (Pearson *et al.*, 1999). Physical description has been provided for working donkeys in different parts of the world such as Europe, Mexico, Ethiopia, Morocco, Zimbabwe and West Africa (Kugler *et al.*, 2008, Aluja *et al.*, 2005, Mustefa *et al.*, 2020, Pearson and Ouassat, 1996, Nengomasha *et al.*, 1999, Hassan *et al.*, 2013 and Nininahazwe *et al.*, 2017). There is scanty literature on the genetic and phenotypic diversity of donkeys raised in Kenya (Blench, 2000). Consequently, optimization of use and breeding for size improvement is hampered by lack of data (Pearson and Vall, 1998). With the objective of describing the phenotypic diversity of donkeys reared in the central highlands of Kenya and relate it to suitability for work, the data will help in determining appropriate load for the donkeys to carry or pull with minimal negative effects on their welfare. The findings will also provide baseline data useful for explaining the genetic diversity of the donkeys raised in Kenya and can inform breeding strategies for size, physical strength and resilience.

**6.2 Methodology of data collection**

Three hundred and sixty working donkeys belonging to pre-selected (351) donkey owning households in the thirteen locations selected for the study were selected for the study.

### **6.2.1 Physical examination**

Using a structured check list (Appendix 3), data was collected on physical characteristics including sex, age and coat color of the donkeys raised in farms. The age was determined by dentition as described by Muylle *et al.*, (1999) based on eruption of permanent central incisors which occur between 3 to 3.5 years. The donkeys with only deciduous incisors were the young donkeys aged up to 3 years while those whose permanent incisors had begun to erupt were the adult donkeys above 3 years which were mostly the working category. Subsequent ages, above 3 to 15 years, were estimated based on eruption of the permanent lateral and corner incisor, appearance of dental stars on permanent incisors and disappearance of dental cups. Observation of the angle formed by opposite incisors estimated donkeys above 15 years. The color coat description was guided by equine identification guide for donkeys used by USDA (2017) where body coat colors were either plain or spotted. The plain colors included shades of grey, brown or black while the spotted body colors comprised of a mixture of the plain colors with white or cream. The description also included the color of the muzzle, eye rings, ventral side of the body as well as the medial side upper side of limbs which were collectively referred to as points and were mainly cream or white colored. Other body markings such as presence of dorsal and shoulder stripes were also recorded.

### **6.2.2 Welfare indicators**

A rapid welfare assessment was conducted on the donkeys. The welfare indicators included body condition score, signs of lameness, physical abnormalities of the backline and presence of skin lesions. The body condition was scored on a scale of 1–5; with 1=thin, 2=Moderate, 3=ideal, 4=fat and 5=Obese; based on muscle and fat distribution and prominence of the spine, hips and ribs (Donkey Sanctuary, 2014).



Body condition score was a key criteria for assessing the welfare of animals (Labocha *et al.*, 2013). Lameness was determined by impeded gait observed as a limp. The gait was examined by watching the donkey walk forward for 10 steps with the researcher observing from behind and the side as described by Pritchard *et al.*, (2005). Donkey hooves were examined for lesions by observing the angle of the hoof to the ground and also by picking up the hoofs one at a time and using a hoof pick to view the base of the hooves. The integrity of the sole, inner and outer walls of the hooves were examined for hoof and heel cracks as well as hoof overgrowth which were recorded as abnormalities (Geiger and Hovorka, 2015). Presence of skin lesions was detected through close physical observations made on the donkeys.

### **6.2.3 Body measurements**

Four morphometric measurements were taken: (A) Heart girth for animals above three years. This was the circumference of the chest posterior to the front limbs to the caudal parts of the withers; or Umbilical girth, for animals below three years, which was the circumference of the umbilicus area at the widest part of the abdomen; (B) Height at withers which was measured as the distance from the apex of the withers to the ground (Sawanon *et al.*, 2011); and (C) Body length which was measured from the tip of the elbow (olecranon) to the pin bone (tuber ischia) diagonally according to Pearson and Ouassat, (1996). These points are indicated in Figure 4.

