COMMUNITY KNOWLEDGE, ATTITUDES AND PRACTICES ON DOG MANAGEMENT AND EPIDEMIOLOGY OF PARASITIC INFESTATIONS IN DOGS OF MVOMERO DISTRICT AND MOROGORO MUNICIPALITY, TANZANIA

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A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENTS OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF PUBLIC HEALTH AND FOOD SAFETY OF SOKOINE UNIVERSITY OF AGRICULTURE MOROGORO, TANZANIA.

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ABSTRACT

Dogs are the earliest animals to be domesticated by humans. In many areas of Tanzania, dogs are poorly managed and rarely protected from diseases which turn them to be reservoirs of diseases that can be shared to human and livestock. A cross sectional study was conducted between October 2017 and January 2018 to assess the community knowledge, attitudes, practices and to study the epidemiology of parasitic infestations in dogs of Mvomero district and Morogoro Municipality. The structured questionnaire was administered to 200 dog keepers, 100 in each study district. A total of 400 dogs were examined for ectoparasite infestations and sampled for laboratory identification using standard identification keys. Faecal samples were also collected from all the study dogs for coprological analysis of gastrointestinal parasites. It was established that 59% of dog keepers had fair to good knowledge on management of dogs, 50.5% showed positive attitude towards dogs. Dogs of Mvomero district were managed under poor conditions compared to those of Morogoro Municipality and the difference was statistically significant (P<0.05). Majority (83.8%) of the dogs were infested with ectoparasites namely ticks, fleas, mites and lice. It was further found that 76.8% of dogs were infested with intestinal parasites and some of them were zoonotic parasites namely *Ancylostoma* (60.5%), *Uncinaria* (22%), *Toxocara* (11.5%), *Toxascaris* (6.3%), *Ascaris* (3.8%), *Taenid* (6%), *Dipylidium* (1.8%), *Cryptosporidium* (15.5%), *Isospora* (8%), *Cyclospora* (4.3%) and *Entamoeba* (3%). Dogs of Mvomero distict were more (P<0.05) infested with parasites than those of Morogoro Municipality. Risk factors for parasitic infestations which were found to be statically significant (P < 0.05) included age, location of origin, management and housing system, lack of routine deworming and feeding system. It was concluded that dogs in Morogoro are poorly managed and had high infestation of parasites that reflect the status of parasitic infestations to other animals in the area. Therefore,

integrative approaches on creating public awareness on dog management practices in the study areas and other areas in Tanzania in order to safeguard the health of dogs and humans is recommended.

DECLARATION

I, Amina Ramadhani Issae, do hereby declare to the Senate of Sokoine University of Agriculture that this dissertation is my own original work, done within the period of registration and that it has neither been submitted nor being concurrently submitted for a higher degree award in any other institution.

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DEDICATION

This research work is dedicated to my husband Alex Joseph for his proper care during the period of my study. I would like also to dedicate this work to my children (Steven Alex, Angel Alex and Rachel Alex) and my mother Fatuma Selemani for their prayers and encouragement during the course of this study.

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DNA	Deoxyribonucleic Acid
AFSCAN	African Small Companion Animal Network
DED	District Executive Director
E	East of Greenwich
ELISA	Enzyme Linked Immunosorbent Assay
EPG	Egg Count per Gram of Faeces
KAP	Knowledge, Altitute and Practice
LFO	Livestock Field Officer
MAFF	Ministry of Agriculture, Fisheries and Food
OIE	Office International des Epizooties
PCR	Polymerase Chain Reaction
S	South of Equator
SPSS	Statistical Package for Social Sciences
SUA	Sokoine University of Agriculture
WEO	Wards Executive Officers
WHO	World Healthy Organization
ZN	Ziehl-Neelsen

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

Dogs are the earliest animals to be domesticated by humans. In most countries in Africa, dogs are kept for security, hunting, herding livestock, warns in case of danger and occasionally as pets (Whitfield and Smith, 2014). In Tanzania, majority of domesticated dogs are Mongrels which are kept mostly in rural areas with poor veterinary attention (Knobel *et al.*, 2008). Maasai, Sukuma, Gogo, Barabaig and Wambulu are some of pastoral and agropastoral societies in Tanzania who keep large groups of dogs for home security and assisting in herding of livestock. It is also the custom of many people living in urban areas to keep guard dogs which are not well managed and end up being stray dogs (Knobel *et al.*, 2008). Boys around 10 to 15 years old are the key people who manage dogs in most of households both in rural and urban areas (Ernest *et al.*, 2013). Normally dogs are kept freely roaming around in streets and villages where they increase the chances of dog bite injuries to people and the likelihood of spreading zoonotic diseases like rabies in the community (Ernest *et al.*, 2013; Swai *et al.*, 2016). Ectoparasites and gastrointestinal parasites are common to stray dogs because of poor management and lack of disease control programs (Kilonzo *et al.*, 2006; Knobel *et al.*, 2008).

Ectoparasites are organisms that may live on, feed on and inhabit the external body surface of another organism mostly vertebrates and may be detrimental to the latter (Hopla *et al.*, 1994). Many ectoparasites cause significant infestation in many species of animals (such as livestock, dogs, cats, and poultry) including humans (Hopla *et al.*, 1994; Durden *et al.*, 2005). Some of these ectoparasites (mostly lice) are species specific, while others (for example ticks) infest a wide range of hosts. The common ectoparasites reported to infest dogs in different areas in the world are ticks, fleas, mites and lice (Durden *et al*., 2005). Ectoparasites especially in heavy infestation may cause different disorders such as anemia, hypersensitivity, irritability, dermatitis, skin necrosis, loss of weight, secondary infections, focal haemorrhage, and blockage of orifices such as ears and inoculation of toxins (Hopla *et al*., 1994). Some ectoparasites of dogs can transmit disease causative agents to humans for example; fleas are potential vectors for *Yersinia pestitis* that cause plague in people (Kilonzo *et al*., 2006).

Surveys conducted elsewhere have documented various levels of ectoparasites infestations on dogs. Kumsa and Mekonnen (2011) in Ethiopia, investigated the prevalence of ticks, fleas and lice of dogs and almost all dogs were infested. A study conducted in Nigeria reported 60.4% as an overall prevalence of ectoparasites infested dogs (Ugbomoiko *et al*., 2008). Another study by Costa and others (2013) in Brazil investigated the prevalence of ectoparasites infestation on dogs of urban and rural area at the magnitude of 63% and 51.3% respectively.

Diagnosis of ectoparasites infestation can be done by either conventional or molecular techniques (Wells *et al*., 2012). Conventional methods include physical examination for pathological lesions, serological analysis and microscopic examination of the parasites (OIE, 1996; Wells *et al*., 2012). Molecular techniques are diagnostic method which deals with identification of genetic materials of the parasite like DNA (OIE, 1996). Advantages of molecular techniques over conventional methods in diagnosis of parasites infestation includes high specificity and sensitivity and can detect carrier animals (Wells *et al*., 2012). Unfortunately application of molecular techniques in developing countries is still minimal due to high cost of most diagnostic kits are available in high costs.

Prevention and control of ectoparasites infestations on dogs can be done by destroying parasites and alternative host habitats. Cutting or removing grass, weeds, and bush piles between fences and along buildings will increase ectoparasites desiccation and decrease protective harborage for wild animals that can also serve as hosts for ectoparasites such as ticks (Dryden and Payne, 2004). In addition, pesticides need to be used to kill ectoparasites in the environment before they attach to a host and feed so as to prevent tick borne pathogens (Young *et al*., 2003). Use of acaricides impregnated collar (for example Amitraz impregnated collar) can prevent ticks infestation in dogs (Estrada-Pena and Ascher, 1999). Furthermore, cleaning the environment and disinfecting dogs' house with regular dipping or spraying dogs with acaricides after every week may prevent dogs from ectoparasites infestation (Bryson *et al.*, 2000).