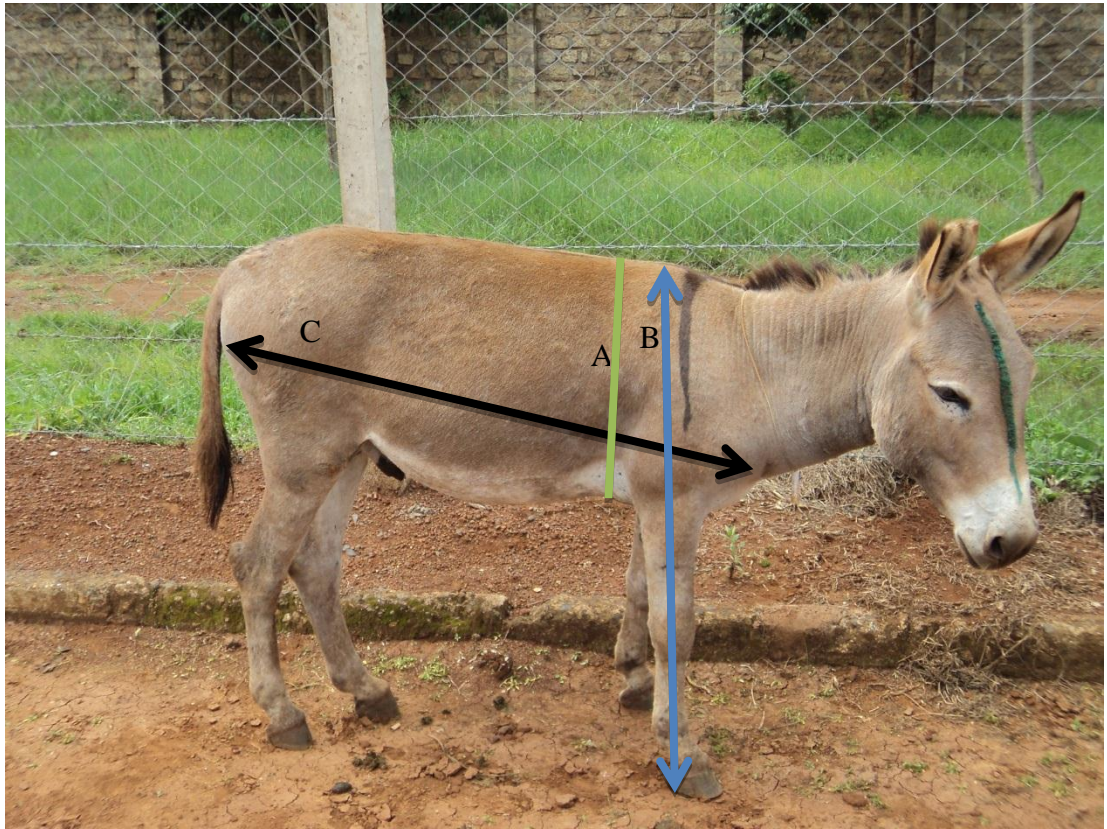


Figure 4: Body measurements used in this study including (A) heart girth circumference, (B) height at the withers and (C) body length.

Measurements were taken with donkeys restrained by use of a head collar and standing upright. All the measurements were taken using the same measuring tape and results recorded in centimeters for each donkey. The measurements were taken by one observer with the aid of an animal handler in order to minimize subjective divergence of measurements. The observer was trained in approaching, handling and taking of donkey measurements. Once all observations and measurements were made, the donkey was marked with an indelible mark so that they were not sampled again.

#### **6.2.4 Estimation of body weight**

The heart girth and body length measurement was used to calculate the live weight of the donkeys. This is an acceptable method of weight estimation in cases where the weighing balance is not available (Nininahazwe, *et al.*, 2017). Weight tapes specific to donkeys were not available in the Kenyan markets at the time when the research was conducted. Various formulas for estimating the body weight of working donkeys were compared (Table 9) (Nengomasha *et al.*, (1999); Nininahazwe *et al.*, (2017) and Pearson and Ouassat (1996) but the latter was preferred since it incorporated both heart girth and body length measurements. All the observations and measurements were recorded in designed data collection sheets for individual donkeys.

**Table 9: Live weight of working donkeys using different equations**

Source	Equation	R <sup>2</sup>
Nengomasha <i>et al.</i> , (1999)	Live weight (Kg) = Heart girth (cm) <sup>2.83</sup> /4786 (For donkeys above 3 years)	0.86
Zimbabwe	Live weight (Kg) = Heart girth (cm) <sup>2.8</sup> /4266 (For donkeys below 3 years)	0.88
Nininahazwe <i>et al.</i> , (2017)	Estimated LW (kg) = 2.55 × HG (cm) - 153.49 Estimated LW kg = Heart girth (cm) <sup>2.68</sup> /2312	0.81 0.81
West Africa		
Pearson and Ouassat, (1996)	Live weight = Heart Girth (cm) <sup>2.12</sup> /2188 (for donkeys above 3 years)	0.81
Morocco	Live weight (kg) = (Umbilical girth [cm] <sup>2.13</sup> ) /302 (for donkeys below 3 years)	0.77
	*Live weight (kg) = (heart girth [cm] <sup>2.12</sup> ) x (body length [cm] <sup>0.688</sup> )/3801 (for donkeys above 3 years)	0.84
	*Live weight (kg) = (heart girth [cm] <sup>1.40</sup> ) x (body length [cm] <sup>1.09</sup> )/1000 (for donkeys below 3 years)	0.87

\*The formulas used to estimate the body weight for young and adult donkeys.

### 6.3 Data management and analysis

Descriptive statistics were used to analyze the quantitative data and present the sample means of all variables. Further analysis involved comparing the differences between the means for the different variables by sex and age categories using one-way analysis of variance.

## **6.4 Results**

### **6.4.1 Description of the animal biological characteristics**

The sampled donkeys comprised of 74 females and 286 males comprising 360 donkeys. The males were significantly older than the females donkeys with an average of 8 years compared to 7 years for females ( $P<0.05$ ). Donkeys' ages were classified in two broad age groups; young (up to 3 years) comprising 29 donkeys and adults (above 3 years old) comprising 331 donkeys. Twenty nine of the adult donkeys were above 15 years old.