Gastrointestinal parasites are the organisms that inhabit in the gastrointestinal tract of other animals. Gastrointestinal parasitism in dogs has been reported worldwide and the severity of infections varies with age, geographical area, breeds, nutritional and immune status of the host (Schandevyl *et al*., 1987; Little *et al*., 2009). Clinical parasitism is characterized by poor body condition and increased mortality in puppies (Makene *et al*., 1996). The gastrointestinal parasites that have been reported to be the major cause of diseases in dogs are helminths like *Ancylostomum* spp and protozoan parasites such as *Giardia* spp (Muhairwa *et al*., 2008; Swai *et al*., 2016; Gbemisola *et al*., 2016).

Gastrointestinal parasitism in dogs may be asymptomatic or cause gastrointestinal disorders, lack of appetites, loss of weight, retarded growth and in severe cases death (Balassiano *et al*., 2009). For example a study performed in Kenya presented 68% prevalence of helmiths and *Ancylostoma canimun* (41%) was the major cause of mortality in dogs (Kagira and Kanyari, 2001). A survey done by Amissah *et al*. (2016) in Ghana, results showed thirteen species of intestinal parasites with an overall prevalence of 52.6%. Another study carried out by Fantanarrosa and others (2006) documented a prevalence of 52.4%. In Nigeria the prevalence of helminths infestation in dogs ranges between 24.7% and 52.5% (Sowemimo and Asaolu, 2008; Okoye *et al*., 2011). In Ethiopia Zewdu *et al*. (2010) a prevalence of helminths of up to 86.5% has been reported.

Gastrointestinal parasitism in dogs can be diagnosed by coprological, serological and molecular techniques. Ordinary coprological techniques, such as flotation in saturated sodium chloride solution, zinc sulphate centrifugal flotation, faecal sedimentation in water techniques, direct smears preparations and Modified Ziehl-Neelsen staining technique are predominantly useful in estimating prevalence of intestinal parasites (OIE Terrestrial Manual, 2008; Dantas-Torres and Otranto, 2014). Coprological methods may present low sensitivity in some instances and result in the underestimation of the magnitude of infestations to some parasites, when compared with necropsy, serological and molecular based data (Dantas-Torres and Otranto, 2014). The reasons for low sensitivity of coprological methods could be fecundity and immaturity of some helminthes as well as male and female ratio. Serological tests are widely employed to assess exposure to pathogens such as *Giardia* spp, *B. vogeli*, *Leishmania* spp, *Toxocara canis, E. granulosus* and *T. gondii* (De Savigny *et al*., 1979; Craig *et al*., 1995; Lee *et al*., 2010; Dantas-Torres and Otranto, 2014).

Prevention and control of gastrointestinal parasitism in dogs can be done by regular and correct use of antihelmintic and antiprotozoal drugs (Palmer *et al*., 2008). Also education to the dog owners on the importance of good husbandry practices may reduce the population of parasites on the environment. Good husbandry practices includes regular cleaning of the home surroundings, cleaning and disinfection of dog premises as well as proper disposal of dog faeces (Palmer *et al*., 2008).

In many places of Tanzania, dogs are rarely protected from diseases therefore plays a key role as a reservoirs and vectors of diseases that are transmissible to human and livestock because of their close interaction (Ernest *et al*., 2013). Morogoro is among the regions in Tanzania with high number of pastoralists and agropastoralists with big herds of livestock and dogs. The dogs rarely get veterinary services and they succumb from a range of disease conditions and act as reservoirs of several diseases which can be transmissible to people. Parasitic infestation is among the common dog problems in Morogoro which significantly cause diarrhea, unthriftness, alopecia, itching and persistent suffering (Makene *et al*., 1996; Kasanga *et al*., 2002; Muhairwa *et al*., 2008; Swai *et al*., 2010). Parasitic infestation is endemic in dogs probably due to lack of knowledge on dog management, poverty and high complexity interaction between definitive and intermediate hosts of parasites (Swai *et al*., 2016). Therefore, the purpose of the current study was to assess knowledge, attitudes and practices of dog keepers on dog management, awareness of parasitic zoonoses and to establish the prevalence of parasites of dogs in Mvomero and Morogoro Municipality.

Studies conducted in different places in the world documented risk factors associated with parasitic infestation in dogs. Rsk factors such as age, sex, body score and husbandry practices were recorded. For example, dogs younger than one year were more likely to be infested with parasites e.g *Toxocara* and dogs living in households with more than one dog are significantly parasitized (Bugg *et al*., 1999; Katagiri and Oliveira-Sequeira, 2008; Nijsse *et al*., 2017). Male dogs and low body scores were associated with mixed infestation. Close animal – human contacts are risky for people, especially in cases of negligence towards proper veterinary care, deworming procedures, as well as human and dog hygiene increase the potential risk of zoonotic parasite diseases spreading (Nijsse *et al*., 2017; Massei *et al*., 2017).

A knowledge, attitude and practice study is a quantitative method that use standardized questionnaire to collect quantitative and qualitative information. Knowledge, attitude and practices (KAP) studies on dogs and their diseases are widely employed in various countries to collect information for planning public health programs (Mascie-Taylor *et al*., 2003). For example in Tanzania, KAP surveys were employed on studying the communities' understanding on rabies prevention, transmission and control in different areas (Sambo *et al*., 2014). In Africa, KAP surveys on dog management and dog diseases have been conducted in several countries such as Ethiopia, South Sudan, Uganda, Nigeria, South Africa (Kilfu *et al*., 2016; Gbemisola *et al*., 2016; Wumbiya *et al*., 2017; Omadang *et al*., 2018). Furthermore, KAP surveys were used in different places in the world to assess communities' awareness on pet management and risks of parasitic zoonoses such as *cystic echinococcosis* in Morocco (El Berbri *et al*., 2015), *Toxocara canis* in household dogs in Canada (Nijsse *et al*., 2015) and parasitic zoonoses of free roaming dog in Nepal (Massei *et al*., 2015). KAP studies have been used in many surveys based on the principle that increasing knowledge will result in changing attitudes and practices to minimize disease burden in communities (Mascie-Taylor *et al*., 2003). KAP studies have been used in identification of knowledge gaps, identification of cultural beliefs and behaviour patterns which may pose barriers to diseases control, formulation of relevant public health awareness campaigns and provision of baseline data for planning, implementation and evaluation of national diseases control programs (Matibag *et al*., 2007; Hlongwana *et al*., 2009).

1.2 Problem Statement

Information on general management of dogs and epidemiology of parasitic infections in dogs of Morogoro region is scant. Gastrointestinal parasitic infestation in dogs is among the common problems in some areas of Morogoro region (Muhairwa *et al*., 2008). This is due to poor management which is probably associated with inadequate knowledge of dog husbandry.

1.3 Study Justification

Few studies targeting parasites infestations in dogs have been conducted previously in some urban and rural areas in Tanzania (Makene *et al*., 1996; Kasanga *et al*., 2002; Muhairwa *et al*., 2008; Swai *et al*., 2010 and 2016) but no study that was carried out to assess knowledge, attitude and practices of dog keepers on dog management, dog parasitic zoonosis and estimate prevalence of ectoparasites and gastrointestinal parasites of dogs in both rural and urban communities. Therefore, there is paucity of information on general management of dogs, status on ectoparasites and gastrointestinal parasitic infections and prevalence of dog zoonotic parasites in Morogoro region. Yet, the information on knowledge of dog zoonotic parasites, attitudes and practices of dog keepers on dog management in Morogoro region is limited. Therefore, these information gaps necessitated a study so as to establish the level of community knowledge, attitudes, and management practices of dogs and to estimate the prevalence of parasites infesting dogs in Morogoro Municipality and Mvomero district in order to safeguard the public health from zoonoses. Importance of the current findings is based on the fact that understanding dog keepers' perception towards dog management practices and dog-parasitic zoonoses knowledge is an important step towards the development of appropriate disease prevention and control programs in dogs.

1.4 Objective

1.4.1 Overall objective

The overall objective of this study was to assess the communities' knowledge, attitudes and practices on dogs' management, awareness on parasitic zoonoses and establish the magnitude of parasitic infestations in dogs of Mvomero district and Morogoro Municipality, Tanzania.

1.4.2 Specific objectives

i. To assess the knowledge, attitudes and practices of dog owners on dog management and the associated health risks in the study areas.
ii. To estimate the prevalence of parasites of dogs in Mvomero district and Morogoro Municipality.
iii. To establish the risk factors for the parasitic infestations in dogs.
iv. To estimate the prevalence of zoonotic parasites of dogs in Mvomero district and Morogoro Municipality.

1.4.3 Research questions

i. What is the knowledge, attitudes and practices of dog owners on dog management and the associated health risks in Mvomero District and Morogoro Municipality?
ii. What are the risk factors that contribute to parasitic infestations in dogs?
iii. What are the common parasites of dogs in Mvomero District and Morogoro Municipality?
iv. What are the prevalent zoonotic parasites of dogs in Mvomero District and Morogoro Municipality?

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Knowledge, Attitude and Practices of Dog Keepers on Dog Management

Dogs are popular animals that live in close intimate with humans and this cohabitation allows the transmission of zoonotic parasites to humans (Amissah *et al*., 2016). The risk may be high in communities with limited knowledge about zoonotic parasites in dogs. Amissah *et al*. (2016) in Ghana, found that knowledge of dog owners on zoonosis and pet management practices were poor. Asmare and Mekuria (2013) in Hawassa–Ethiopia, reported that community awareness on dog management and zoonotic parasites was poor as there was no treatment of dogs against parasites and none of the dog keeper was aware of zoonotic diseases from dogs. A survey carried out in Addis-Ababa Ethiopia on KAP showed that majority of the respondent (87%) believed that there is a risk of acquiring zoonotic disease from dogs. However, most of them (95.4%) knew only rabies and only 4.6% of respondents were aware of parasitic diseases (Kilfu *et al*., 2016). A study conducted by Muhairwa *et al*. (2008) in Morogoro Tanzania reported that intestinal helminthosis is common in dogs of all age groups and may be related to poor husbandry practices of dogs which imply that the public is at risk of acquiring the infections.

2.2 Parasites Spectrum

Parasite is an organism that takes benefit from another (the host), without giving something back and usually causing some damage to it. Incidentally, parasites constitute a diverse group of organisms that may affect a wide range of animal hosts, including amphibians, birds, fishes, mammals, and reptiles (Dantas-Torres and Otranto, 2014). They may be generally subdivided as endoparasites and ectoparasites, according to their location in the host. Ectoparasites may also be classified as permanent (e.g lice and mites) or non-permanent (e.g ticks), depending on the relationship with their host; whether their life cycle takes place solely on their hosts or also in the environment (Dantas-Torres and Otranto, 2014).

The importance of parasites and parasite control may or may not be obvious to many people because, however where studies have been conducted; parasitic diseases have been identified as the major impediment to dog health and welfare worldwide (Muhairwa *et al*., 2008; Whitfield and Smith, 2014). Parasites can cause a variety of problems in dogs ranging from mild to severe illness. Parasites especially in heavy infestation may debilitate domestic animals through different disorders such as anaemia, hypersensitivity, irritability, dermatitis, skin necrosis, loss of weight; predispose hosts to secondary infections, focal haemorrhage, blockage of orifices such as ears and inoculation of toxins (Hopla *et al*., 1994; Kumsa and Mekonnen, 2011).

2.3 Common Parasites of Dogs

2.3.1 Ectoparasites of dogs

2.3.1.1Common types of ectoparasites that can infest dogs

Ectoparasites are parasites that live on the dog and include fleas, ticks, mites and lice. Ectoparasites may cause irritation, blood depletion, pruritus, and skin lesions, potentially leading to the occurrence of secondary bacterial infections. Some ectoparasites such as fleas, lice and ticks may also transmit pathogens to dogs that include bacteria, protozoa, and helminths (Alcaino *et al*., 2002; Rinaldi *et al*., 2007; Kumsa and Mekonnen, 2011).

Fleas

Fleas are the most common ectoparasite of dogs and are considered significant public health pests (Földvári and Farkas, 2005). Fleas found on dogs originate from rodents, birds, insectivores and from other *Carnivore*. Dogs therefore may serve as ideal bridging hosts for introduction of flea-borne diseases from nature to home (Dobler and Pfeffer, 2011). *Pulex irritans* (Human fleas), *Echidinophaga gallinacea* (sticktight poultry flea), *Ctenocephalides felis* and *Ctenocephalides canis* are frequently reported species of fleas from dogs in different places in the world. The infestation of animals with ectoparasite like fleas is an indication of poor management practices. The effects of flea infestation include pruritus, self-inflicted trauma and flea allergy dermatitis (Kumsa and Mekonnen, 2011). Treatment of fleas should include the animals and the surrounding areas.

A study performed (Haule *et al*., 2013) in North-Eastern Tanzania demonstrated high magnitude of flea infestation in domestic animals including dogs; over 90% were *Ctenocephalides* spp. Kumsa and Mekonnen (2011) in Ethiopia documented three species of fleas infesting dogs which are *Ctenocephalides felis* (82.9%), *Ctenocephalides canis* (73.8%) and *Pulex irritans* (2.5%). Report of ectoparasites prevalence on dogs of Turkey presented two species of fleas which are *Ctenocephalides canis* (31.25%) and *Ctenocephalides felis* (4.17%) (Aldemir, 2007). These differences among study areas may be due to management practices of dogs and geographical distribution of fleas.

Fleas are mainly the vectors of bacterial agents such as *Yersinia pestis*, *Rickettsia typhi*, *Rickettsia felis* and *Bartonella* spp. *Yersinia pestis* cause Plaque which is a highly infectious bacterial zoonotic disease. The plaque coccobacillus causes a rapidly progressing serious illness that in its bubonic form is likely to be fatal (Haule *et al*., 2013).This human disease caused by *Y. pestis* has been historically associated with rats, mainly with *Rattus norvegicus* and *Rattus rattus* (Nisimov *et al*., 2004; Kilonzo *et al*., 2006; Kumsa and Mekonnen, 2011). The second group of pathogen is *rickettsiae.* There are mainly two species of *rickettsiae* which are naturally transmitted by fleas, *Rickettsia* *typhi, the* pathogen of *murine typhus* and *R. felis* are recently discovered *Rickettsia* species causing flea-borne spotted fever. Murine typhus is a zoonotic disease which is maintained in nature mainly by a flea-rat-flea transmission cycle. Fleas also are vectors of *Bartonella* and *Dipylidium caninum* (Sousby, 1982; Kumsa and Mekonnen, 2011). Fleas support growth of some disease causing agents or may act as transport vehicles for infected fleas between their natural reservoirs and humans (Kilonzo *et al*., 2006).

Ticks

Ticks infesting dogs are divided into two families, *Argasidae* (soft ticks) and *Ixodidae* (hard ticks). The most important ticks in dogs are the *Ixodidae* which are characterized by a hardened dorsal shield (*scutum*) and a head (*capitulum*) that extends in front of the body (Dryden and Payne, 2004). Common ixodid tick species that infest dogs are found in genera *Amblyomma*, *Rhipicepthalus* and *Haemophysalis*. Ticks may cause direct damage to the host through their feeding behavior, act as vectors for disease causative agents such as bacterial, rickettsial and protozoal diseases and may also cause tick paralysis (Földvári and Farkas, 2005; Marchiondo *et al.*, 2007).

Studies conducted in different places in the world reported different species of ticks that infest dogs. A study conducted in Nigeria by Oguntomole *et al.* (2018), reported three species of ticks namely *Rhipicephalus sanguineus* with infestation rate ranging from 0.3-80%, *Amblyomma variegatum* (0.3–70.2%) and *Haemaphysalis leachi leachi* (4.4–33.2%). Another survey carried out by Arong *et al*. (2011) in Nigeria, reported three species of ticks infested dogs which were *Rhipicephalus sanguineus* (40.58%), *Boophilus decoloratus* (33.5%) and *Haemaphysalis leachi leachi* (25.92%). Also a study conducted by Kumsa and Mekonnen (2011) in Ethiopia, documented two species of ticks found to infest dogs which are *Amblyomma* spp (3.5%) and *H. leachi leachi* (0.5%). In Albania

Rhipicephalus sanguineus (0.6%) and *Ixodes ricinus* (4.4%) species were found to infest dogs (Xhaxhiu *et al*., 2009). In Brazil *Rhipicephalus sanguineus* was reported to infest all the studied dogs while in Argentina 73% of the dogs were affected (González *et al*., 2004; Klimpel *et al*., 2010). *Rhipicephalus sanguineus* is probably the most widespread ixodid tick, colonising both human and canine dwellings (González *et al*., 2004; Xhaxhiu *et al*., 2009; Klimpel *et al*., 2010; Arong *et al*., 2011; Kumsa and Mekonnen, 2011).