### **6.4.2 Physical observations**

Most donkeys had a grey dun color coat with only two having a chocolate brown color. They all had a well-defined dark dorsal stripe along the backline from the poll area to the tail as well as a shoulder stripe running across the withers area. The ventral side of their bodies mainly the sternal and abdominal regions, the muzzle and nostril points were white in color. The two coat colors observed in donkeys are presented in

Figure

5.



Figure 5: Different coat colors of donkeys raised in Kirinyaga County. Photo Courtesy of KENDAT

Majority of the donkeys had a body condition score of 3 (64%; 232/360) and 2.5 (22%; 80/360). Just a few donkeys had signs of wastage in body condition with a score of 2 (13%; 48/360). And, none of the sampled donkeys had a body condition score below 2. A few donkeys (18%; 62/360) had evidence of hoof abnormalities on one or more hoofs, and out of all the examined donkeys, 5% (17/360) had evidence of lesions on at least one location on their skin which also compromises their welfare status.

#### **6.4.3 Description of the body measurements for donkeys**

The study reveals that the average weight of the adult working donkey in the central highlands of Kenya was 155.5Kgs  $\pm$  1.71. Their height at withers was 99.7 cm  $\pm$  0.50, with a heart girth of 113.7cm  $\pm$  0.43 and a body length of 113.2 cm  $\pm$  0.58 (Table 10).

**Table 10: Descriptive measures of body conditions for working donkeys sampled from central highlands in Kenya**

<b>Parameter</b>	<b>Mean</b>	<b>Median</b>	<b>Min</b>	<b>Max</b>	<b>SD</b>	<b>Var</b>	<b>SEM</b>
Heart Girth	113.7	114	79	131	8.227	67.68	0.43
Height at withers	99.67	100	62	159	9.624	92.62	0.50
Body length	113.2	114	76	141	11.88	141	0.58
Donkey weight	155.5	157.8	54.6	241.6	32.62	1064	1.71

The body measurements varied significantly depending on sex and age groups of the donkeys (Table 11 and 12). The donkeys aged up to 3 years had significantly lower average body measurements when compared to adult donkeys ( $P < 0.001$ ). The overall size of male donkeys was significantly larger in size compared to the females ( $P < 0.001$ ). The weight of the donkeys was associated with higher body condition

scores; where donkeys with body condition scores of 2, 2.5 and 3 would weigh 137.7kgs, 157.7 and 158.4kgs respectively.

**Table 11: Inferential analysis for weight, heart girth, body length and height at withers for working donkeys classified by sex**

<b>Parameter description</b>	<b>Male (n =286)</b>	<b>Female (n = 74)</b>	<b>P value</b>
Body weight (kg)	159.1 (SEM 1.79)	141.8 (SEM 4.36)	< 0.001
Heart girth (cm)	114.6 (SEM 0.42)	110.2 (SEM 1.22)	< 0.001
Body length (cm)	114.4 (SEM 0.62)	109.4 (SEM 1.39)	< 0.001
Height at withers (cm)	100.5 (SEM 0.59)	96.28 (SEM 1.11)	< 0.001

**Table 12: Inferential analysis for weight, heart girth, body length and height at withers for working donkeys classified by age group**

<b>Parameter description</b>	<b>Up to 3 Years (n=29)</b>	<b>Above 3 Years (n= 331)</b>	<b>P value</b>
Body weight (kg)	91.9 (SEM 3.34)	161.1 (SEM 1.49)	< 0.001
Heart girth (cm)	96.1 (SEM 1.62)	115.3 (SEM 0.33)	< 0.001
Body length (cm)	101.1 (SEM 2.25)	114.3 (SEM 0.56)	< 0.001
Height at withers (cm)	90.52 (SEM 2.09)	100.5 (SEM 0.49)	< 0.001

Besides body measurements, 38% (137/360) of the donkeys had irregular teeth indicating the presence of dental problems; while 42% (150/360) had broken ears. Most donkeys 92% (332/360) had a straight backline with only a few with either a humped 4% (15/360) or depressed 4% (13/360) backline. Majority of the donkeys had straight forelimbs 99% (358/360) and hind limbs 92% (331/360); with 82% (294/360) making a desired hoof to ground angle of 45°. Those donkeys whose hoof to ground



angle was  $<45^\circ$  were only 17% (60/360) while those with  $>45^\circ$  were 1% (6/360) and these comprised the donkeys which were lame. The base of the hooves was concave in 98% (354/360) of the donkeys.

## **6.5 Discussion**

Grey dun was the most predominant coat color for the working donkeys in Kenya as reported elsewhere Zimbabwe (Nengomasha *et al.*, 1999). The two donkeys which had a chocolate brown color could be as a result purchasing donkeys from different geographical locations. All donkeys had the primitive equine stripes which comprised of a well-defined dorsal stripe along the backline with a shoulder stripe running across the withers area to make a cross. This primitive equine stripe was missing in the Somali wild donkeys (Orhan *et al.*, 2012).