Mites

These parasites are normally found in different shapes and sizes. Examples of mites that infest dogs are *Demodex canis*, *Otodectes cynotis*, and *Sarcoptes scabiei*. *Sarcoptic* mange is one of the skin diseases that dog can transmit to human. It is a highly contagious disease caused by *Sarcoptes scabiei* var *canis* is transmissible to humans (Schantz, 1991). *Sarcoptes scabiei* burrow deeply into animal’s skin and cause severe itching, scaling, skin crust, hair matting and loss. Although the mites spend their entire life-cycle on the dog, they can survive for up to 3 weeks away from the host. The mites burrow tunnels through the skin where they live and lay their eggs. Because they actually live deep in the skin, is impossible to see them outside, and brushing and bathing will not remove them (Schantz, 1991).

Several studies conducted in different countries reported different levels of *S. scabiei* infestations. A study on ectoparasites investigation in Nigeria by Ugbomoiko *et al*. (2008) reported 2.0% prevalence of *S. scarbiei* infestations in dogs. Another survey was conducted in China reported prevalence (1.18%) of *S. scabiei* infestation on pets (Chen *et al*., 2014). In Iran and Bangladesh the prevalence of *S. scabiei* and *Demodex canis* infestations on dogs has been reported at rate of 5.6% and 62.5%, respectively (Ali *et al*., 2011; Mosallanejad *et al*., 2012). *Scabies* is a zoonotic disease caused by *S. scabiei* mite especially in developing countries (Hay *et al*., 2012).

Lice

Infestation with lice, a common problem in human, is actually rare in dogs. Lice are species specific, therefore human lice cannot infest dogs and vice versa. The entire life cycle of lice is completed on the dog within 3 weeks (Hanssen *et al*., 1999). There are two species of lice that infest dogs, namely *Trichodectes canis*, known as a chewing/biting louse, it chews the skin of infested dog, and the second is *Linognathus setosus*, blood sucking louse. Clinical signs range from no symptoms at all to severe skin disease with biting lice and anemia with blood sucking lice (Hanssen *et al*., 1999).

2.3.1.2 Prevention and control of ectoparasites of dogs

Prevention and control start by destroying parasites and alternative host habitats. There are two techniques that are widely used to prevent parasites infestations which include mechanical and chemical methods. Mechanical control of the parasites infestations involves maintaining a hygienic environment (Durden and Hinkle, 2009). Cutting or removing grass, weeds, and bush piles between fences and along buildings will increase ectoparasites desiccation and decrease protective harborage for wild animals that can also serve as hosts for ectoparasites such as ticks (Dryden and Payne, 2004). Bathing of dogs regularly removes ectoparasites like fleas and debris that would otherwise cause irritation. In case of an infestation, contaminated bedding, nesting material, or clothing should be either properly disposed or exhaustively washed and placed in the sun. Chemical control of ectoparasites can be employed through direct use on dogs or on environment infested with parasites. Cleaning and disinfecting dogs' house with regular dipping or spraying dogs' acaricides after every week may prevent dogs from ectoparasites infestation (Bryson *et al.*, 2000). Topical or spot-on, treatments for dogs are available in many formulations which include flea shampoos, sprays, insecticides or insect growth regulators. Proper use of topical treatment may clear parasites infestations on dogs (Durden and Hinkle, 2009). Use of acaricides impregnated collar (for example Amitraz impregnated collar) can prevent ticks infestation in dogs (Estrada-Pena and Ascher., 1999).

2.3.2 Endoparasites

Endoparasites are parasites that live in the internal organs of an animal. Endoparasites are divided into two groups; intestinal and non-intestinal parasites. The endoparasites may be helminths, protozoa and intermediate stages of some insects like maggots. Intestinal helminths include Fluke (Trematodes), Tapeworms (Cestode) and Nematode (Ascarid, Hook worms and Whipworms). Non intestinal helminths are Heartworm (*Dirofilaria immits*), Lung worms (*Cappilaria* spp), Oesophageal worms (*Spirocerca lupi*) and Eye worms (*Thelazia* spp). The hookworms include *Ancylostoma* spp. and *Uncinaria stenocephala* (Foreyt, 2013). The *Ascarids* (roundworms) are *Toxascaris leonina* and *Toxocara canis* while the whipworms are *Trichuris vulpis*. The tape worms are *Echinococcus* spp, *Dipylidium caninum*, *Mesocestoides* spp and *Taenia* spp. The flukes are *Alaria alata* and *Nanophyetus salmincola* (Foreyt, 2013).

Dogs have been associated with several zoonotic diseases of which some of them are gastrointestinal parasites (Kavana *et al*., 2014). The most common helminths of dogs with zoonotic potential are *Ancylostoma caninum*, *Dipylidium caninum*, *Toxocara canis* and *Echinococcus granulosus* (Robertson *et al*., 2002).The protozoan gastrointestinal parasites of dogs include *Cryptosporidium*, *Balantidium*, *Cyclospora*, *Toxoplasma*, *Giardia* and *Coccidia* (Swai *et al*., 2010).

2.3.2.1 Helminthosis

Helminths are invertebrates characterized by elongated, flat or round bodies. Flatworms (platyhelminthes) include flukes (trematodes), tapeworms (cestodes) and roundworms (nematodes) (Foreyt, 2013; Wani, 2018).

2.3.2.1.1 Nematodes

Nematodes are cylindrical in structure and usually bisexual which include the round worms like hookworms, whipworms, heartworms, lungworms, oesophageal worms and eye worms (Foreyt, 2013).

Round worms

Toxocara canis and *Toxascaris leonina* are common roundworm of dogs, their presence have been reported in studies of intestinal parasites of dogs all over the world (Overgaauw, 1997; Dalimi *et al*., 2006). The life cycle of *Toxocara* is complex and involves both somatic and tracheal routes of migration. Infection may involve trans-placental migration and trans-mammary transmission, direct transmission and transmission via paratenic hosts (Irwin and Traub, 2011).

Round worms infection in animals is worldwide distributed. It has been reported in various countries such as Tanzania, Ghana and Iran (Anteson *et al*., 1975; Dalimi *et al*., 2006; Muhairwa *et al*., 2008: Amissah *et al*., 2016). A study by Muhairwa *et al*. (2008) in Morogoro Tanzania reported a prevalence of 5.1% *Toxocara canis* infestation in dogs. Another study by Amissah *et al*. (2016) in Ghana reported a prevalence of 18.8% *Toxocara canis* infection in dogs. Other studies elsewhere have reported the prevalence of *Toxocara* ranged between 3.1% and 40% (Anteson *et al*., 1975; Dalimi *et al*., 2006; Awadallah and Salem, 2015).

Toxocara eggs are distinguished from those of *Toxascaris* by comparing morphological features of the respective eggs following a simple faecal smear or a simple flotation technique (Irwin and Traub, 2011). The smooth eggs of *Toxascaris* can be easily distinguished from the pitted eggs of *Toxocara*. The most commonly used drugs for treatment of ascarid infections in dogs include pyrantel and piperazine salts, fenbendazole, mebendazole, febantel, selamectin, ivermectin and milbemycin (Irwin and Traub, 2011).

Hookworms

Ancylostoma caninum and *Uncinaria stenocephala* are some of the hookworms found in dogs in tropics (Klimpel *et al.*, 2010). In favorable environmental conditions, hookworm eggs develop into an infective third stage larva within 8 days (Irwin and Traub, 2011). Dogs acquire hookworms' infection through ingestion of larvae or skin penetration by infective larvae. The principal importance of these hookworms arises from their ability to suck blood in their primary host. Damage to the intestinal mucosa is also due to multiple lacerations caused by the worms (Irwin and Traub, 2011). The severity of clinical signs depends on the age and nutritional status of the host and its worm burden. In puppies and immuno-suppressed dogs even light to moderate infections with *A. caninum* can result in significant anaemia, hypo-proteinemia and bloody diarrhoea, and may result in fatalities (Irwin and Traub, 2011). The *A. caninum* and *Uncinaria stenocephala* are zoonotic in nature and infest humans through ingestions of contaminated food or skin penetration by infective larvae. Then larvae undergo a prolonged migration that causes a cutaneous larva migrans (Bowman, 1999).