The average weight of the donkeys raised in Kenya of 155.5kgs was larger than donkeys raised in Ethiopia, West Africa, Morocco and Zimbabwe which weighed 113-127, 126Kgs, 135Kgs and 142Kgs respectively. The calculated live weight could however be biased by the equation used to estimate it although the selected formula incorporated the heart girth and body length. Likewise, the body length of 113.2 cm for the donkeys raised in Kenya was higher than those raised in Ethiopia, West Africa, Zimbabwe and Morocco which measured 88-91cm, 104cm, 90cm and 64-106cm respectively. Similarly in Kenya, the working donkeys' heart girth measured 113.7cm which was higher than those raised in Ethiopia 106-110, West Africa 104cm but lower than Zimbabwe 115cm. The measurements were within the range indicated for Morocco 82-129. The average height at withers of the working donkeys in Kenya (99.67 cm) was similar to donkeys raised in Ethiopia, West Africa, Zimbabwe and Morocco which measured 100-104 cm, 99.5 cm, 100 cm and 82-129 cm respectively. (Mustefa *et al.*, 2020; Nininahazwe *et al.*, 2017; Nengomasha *et al.*, 1999; Pearson

and Ouassat, 1996). All the recorded body measurements were within the ranges indicated for the donkeys raised in Morocco due to pooling all donkeys regardless of type, age, sex, body condition score and pregnancy status (Pearson and Ouassat, 1996). Further comparisons with donkeys raised in Mexico and Turkey are indicated in Table 13.

**Table 13: Comparison of some morphometric measurements on donkeys from central Kenya and different parts of the world**

<b>Country of study</b>	<b>Sample sizes (n)</b>	<b>Body weight (Kg)</b>	<b>Heart girth (Cm)</b>	<b>Body length (Cm)</b>	<b>Height at withers (Cm)</b>	<b>Source of data</b>
Kenya <sup>a</sup>	360	166	114	122.6	100	Present study
Ethiopia <sup>b</sup>	323	113-127	106-110	89.9-92.4	100-104	<i>Mustefa et al., 2020</i>
Morocco <sup>c</sup>	516	74-252	82-129	64-106	82-129	<i>Pearson and Ouassat, 1996</i>
Zimbabwe <sup>d</sup>	335	142	115	90	100	<i>Nengomasha et al., 1999</i>
West Africa <sup>e</sup>	1352	126	104	104	99.5	<i>Burkina faso, Mali, Niger, Senegal) (Nininahazwe et al., 2017</i>
Mexico <sup>f</sup>	160	112-122	88-152	-	87-120	<i>Aluja et al., 2005</i>
Turkey <sup>g</sup>	194	134	113.5	105.2	102.3	<i>Orhan and Mehmet, 2012</i>

The height at withers was similar to other working donkeys elsewhere in the world but other body measurements were uniquely larger for donkeys raised in Kenya when compared to other domesticated working donkeys indicating the diversity due to geographical location. Further, interbreeding the domesticated Kenyan donkey with the wild Somali donkey (Orhan *et al.*, 2012) and other donkeys from different parts of the country could contribute to the overall larger body sizes (Barczak *et al.*, 2009).

The association of body condition score with body weight emphasized the importance of nutrition to body weight. Nutritional management is often associated with variation in body condition (Lukuyu *et al.*, 2016). Within the central highlands of Kenya, donkey feeds included grazing on natural pastures, rice hay and straw from the fields, crop residues such as vegetable trimmings from the markets as well as feed wastes from other animals. These feeds were plenty in the area due to the highland climate that favored vegetation growth. A few donkeys were also fed with concentrates such as rice bran, maize bran or maize germ from the milling companies. These were offered to the donkeys based on the owner's ability to purchase the concentrates. The variety of feeds caused the price of feeds, feeding and watering to be 109 KES per donkey per day contributing to 54% (109/200) of the variable costs in donkey farming. This was within the range (50-60%) indicated for cattle production (Moran, 2005).

Generally, the weights and body measurements increased from young to adult donkeys due to morphological growth (Nininahazwe *et al.*, 2017). Female donkeys sampled in the study were significantly smaller when compared to males in body weight, heart girth, body length and height at withers which could be explained by sexual dimorphism (Aluja *et al.*, 2005). This could further explain the preference of male donkeys over the females for work.

The high standard deviations observed in this study may have been as a result of the variability due to age and genetic makeup due to the different geographical locations from where the donkeys were purchased.

There is an inextricable link between donkey welfare and the people who depend on them (Valette, 2015). Good animal welfare determines the level of benefits obtained from the animals. Based on the physical parameters, majority of the donkeys in the central highlands of Kenya were in good welfare according to Greiger and Hovorka (2015). This was because most of donkeys had a moderate to ideal body condition score (86%; 64%+11%), with few cases of lameness 18%) and irregular backline (8%). A strong straight backline was an indication of good welfare in working animals (Lesimple, 2010). The donkeys were therefore considered to be physically fit for work. On the contrary, donkeys which were thin, lame and had skin lesions were likely to have behavioral changes which ranged from unresponsiveness and aggression towards other donkeys, animals and human beings and hence they were unsuitable for work (Pritchard *et al.*, 2005). The present cross-sectional study design only provided a rapid assessment on the welfare of the working animals. Future comprehensive studies were recommended to link the welfare status of the animals with the management practices they received in order to improve their welfare wholly.