Hookworms' infestations in dogs have been documented worldwide including Tanzania, Ghana and Iran (Anteson *et al*., 1975; Dalimi *et al*., 2006; Muhairwa *et al*., 2008: Amissah *et al*., 2016). For example Anteson *et al*. (1975) in Acra Ghana, reported 58% prevalence of *Ancylostoma caninum* infestation in dogs. The helminths affect dogs of all age groups.

Whipwoms

Whipworms are small, dark worms which live in the large intestine of the dog. The adult whipworm attaches into the tissue of the intestine and sucks blood. Large numbers of whipworms can cause irritation and bloody diarrhea. Example of whipworm is *Trichuris vulpis* commonly infest dogs (Irwin and Traub, 2011). An infestation with whipworms is characterized by mucoid haemorrhagic diarrhea, weight loss and anemia. Diagnosis is based on coprological analysis of faecal sample (Irwin and Traub, 2011).

Spirocercosis

Spirocercosis is a disease occurring predominantly in *Canidae*, caused by the nematode *Spirocerca lupi*. Typical clinical signs are regurgitation, vomiting and dyspnoea (Berry, 2000; Van der Merwe *et al*., 2008). The life-cycle involves an intermediate (coprophagous beetle) and a variety of paratenic hosts. Larvae follow a specific migratory route, penetrating the gastric mucosa of the host, migrating along arteries, maturing in the thoracic aorta before eventually moving to the caudal oesophagus. Here the worm lives in nodules and passes larvated eggs which can be detected using zinc sulphate faecal flotation (Van der Merwe *et al*., 2008). Histologically, the mature oesophageal nodule is composed mostly of actively dividing fibroblasts.

Spirocerca lupi-associated oesophageal sarcomas may occur and damage to the aorta results in aneurysms (Berry, 2000). A pathognomonic lesion for *spirocercosis* is spondylitis of the thoracic vertebrae. Primary radiological lesions include an oesophageal mass, usually in the terminal oesophagus, spondylitis, and undulation of the aortic border.

Contrast radiography and computed tomography are helpful additional emerging modalities (Van der Merwe *et al*., 2008). Oesophageal endoscopy has a greater diagnostic sensitivity than radiography. Endoscopic biopsies are not sensitive for detecting neoplastic transformation. Doramectin is the current drug of choice, effectively killing adult worms and decreasing egg shedding (Berry, 2000). Early diagnosis of infection is still a challenge and to date no ideal regimen for prophylaxis has been published (Van der Merwe *et al*., 2008). The prevalence of *Spirocerca lupi* in 260 privately owned dogs with different life and hunting styles in Greece was 10% (Mylonakis *et al*., 2001).

Dirofilaria immitis

Dirofilaria are long, thin parasitic roundworms that infect a variety of mammals. Infection is transmitted by mosquito bites. *D. immitis* is also known as “heartworm.” *Dirofilariasis* is the disease caused by *Dirofilaria* worm infections (Yildirim *et al*., 2007). In dogs, one form is called “heartworm disease” and is caused by *D. immitis* adult worms can cause pulmonary artery blockage in dogs, leading to an illness that can include cough, exhaustion upon exercise, fainting, coughing up blood, and severe weight loss (Yildirim *et al*., 2007).

Like dogs, humans become infected with *Dirofilaria* through mosquito bites. In persons infected with *D. immitis*, dying worms in pulmonary artery branches can produce granulomas (small nodules formed by an inflammatory reaction), a condition called “pulmonary *dirofilariasis*.” The granulomas appear as coin lesions (small, round abnormalities) on chest X-rays (Labarthe *et al*., 2003). Most persons with pulmonary *dirofilariasis* have no symptoms. People with symptoms may experience cough (including coughing up blood), chest pain, fever, and pleural effusion. Prevalence of 2.0% and 9.6%

of *D. immitis* infections in dogs have been reported in Brazil and Turkey, respectively (Labarthe *et al*., 2003; Yildirim *et al*., 2007).

2.3.2.1.2 Cestodes

Cestodes (tapeworm) are long, flat worm made up of numerous segments containing eggs (Irwin and Traub, 2011). The tapeworm genera of dogs include *Taenia*, *Dipylidium*, *Echinococcus* and *Mesocestoides*. Life cycle of tapeworm involves two hosts, definitive and intermediate hosts. Domestic dogs are the definitive hosts and transmission occurs through predator-prey relationship (Schantz *et al*., 2003). Humans and other mammals acquire cystic hydatidosis through ingestion of *Echinicoccus* oncosphers in food or water (Schantz *et al*., 2003). Studies have reported hydatidosis in slaughter animals (Sissay *et al*., 2008; Nonga and Karimuribo, 2009). Sissay *et al*. (2008) in Ethiopia reported prevalence of 68% and 65% of hydatid cysts in slaughtered sheep and goats, respectively.

Cestode species are worldwide distributed as reported in many studies performed in different continents. Muhairwa *et al*. (2008) in Morogoro Tanzania reported that *Ancylostomum caninum* (67.2%) and *Diyplidium caninum* (6.2%) are the common cestode of dogs. Asmare and Mekuria (2013) in Ethiopia reported *E. granulossus* eggs at 3.6% and *Anclyostoma caninum* eggs (54.5%) whereas stray dogs had high prevalence (97.3%) as compared to that of semi-confined (79.7) and confined (69.6%) dogs. A study conducted by Wang *et al*. (2006) in Heilongjiang Province, China found two cestode species infested dogs; *Taenia hydatigena* (19.7%) and *Dipylidium caninum* (14.6%). Several other studies have reported variable levels of cestode infestation in dog worldwide (Dalimi *et al*., 2006; El-Shehabi *et al*., 1999; Awadallah and Salem, 2015).

Since the eggs of *Echinococcus* spp cannot be differentiated from other *Taeniidae* species the gold standard for diagnosing of *Echinococcus* in the dog is by examination of the small intestines for adult worms during necropsy (Irwin and Traub, 2011). A commercially available coproantigen ELISA based on the excretory-secretory antigen of *E. granulosus* and *E. multilocularis* is now available (Siles-Lucas *et al*., 2017). Polymerase chain reaction (PCR) based methods are highly sensitive and at present are widely used for *Echinococcus* identification and genetic typing (Rahman *et al*., 2014). Due to the high costs involved in molecular screening however, it is recommended that the diagnostic strategy used for screening dogs in large populations include coproantigen ELISA and only the positive cases can be confirmed with PCR (Irwin and Traub, 2011).

2.3.2.1.3 Trematodes

Trematodes or flukes are relatively rare parasites in dogs and are commonly seen associated with consumption of raw meat. In dogs, there are intestinal and liver flukes. The common intestinal flukes include *Nanophyetus (Troglotrema) salmincola*, *Alaria alata*, *Alaria canis,* and other *Alaria* spp. Some species of liver flukes of dogs are *Opisthorchis* species and *Metorchis* species, *Clonorchis sinensis*, *Platynosomum concinnum* and *Eurytrema procyonis*. Trematodes, or flukes, are parasitic flatworms with unique life cycles involving sexual reproduction in mammalian and other vertebrate definitive hosts and asexual reproduction in snail intermediate hosts (Fritsche *et al*., 1989). Trematode infestation in dogs has been reported in different studies worldwide and their prevalence ranges between 0.8 and 30% (El-Gayar, 2007; Schuster *et al*., 2007; Wang *et al*., 2006; Dai *et al*., 2009). Adult dogs suffer more than young ones.

2.3.2.2 Protozoan parasites

Common protozoan parasites infecting dogs include *Cryptosporidium* spp, *Isospora* spp, *Giardia, Entamoeba* spp and *Balantidium* spp (Irwin and Traub, 2011; Awadallah and Salem, 2015).