## **6.6 Conclusions and recommendations of the phenotypic characteristics of working donkeys in Central highlands**

In conclusion, the donkeys raised in the central highlands of Kenya were bigger in size when compared to other working donkeys elsewhere in the world. The size of the donkey, which determined the amount of load it could carry, was also considered to be a factor associated with incomes earned for the households. Further studies are

recommended to describe weights and linear measurements of donkeys in different parts of the country to record diversity.

## **CHAPTER SEVEN: GENERAL DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS**

### **7.1 GENERAL DISCUSSION**

The contribution of livestock to the agricultural economy and household income for smallholder farms cannot be overstated. Income is realized through the sale of animals or animal products. For working animals, draught power is the most important output (FAO, 1996). In the central highlands of Kenya, Kirinyaga County where the study was conducted, donkeys were kept for the provision of transport and for manure production. Both charging of commercial transport services using donkeys (Valette, 2014) and sale of manure (Karanja *et al.*, 2019) contributed to household income. Income was also saved when donkeys are used for domestic transport. Donkeys were therefore players in the transport sector and the income obtained through them provided household sustenance hence contributed to other sectors of development such as food security and education (Lumumba *et al.*, 2019).

The income obtained through working donkeys was their focal point to households of the smallholder farming communities. Several factors affected the level of this income. In this study, they were classified as farm level factors, animal factors, human factors and external factors which comprised the challenges faced by working donkeys therefore proving the alternate hypothesis.

The identified farm level factors associated with this income included the number of donkeys raised in the farm and the number of hours these donkeys worked increased the level of income from the donkeys. Complementing donkey farming with other income generating activities provided additional income for the household and therefore reduced the dependence of income earned through working donkeys as was seen by Corawa (2016) through mixed farming and engaging in alternative income

generating activities such as casual work (Valette, 2015). Income from the working donkeys could be potentially increased through diversification of the products obtained from the donkeys. Draught power is the most utilized product from working donkeys (FAO, 2011). Utilization of other products such as milk (Fernando and Starkey, 2004), and meat (Rono *et al.*, 2018) as well as by-products such as skin (Lumumba, 2019) and manure (Valette, 2015; Karanja *et al.*, 2019) could help farmers to optimize gains from donkey farming. The present study also proposes sale of adult donkeys and foals as replacement stock. This however calls for increased awareness to create acceptance and demand for edible products such as milk and meat and intensified breeding of donkeys for breeders to meet the increased demand.

Human factors associated with working donkeys revolved around the role of gender with working donkeys. The present study revealed that men were the owners and often the users and benefited more from working donkeys. This contradicts a previous study by Fernando and Starkey, (2004) who recorded that women were the main beneficiaries of donkey transport services. The finding that men made majority of livestock related decisions even regarding livestock owned by women in male headed households concurs with the observation by World Bank, (2012) and Garden Veterinary Services Ltd, (2017). Men were better (95%) at donkey husbandry and management roles such as providing feeds, water, clearing the shelter of dung and calling for veterinary attention which was attributed to exposure to donkey husbandry management and early disease identification trainings. Womens' participation in livestock duties has remained low with them assisting the men with the livestock duties. This finding differed with Valette, (2014) who reported a high involvement in donkey farming communities was high where they were primary care takers to donkeys. It appears that women were not actively involved with working donkeys in



small holder farming systems. The potential of women must be tapped for the socioeconomic improvement of their families and development of the nation as a whole (Roy *et al.*, 2017). Their access to extension services should also be prioritized and in future, they should be provided with equal opportunities for trainings, donkey ownership and controlling the incomes obtained from the working donkeys. Additionally, they should be encouraged and empowered to participate equally in donkey farming roles in order to realize the benefits.

The animal factors associated with the level of income from working donkeys included the size of the donkey (Pearson *et al.*, 1999) as well as its welfare status (Geiger and Hovorka, 2015). The welfare of the animal which was assessed based on parameters such as the body condition score (Labocha *et al.*, 2013), presence of skin lesions, lameness (Pritchard *et al.*, 2005) and straightness of the backline (Lesimple, 2010) which determined the strength and ability to pull the cart. Indeed, body condition score was positively correlated to income from working donkeys (Ibrahim *et al.*, 2011). The body condition score was also determined by the nutrition of the animal (Lukuyu *et al.*, 2016) which consequently affected the work output of the donkeys (Aganga *et al.*, 2000, Pearson and Vall, 1998 and Ram *et al.*, 2004). Donkeys which were thin due to poor or inadequate nutrition were often weak with decreased work output. This study finds that the working donkeys raised in the central highlands of Kenya were in a state of good welfare and hence capable of working and therefore contributing to household income. The amount of load pulled by the donkey would then be guided by the body weight of the donkey. The assessed working donkeys were larger in body size compared to other donkeys in the world in terms of body weight heart girth and body length. Being a cross-sectional study design, providing

causal factors for this large size was beyond the scope of the study, although the variations could be attributed to genetic diversity and nutritional management.

External factors comprised the identified challenges which included theft for slaughter, road accidents, malicious cutting and diseases. Presence of these factors reduced the level of income from working donkeys through reduced work output, use of money for management or death of the donkeys. Theft of donkeys is a security concern in Kenya. Increase cases of donkey theft were reported following the opening of the four export slaughterhouses for donkeys in Nakuru, Baringo, Turkana and Machakos Counties for the trade of donkey meat and skin. At the time of data collection (June-September 20118), the slaughter houses were in operation and donkey theft was the most significant ( $Z = 5.99$ ) challenge facing working donkeys. This was because of the increased demand of donkeys by the abattoirs and the short supply of willing sellers. Unscrupulous traders then resulted to stealing donkeys for sale to the abattoirs (Lumumba *et al.*, 2019). During the period of completion of the study, the license of operation of all the slaughterhouses was revoked through a gazette notice (Appendix 4). This translated to a continued increase in donkey populations. Generally, diseases affected the productivity of working donkeys (Pearson and Vall, 1998). Tetanus, hoof problem, worm infestation (Helminthosis) and mange were the significant diseases affecting working donkeys. Helminthosis particularly reduced work output of donkeys and consequently the income obtained through them (Ibrahim *et al.*, 2011; Saul *et al.*, 1997).

Donkeys get infected with tetanus when *Clostridium tetani* spores which are found in soil enter the body through wound and release enterotoxins. Their natural behaviors of rolling on the ground (Regan *et al.*, 2014) predisposes them more to tetanus compared to other domestic animals. Tetanus was identified as the most significant disease ( $Z =$

5.35) affecting working since its prognosis was guarded and mostly fatal due to toxemia. Donkeys are however vaccinated against tetanus to reduce the chances of infection (Khan, 2005) and can be treated once an early diagnosis is made (El Meshad *et al.*, 2013). A high sero-prevalence of 76.8% was recorded in Nigeria (Emanuel *et al.*, 2020) compared to a very low prevalence of 0.025% in Egypt (El Nahaz, 1962) but similar studies in Kenya were lacking. In that study, donkeys with wounds were more likely to test positive to tetanus compared to those without wounds (Emanuel *et al.*, 2020). Wounds in working donkeys resulted from injurious carts and harnesses, ecto-parasite infestations causing pruritus as well as mistreatment through excessive whipping and malicious cutting. Presence of skin lesions was an indication of poor welfare status and was a health concern in working donkeys (Biffa and Woldemeskel, 2006). Similarly, hoof problems were reported to be significant in working donkey compared to a low prevalence of 18%. Lameness decreased work output due to the reduced speed and resulted in lost work days. It was a major welfare concern for working donkeys (Reix *et al.*, 2014).

External factors such as theft for slaughter and road accidents and malicious cutting could be addressed through collaborative efforts among stakeholders involved in the working donkeys' value chain to address the identified challenges. The donkey owners had a role to play in restraining their donkeys to prevent roaming and theft; and observing safe road use to prevent road accident. Legislation such as the prevention of cruelty to animals act (CAP 360, 2012) and the traffic act (CAP 403, 2013) are present to protect the donkeys and their users from mistreatment and to ensure proper road use. Establishing whether these laws were enforced and conducting a stakeholder review to address the challenges faced by the working donkeys was however beyond the scope of this study. The overall result of addressing

the external factors is creation of an ideal working environment for the donkeys to thrive in and work efficiently.

It is apparent that the factors affecting the level of income from donkeys were interconnected hence disproving the null hypothesis. The human factors determined the farm level factors by determining the number of donkeys raised per farm. Humans provided the husbandry and management requirements for the working donkeys required for them to increase their work output. Human factors also influenced animal factors as explained by the association of nutrition with body condition score and the weight of the donkey which in turn determined the appropriate loads for the donkeys to carry (Ram *et al.*, 2004). The external factors also had human involvement by proper restraining of donkeys to prevent roaming and theft, observing safe road use to prevent occurrences or road accidents and practicing disease prevention measures such as vaccinations, deworming and hoof management to prevent occurrence of diseases.

Although the study was conducted in the high potential areas of central Kenya, a similar study is recommended in other parts of the country particularly in the semi-arid areas where donkeys are also raised in order to identify the benefits and challenges of donkeys in these areas as well as describe the physical characteristics of donkeys in these areas.

The study was conducted during the period when the donkey population had decreased due to theft of donkeys and slaughter. Collection of data on body measurements on these donkeys was a challenge since some respondents feared that presenting many of their donkeys would expose them to donkey thieves. As a result the study design was affected and fewer donkeys were sampled. The initial proposal was to sample all donkeys from the selected households, but due to the challenge,

approximately only one donkey was sampled per household. The sampled households were 354 against 360 donkeys sampled. The owner however selected the donkey to be sampled creating randomness in the study.

Increasing the level of income from working income from donkeys means that more households will be able to sustain their livelihoods. This addresses millennium development goal 1 to eradicate poverty.