Cryptosporidium

Cryptosporidiun is an apicomplexan protozoan parasite that causes intestinal infection in animals worldwide. It is a zoonotic parasite that causes *cryptosporidiosis*, a diarrhoeal disease in a wide range of animals (Irwin and Traub, 2011). The parasite has been isolated in many species of domestic animals including dogs. Animals acquire *Crymptosporidium* infection through consumption of contaminated food or drinking water contained oocysts. Feeding dog raw meat or allowing scavenging in garbage predisposes them to *cryptosporidiosis* (Ahmed *et al*., 2014). Humans get *cryptosporidiosi*s infection through several routes which are contact with infected animals, human-to-human transmission and eating food or drinking water contaminated with oocysts (Nichols *et al*., 2009). *Cryptosporidium* live in soil, food, water and on contaminated surfaces with waste.

Cryptosporidiosis may either be asymptomatic or symptomatic. In symptomatic infections several clinical signs may be observed which include diarrhoea, vomiting, weight loss and anorexia (Fayer and ungar, 1986; Hunter and Thompson, 2005). *Cryptosporidium* infection can be diagnosed by observation of clinical signs and laboratory methods. Laboratory techniques are corporological analysis (direct smear on ether concentration methods and Modified ZN staining technique), serological (eg. Enzyme Linked Immunosorbent Assay (ELISA) and molecular techniques (e.g, PCR) (Katanik *et al*., 2001; Kaushik *et al*., 2008).The prevalence of *Cryptosporidium* infestation in dogs has been reported to range from 0% to 44.8% worldwide (Hamnes *et al*., 2007). Age and sex are the risk factors of *Cryptosporidium* infection (Abere *et al*., 2013; Gbemisola *et al*., 2016).

Giardia

Giardia is pear-shaped, single-celled protozoan parasites that infect the small intestine of animals worldwide. There are several species of *Giardia* such as *Giardia lumbria* and *Giardia duodenalis*. Young animals are more commonly affected by *Giardia* and shows clinical signs of pale mucus membrane and foul-smelling diarrhea. Transmission is through direct contact with infected faeces, soil and drinking water from contaminated water body. *Giardia* is one of the most common protozoan parasites in dogs, with a worldwide prevalence of 5.4–55.2% (Hamnes *et al*., 2007). Berrilli *et al*. (2012) and Mundim *et al*. (2007) in Brazil reported *Giardia* infection in dogs with a prevalence of 16.9% and 49.7%, respectively.

Coccidia

Coccidia are small, single-celled protozoan parasites that invade and infect the lining of the small intestine of animals all over the world. Most *Coccidi*a spp are considered to be highly host specific and only parasitize a single host species. There are many species of coccidia that infect dogs such as *Isospora* spp and *Cyclospora* spp (Levine, 1985). These parasites can cause diarrhea which may be mild to severe depending on the level of infection. Young dogs with immature immune systems and dogs with weakened immune systems are most commonly affected. Infections are passed between hosts by the fecal-oral transmission through contaminated food and water following ingestion of infective oocysts and sporocysts excyst in the intestines releasing their contained sporozoites which then invade the host cells (Levine, 1985).

Entamoeba

Entamoeba is a protozoan parasite commonly found in human and non human primates and sometime seen in canine and feline and rare in other mammalian animals (Wittnich, 1976; Alam *et al*., 2015). The parasite is worldwide distributed and prevalent in tropical and subtropical areas. There are several species of *Entamoeba* that affect animals but the well known is *Entamoeba histolytica.* Humans are the natural host of *Entamoeba histolytica* and the usual source of infection for other domestic animals. Mammals become infected by ingesting food or water contaminated with faeces containing infective cysts (Wittnich, 1976). Diagnosis is based on corprological and serological analysis techniques (Alam *et al*., 2015). Alam *et al*. (2015) in Lahore Pakistan, reported a prevalence of amoebiasis in dogs ranged between 8.3% and 14.2%.

Toxoplasma

Toxoplasma gondii is a protozoan parasite that infects wide range of species of warm blooded animals including humans, while the definitive host is only the cat (Jadoon *et al*., 2009; Kalinová *et al*., 2015). Animals can get infection through ingestion of oocysts or tissue cysts from contaminated water and food. Vertical transmission is possible by the transplacental route (Kalinová *et al*., 2015). After ingestion the parasite escapes from the cyst and penetrate intestinal wall and emerge either as tachyzoites or sporozoites (Burney, 1996). The parasite is cosmopolitan in distribution. *Toxoplasmosis* is a zoonotic disease and is a major cause of abortion and the infection is usually asymptomatic in animals (Jadoon *et al*., 2009). The prevalence of toxoplasmosis in dogs of China ranges between 32.5% and 52% (Jadoon *et al*., 2009; Shahzad *et al*., 2006).

Balantidium

Balantidium is a ciliated protozoan parasite that cause a disease called *Balantidiosis.* This pathogen has a worldwide distribution but it is more common in tropical and subtropical regions (Neafie *et al*., 2016). *Balantidiasis* in animals usually occurs by ingesting cysts in faecally contaminated drinking water or food (Neafie *et al*., 2016). The infection is rare in dogs and is frequently associated with interaction with/sharing environment with pigs. Trophozoites reside in the colon and result in ulcerative colitis. Diagnosis is based on coprological identification of motile ciliated trophozoites with prominent macronuclei in fresh saline smears of faecal samples or cysts in flotation (Neafie *et al*., 2016).

2.3.3 Summary of the key issues in literature review

Dogs are popular animals that live close with humans so may play an active role in transmission of zoonotic diseases to humans. Ectoparasites and gastrointestinal parasites are common to stray dogs because of poor management practices associated with lack of knowledge and disease control programs. Common ectoparasites of dogs are fleas, ticks, mites and lice. Ectoparasites can infest a wide range of hosts and may act as vectors of disease agents that are transmissible to other animals. Common gastrointestinal parasites of dogs include helminths and protozoa. Frequently detected species of intestinal parasites in faeces of dogs are *Ancylostoma* spp, *Uncinaria* spp, *Toxocara*, *Echinococcocus, Dipylidium, Cryptosporidium*, *Isospora* and *Giardia* and most of these parasites are zoonotic.

Parasitism in dogs is associated with several risk factors such as age, immunity, sex, location of the origin, climatic condition and husbandry practices. Clinical parasitism relate with several disorders such as; anemia, hypersensitivity, irritability, dermatitis, skin necrosis, alopecia and loss of weight. Others are focal haemorrhage, blockage of orifices such as ears and inoculation of toxins. Parasitic infestation in dog can be diagnosed by either conventional or molecular techniques. The general methods for control of parasitic infestation in dogs include regular dipping, deworming and good hygiene. Creation of public awareness on canine zoonoses and application of good sanitary measures is important in order to safeguard the public health from the risk of infection.

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Description of the Study Area

This study was conducted in Mvomero district (regarded as rural area) and Morogoro Municipality (urban area) in Tanzania. Mvomero district was selected because it has a large number of pastoralists and agro-pastoralists who keep many dogs and documented information on dogs' parasitic infestation is limited. Mvomero district is located at the north east of Morogoro region between latitudes 8,000° and 10,000° S and longitude 37,000° and 28,022° E (Fig. 1). It bordered to the north by the Tanga region, to the north east by the Pwani region, to the east and south east by Morogoro Rural district and Morogoro Municipality and to the west by Kilosa district. The District is administratively divided into four divisions, 30 wards and 115 villages and population size is 312 109 (National census, 2012). It has a tropical climate with the annual average temperature of 25°C and average annual rainfall of 975 mm. According to Tanzania Meteorological Agency (TMA), the district experiences the bimodal rainfall patterns, where long rains occur from March to May while short rains occurs from October to November. The dry seasons are from June to September and December to February (TMA).