## **7.2 CONCLUSIONS**

- 1) Donkeys were used as a means of transportation and manure production. They faced challenges such as theft for slaughter, diseases, road accidents, malicious cutting.
- 2) Men were mostly the owners and were more involved in the management of working donkey than women.
- 3) Working donkeys in Kenya are larger than any other working donkeys in the world.
- 4) The farm level factors that were associated with level of household incomes from working donkeys included the number of working donkeys reared per farm, number of hours these donkey actually work and households savings from using own donkey transportations.
- 5) The estimated daily gross margins obtained though working donkeys was 300 KES implying a gross profit of 62%.

## **7.3 RECOMMENDATIONS**

- 1) Studies on the genetic diversity of the working donkeys should be conducted
- 2) The health and welfare of the working donkeys should be improved through collaborative efforts by policy makers, extension agents, animal health practitioners and donkey owners in order to optimize their use and performance.

- 3) Additional uses of donkeys such as hiring out or breeding for sale should be encouraged to maximize their benefits.
- 4) Future prospective studies should be conducted to determine the animal and herd level prevalence for the identified diseases which were ranked by respondents.

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## CHAPTER NINE: APPENDICES

### APPENDIX 1: Focused group discussions guide for donkey owners

Date..... Venue..... No. of participants.....

1. Why are donkeys kept in Kirinyaga county? (Indicate importance)

i) ..... ii) .....

ii) ..... iv) .....

v) ..... vi) .....

2. Give more details on the items transported (Indicate by number)

.....

.....

5. Enquire about the following diseases and their effect on the level of production

Disease affecting donkeys	Rank	Reason of importance					Other
		Work	Death	Abortion	Cost of treatment		
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							

6. What are the sources or suppliers of the following inputs for donkeys in this area?

a) Feeds.....

b) Water.....

- c) Veterinary services .....
- d) Replacement stock .....
- e) Carts maintenance services.....
- f) Other.....

7. Give reasons for your choice of veterinary services?

- a).....
- b) .....
- c).....
- d) .....

8. List five challenges (in order of importance) affecting working donkeys

- i) .....
- ii) .....
- iii) .....
- iv) .....
- v) .....

9. What solutions would you propose for the above challenges

- i) .....
- ii) .....
- iii) .....
- iv) .....
- v) .....

10. Are there other opportunities for working donkeys in this region? (reasons that favour existence of donkeys in Kirinyaga)

- i) .....
- ii) .....



iii) .....

iv) .....

11. Who works with the donkeys often? Indicate the role done by the males and females .....

12. Who is the main controller of the benefits from donkeys?  
.....

**APPENDIX 2: Individual questionnaire**

1. Name of the respondent.....Sex Male (....) Female (....) Village.....
2. Age group I ( <20 yrs)..... ii (20-35 yrs).....iii (36-50 yrs).....
3. Indicate on average how much money you get from the following activities per day

	KES	Rank	Reasons of importance
Donkey			
Cattle			
Sheep/ goats			
Other animals			
Crop farming			
Salary/ wages			
Other			

\*Where gains are not direct to estimate, insert the value of hired labor for the equivalent work)

4. Land ownership (Own.....) (Rented.....) (Parents'.....)
5. Land allocation for different members of the family (approximate by percentage)

Donkey .....	Cattle .....	Poultry/ Birds .....	Others .....
--------------	--------------	----------------------	--------------

6. Fill in the checklist below with the numbers of respective animals (Herd structure)

	Donkeys	Cattle	Sheep	Goats	Pigs	Chicken	Other	
Young								
Breeding Male								

Breeding Female								
-----------------	--	--	--	--	--	--	--	--

\*(NB) Young/Old depending on the Owner's response

7. Which animal is considered most important?.....

Why?.....

8. Where do you get replacement stock of donkeys from?

Own farm breeding (...) Bought in (.....) exchange/barter (.....) Other (.....)

9. How many animals have been born in your farm in the last 2 years?

Donkeys (...) Cattle (...) Sheep (...) Goats (...) Pigs (...) Chicken (...) Other (...)

10. Why do you keep your donkeys

i) .....

ii) .....

iii) .....

iv) .....

v) Other (please specify).....

11. If work? What type of

work.....

12. Fill the following welfare assessment matrix based on a score of 1 to 5 (where 1 is

poor, 2 moderate, 3 adequate, 4 good 5 is ideal)

Parameters	Score					Notes eg Sources
	1	2	3	4	5	
Adequate feeding						
Watering						
Health status						
Shelter/ housing						
Social interaction						

13. Which seasons of the years does the donkey have more work?

i) Rainy season .....

ii) Dry season .....

14. How many hours (on average) does the donkey work per day.....

15. On which days of the week does the donkey work.....

16. Which category of donkeys do you allowed to work?

Mature males..... Mature females..... Foals..... Pregnant females (up to what age)?.....

17. When do you consider a donkey ready for work?

i) By age ..... (Specify which age).....

ii) By size ..... (Specify which size).....

iii) Other (Specify) .....

18. When the donkey is not working, where is it normally found?

i) Grazing in communal land .....

ii) Grazing within the homesteads .....

iii) Zero grazing at homesteads .....

19. Do you hire out your donkey? Yes..... No.....

20. What is the market price of a donkey

i) Adult male.....

ii) Adult female.....

iii) Male foal.....

iv) Female foal.....

21. What are the charges for the following (in KES)

Mating .....	Treatment.....	Hiring a cart.....
--------------	----------------	--------------------

Feeding.....	Cart (grease, tires) and harness maintenance....	Other.....
Watering.....	Hiring a donkey (per day).....	
Housing.....	Labor (if you have employed someone to work with the donkeys) .....	

22. Do you use donkey manure from the farm? i) Yes..... ii) No.....

23. Indicate the price of manure of the following animals

Donkey.....	Cattle.....	Shoats.....	Poultry.....
-------------	-------------	-------------	--------------

24. Complete the following table on diseases

Disease	Cause	Usual treatment	Charges for treatment	Prevention

25. How many of your donkeys died in the last one year? .....

26. How do you determine the prices of work done by the donkeys?

- i. Equal to what peers are charging ( )
- ii. Lower than what peers are charging (...)
- iii. Based on the agreement with your client (...)
- iv. Based on the number of donkeys on the cart (.....)

27. Complete the following table of pricing of load by cart

Item	Estimated weight	Charge of load
Grain		
Husks		
Hay		
Maize stover		
Water		
Building material		
Firewood		

28. If the donkey business is not there, what alternative activity/ business would you be involved in? .....

**APPENDIX 3: Animal parameters (Phenotypic description of the animal)**

1	Date .....	6	Shoulder height in centimeters....
2	Location.....	7	Heart girth in centimeters.....
3	Name of the animal.....	8	Nose to tail in centimeters.....
4	Sex of animal .....	9	Length of legs in centimeters.....
5	Age of the animal .....	10	Length of the body in centimeters.....

Ageing: All deciduous teeth = less than 3 years, presence of permanent teeth = above 3 years

Fill the table below

Parameter	Assessment				
	Are the front legs straight when viewed from all sides	Yes.....	No.....		
Are the hind legs straight when viewed from the back	Yes.....	No.....			
Assessment of the back line	Straight.....	Humped.....	Depressed...		
Assessment of the base of fore hoofs	Well shaped....	Regular.....	Concave.....		
Assessment of the ears	Broken.....	Unbroken...			
Are the teeth regular and uniform in shape, meeting squarely	Yes.....	No.....			
Estimate the angle of the hoofs to the ground					
Indicate the body condition score	1	2	3	4	5

Body condition score scale of 1–5; with 1=thin, 2=Moderate, 3=ideal, 4=fat and 5=Obese

**APPENDIX 4: Gazette notice to revoke the declaration of slaughter houses for donkeys**

**SPECIAL ISSUE**

741

Kenya Gazette Supplement No. 50

20th April, 2020

(Legislative Supplement No. 34)

LEGAL NOTICE NO. 63

THE MEAT CONTROL ACT

(Cap. 356)

THE MEAT CONTROL (EXPORT SLAUGHTERHOUSE)  
REGULATIONS

REVOCATION OF DECLARATION

IN EXERCISE of the powers conferred by regulation 3 (1) of the Meat Control Act (Export Slaughterhouse) Regulations, the Cabinet Secretary for Agriculture, Livestock, Fisheries and Co-operatives revokes the declaration of the following slaughterhouses as export slaughterhouses for the purpose of these Regulations with effect from the 31st March, 2020.

1. Star Brilliant (EPZ) Limited
2. Goldox (K) Limited
3. Silzha Limited
4. Fuhai Machakos Trading Company Limited

Dated the 31st March, 2020.

PETER G. MUNYA,  
*Cabinet Secretary for Agriculture,  
Livestock, Fisheries and Co-operatives.*



## APPENDIX 5: Biosafety, Animal use and Ethical approval



**UNIVERSITY OF NAIROBI**  
FACULTY OF VETERINARY MEDICINE  
DEPARTMENT OF VETERINARY ANATOMY AND PHYSIOLOGY

P.O. Box 30197,  
00100 Nairobi,  
Kenya.

Tel: 4449004/4442014/ 6  
Ext. 2300  
Direct Line. 4448648

Dr Mary N. Gichure  
C/o Dept. of PHPT

**REF: FVM BAUEC/2018/165**  
**06/09/2018**

Dear Dr Gichure,

**RE: Approval of Proposal by Biosafety, Animal use and Ethics committee**

**An investigation of the contribution of working donkeys to farming households in Kirinyaga County, Kenya**


**By Gichure Mary Nyambura J87/51697/2017**

We refer to the above PhD proposal that you re-submitted to our committee for review and approval. We have now reviewed the proposal and have noted that you have addressed the issues we had raised on the use of donkeys for your project. These included issues to do with restraint and the measurements that were to be made, and occupational safety issues.

We hereby approve your work as per the revised proposal that you submitted.

Dr Catherine Kaingu, Ph.D  
Chairperson,  
Biosafety, Animal Use and Ethics Committee,  
Faculty of Veterinary Medicine

## APPENDIX 6: Turn it in originality report

 **Turnitin Originality Report**

**INVESTIGATION OF FACTORS ASSOCIATED WITH INCOME FROM WORKING DONKEYS AMONG SMALLHOLDER FARMERS IN KIRINYAGA COUNTY, KENYA** by Gichure Mary

From Thesis (MSc and PhD Thesis and Proposal)

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