Morogoro Municipality was involved in the study for comparison of dogs' husbandry practices in urban versus Mvomero rural areas. Morogoro Municipality lies between latitude 5.7 to 10 °S and longitude 35.6 to 39.5°E and is situated on the lower slopes of Uluguru Mountain whose peak is about 500 to 600 metres above sea level (Fig. 1). It is located at about 195 km to the West of Dar es Salaam City. It is divided into 29 administrative wards and 272 streets with estimated population of 315,866 based on 2012 census. It has temperature ranging from 27°C to 33.7°C in dry seasons and 14.2°C to

21.7°C in wet season. According to TMA the Municipal experiences a sub-humid tropical climate with a bimodal rainfall patterns which is characterized by two rainfall seasons in a year with a dry season separating the short rains (October to December) and long rains (from March to May/June). Estimated dog population in Morogoro Municipality was 10,000 (Morogoro Municipality Director office).

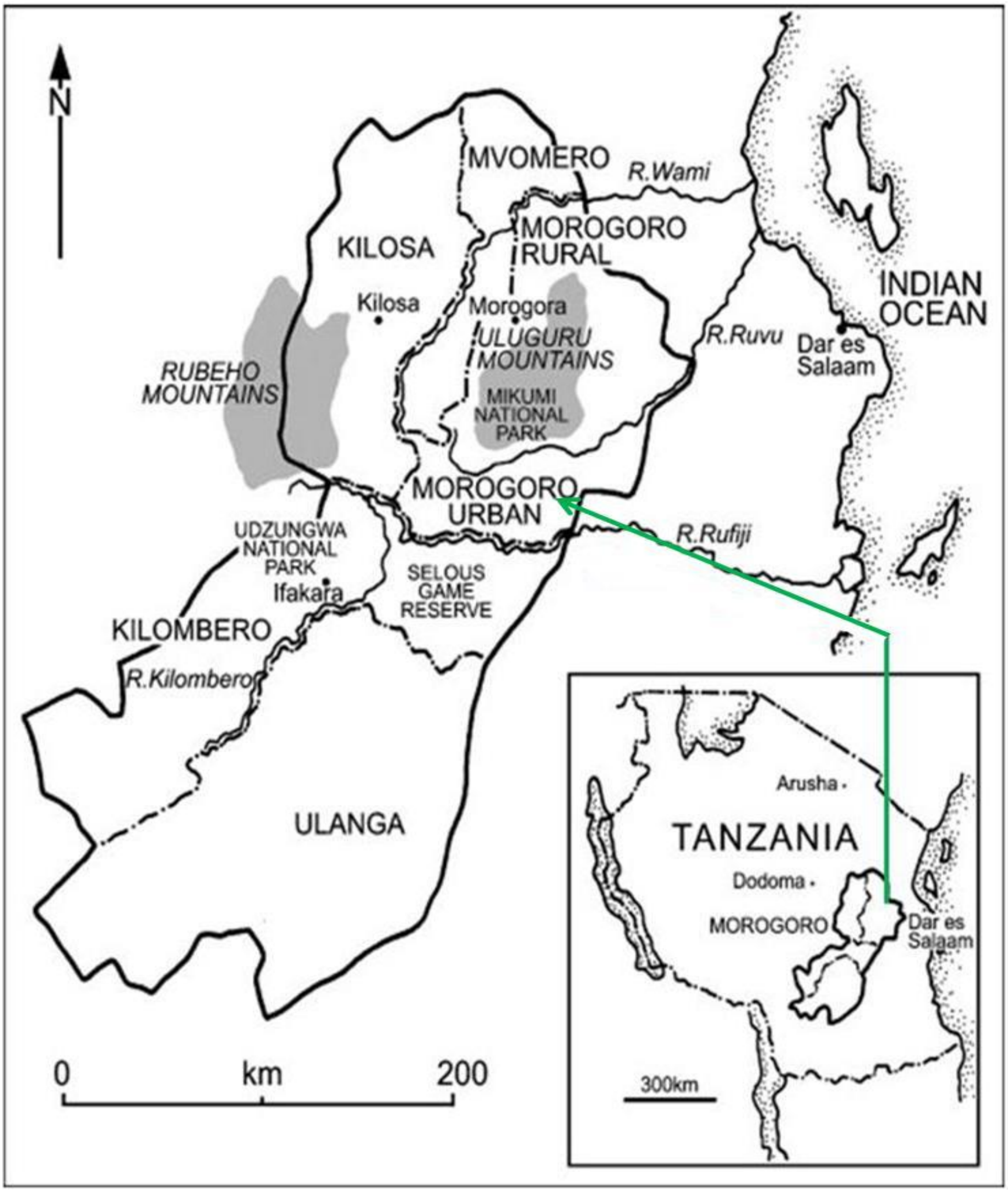

Figure 1: A map showing location of Morogoro region where Mvomero district and Morogoro Municipality are found.

3.2 Study Design and Population

A cross sectional study was conducted to assess knowledge, attitudes, practices and estimate the prevalence of ectoparasites and endoparasites of dogs in each study district. Study population comprised all households that keep dogs and dogs in Mvomero district and Morogoro Municipality. The inclusion criteria were; dog keepers both women and men, adult (age 18 years and above), willing to participate in the study, able to give information and accessibility of the place during data collection.

3.3 Sample Size Determination

A formula developed by Daniel (1999) ($n = Z^2 P (1\text{-}P)/d^2$) was used in estimation of the sample size of dogs. Expected prevalence of 50% was used in calculating the sample size because the prevalence of parasites infestation in dogs of Mvomero district and Morogoro Municipality was unknown. From the formula: d= precision at 5%, Z= Standard normal deviation (1.96) at a 95% confidence interval, P= expected prevalence and the calculated sample size was 384 dogs, 192 in each study area. A total of 200 dog keepers were also involved in the study as respondents to the questionnaire. Sample size of 200 respondents was obtained from the sample size of 384 dogs, whereby only 200 households were visited, 100 in each study area.

3.3.1 Sampling frame and sampling techniques

Sampling frame for Mvomero district was 15 wards where most of pastoralists and agro-pastoralists lives whereas for Morogoro Municipality was 29 wards. Selection of wards and villages/streets was purposively based on availability of dog keepers, accessibility of the area and compliance. In each district, five wards were selected purposively. In Mvomero district the selected wards were Dakawa, Mangae, Melela, Doma and Hembeti. Similarly, in Morogoro Municipality Magadu, Lukobe, Kihonda magorofani, Mafisa and

Mazimbu were selected for the study. Selection of study households was done by simple random selection from the list of all dog keepers in a study village or street. A total of 12 Villages and 100 households were involved in the study in Mvomero district. In Morogoro Municipality 27 streets were involved and 100 households' heads were interviewed. Selection of villages/ streets and households was done randomly. Furthermore, 8-10 and 3-7 respondents per village/street in Mvomero district and Morogoro Municipality were interviewed, respectively.

Ethical Consideration

Research permit was provided by the Vice Chancellor of Sokoine University of Agriculture (SUA) (Appendix 1) and the permission letter at district levels was obtained from Executive Director of Morogoro Municipality (Appendix 2) and Mvomero District Executive Director (DED) (Appendix 3). Verbal permits were also sought from the Wards Executive Officers (WEO) and Village/Street Executive Officers in the respective wards, villages and streets. The verbal consents were obtained from heads of households in the study villages/streets after explaining the purpose and importance of the study prior to commencement of interviews and subsequent sampling of dogs. Participation in the study was on voluntary basis. All the information collected from the participants was kept under the custody of the researcher as confidential and the study participants were anonymized.

3.3.2 Sociological data collection

3.3.2.1 Questionnaire survey

A cross sectional questionnaire, based survey was carried out in Mvomero District and Morogoro Municipality to assess knowledge, attitudes and practices of dogs' keepers on the risks of dog parasitic infestation (Appendix 4). The structured questionnaire with closed ended and few open ended questions were administered to 200 dog keepers from

October 2017 to January 2018, 100 in each study area. The questionnaires were pretested in the field and amended accordingly. Pretesting of questionnaires was done in order to test the clarity, sequence of the questions and estimate the duration for each questionnaire. After testing the questionnaires, they were revised and arranged in a better chronology. The revised version of the questionnaires that was used in the study was translated into 'Kiswahili', the national language understood by majority of Tanzanians. The questionnaires contained questions that explored basic information of dogs such as age, breed, sex, treatment regime, and feeding, housing, body condition and health status (Appendix 5). Also the questions gathered information on demographic characteristics of dog keepers like, sex, education level, socio-economical status, and awareness on dog management practices, diseases and zoonoses associated with dog keeping. The questionnaire was well explained to the respondents by the researcher and their responses were clearly recorded. It was administered by face to face interview to dog keeper who was present and willing to participate during the course of this study.

To measure the various aspects of knowledge, attitude and practice (KAP), the questionnaire was divided into three modules (Appendix 4). In each module, relevant questions were asked to respondents such as in knowledge module the emphasis was given to the level of knowledge of respondents regarding management of dogs and diseases associated with dog keeping. To assess knowledge together with practice, 22 questions were asked and eight questions for attitude. In assessing the attitudes of people towards dogs, a series of eight short questions were asked and responses were classified and given weights as follows: 1= Strongly agree, 2= Agree, 3= Neutral, 4= Disagree and 5= Strongly disagree. Also the questionnaire included aspect of experiences and behavioral responses toward dogs and dog management. Twelve questions of experiences and behavioral responses were asked (Appendix 4).

Analysis of the questionnaire was done on the basis of scalar scoring method. There were four types of questions, questions having two possible answers (yes/no), multiple choices, listing and Likert scale. There were five Likert responses' which were strongly agree, agree, neutral, disagree and strongly disagree (Allen and Seaman, 2007). A marking scheme with a list of correct answers was used in marking and scoring of responses. Don't know responses were regarded as wrong answers. Then each correct answer was assigned one point score and zero point score for the wrong answer (Memon *et al*., 2015). Overall, there were 50 questions in the questionnaire. Total score points for knowledge with practices, attitude, experiences and behavioral response questions were 24, 42 and 14 respectively. Therefore, if a person answered all questions correctly, 80 points were awarded. The mean and median values of knowledge, attitudes and practices scores of respondents were calculated. Respondents with knowledge, attitude and practices score value greater than mean value were considered to have high, with score value equal to mean were regarded as having medium while those with score value below mean were ranked as having low KAP, respectively (Memon *et al*., 2015).

3.3.2.2 Study dogs and clinical examination

After the questionnaire administration in the study households, dogs for study were selected. The inclusion criteria were the dog with age of three months and above and readiness of the owner to allow the dog to be used for the study. For households that had between one and five dogs, and had met the inclusion criteria, all dogs were selected for the study. In case the household had dogs above five and had met the inclusion criteria, three to five dogs were randomly selected for study. Before the dog was restrained for examination and sampling, age, sex, breed, management system, history of ectoparasite control and the general body condition were recorded. Animals were grouped into two age categories, as young (three months to one year) and adult (above one year). Age determination was done based on owners' records, dentition and body size (Aiello and Moses, 2010). Body condition was categorized as poor or good based on the dog appearance (Aiello and Moses, 2010). A poor body condition score was given for dogs which were emaciated with prominent bones and rough hair coat. Good body condition score was given for animals when the bones are well covered with muscles and with smooth hair coat (Aiello and Moses, 2010).

The study dogs were restrained by using different methods including dog catcher, dog muzzle and rope or by manual restraint depending on the temperament of the dog. Clinical examination of each selected dog was performed by taking the rectal temperature, heart rate and respiration rate. The general physical examination of skin for pathological lesions or ectoparasites was done and the findings recorded accordingly. This was followed by detailed examination by inspection and palpation of the skin across all parts of the body for presence of ectoparasites as detailed in the subsequent sections. The dogs that were found infested with ectoparasites were considered as positive.

Sample collection and microscopic identification of ectoparasites

Dogs were restrained and thoroughly examined for skin pathological lesions and presence of ectoparasite infestation on different parts of the skin. Thereafter dogs were put on lateral recumbency on a white cloth so that dropping parasites can be visible and simplify the task of collecting them as specimens (Fig. 2). Dogs were examined by visual and palpation of all body regions beginning from the head, followed by the neck, dorsum trunk, limbs and tail. Ectoparasites encountered on the skin surface, inside the ears and between the toes were manually collected. The ticks were removed from the skin by using thumb forceps to retain the mouth part for easy identification.

For the purpose of getting fleas for sampling, absolute acetone was smeared all over the skin using cotton wool so as to immobilize them for easiness of sampling. Thereafter the furs of the dog were brushed from backward to forward direction to allow fleas to fall on the white cloth.The fleas and other ectoparasite collected from each dog were transferred into labeled bottles containing 70% ethanol. The collected samples were labeled according to body regions such as ear, head, neck, abdomen, and between the thighs. After field sampling of ectoparasites from dogs, the samples were subsequently transported to Parasitology laboratory in the Department of Veterinary Microbiology, Parasitology and Immunology (SUA) for analysis. In the laboratory, the specimens from each dog were identified, counted and recorded according to body regions. In cases of dogs with skin lesions suggestive of mange infestation, skin scrapings were collected. This was made by scraping the lesion with scalpel blade and scooping spoon until capillary blood oozing was evident. The collected samples were preserved in the glass tubes and subsequently sent to the same laboratory for analysis.

Figure 2: A photograph showing a dog lied on a white cloth during sampling of fleas and other ectoparasites

Microscopic identification of collected ectoparasites

In the laboratory, different specimens of ectoparasites were mounted on microscopic slides with mineral oil preparation. Ectoparasites were examined and identified microscopically with the basis of their morphological structure at 40x magnifications by using light microscope. Identification of ticks and fleas was carried out referring to the Veterinary parasitological reference manuals (Foreyt, 2013). For the skin scrapping samples, few drops of 10% potassium hydroxide were added into each of the specimen, allowed to stand for 3 hours so as to allow digestion of crusts. The plastic pipette was used to mix a sample solution and two to three drops of the mixed sample was put on a glass slide and examined under a light microscope at ×10 and ×40 objectives. Then the mange mites were identified using the morphological keys of Urquhart *et al*. (1996) and Wall and Shearer (2001).

3.3.2.3 Faecal sampling for gastrointestinal parasite analysis

Fecal samples were obtained directly from the rectum of each study dog, with lubricated gloved finger after proper restraining. The glove was peeled off the hand keeping the fecal sample encased within it. After squeezing the glove to remove much air, the wrist portion of the glove was twisted and tied. Each glove with faecal sample was labeled accordingly. The samples were transported in cool box with ice packs to Parasitology Laboratory in the Department of Veterinary Microbiology, Parasitology and Immunology (SUA) for for analysis.

3.3.3 Faecal sample processing for gastrointestinal parasites identification

3.3.3.1 Coprological analysis

3.3.3.1.1 Qualitative analysis of fecal sample

In the laboratory, each fecal sample was examined physically for the presence of adult worms, larvae and tapeworm segments in a Petri dish. Four methods were used for examination of faecal samples namely, simple test tube floatation, sedimentation, direct normal saline/iodine wet mount and modified Ziehl-Neelsen staining technique. Simple test tube flotation technique was employed in determination of nematodes eggs, cestodes eggs and protozoan cysts.

Simple test tube floatation

First, the super saturated salt solution was prepared by using table salt and distilled water. More salt was added in a given volume of distilled water until there is no more salt dissolving and this was regarded as a floatation solution which had the specific gravity of 1.20 (OIE Terrestrial Manual, 2008). Then, approximately 3 g of faecal sample was measured by using a pre calibrated teaspoon and put into a plastic cup and added with 50 ml of flotation solution. The mixture was thoroughly stirred with a tongue blade to make a solution. The faecal suspension was poured through a tea strainer into another cup. Then the fecal suspension was poured into test tube supported in a rack from cup two. The test tube was gently topped off with the suspension leaving a convex meniscus at the top. Carefully a cover slip was placed on top of the test tube and was left to stand for 20 minutes. Carefully the cover slip was lifted off the test tube together with the drop of fluid adhering to it and the cover slip was placed on a clean glass slide for microscopic examination at 40 × magnifications (WHO, 1991).

Sedimentation technique

This technique was used for determination of trematode and cestode eggs. Approximately 3 g of fecal sample was measured into container one and mixed with 50 ml of tap water. The mixture was thoroughly stirred by using a tongue blade. The fecal suspension was filtered through a tea strainer into container two. The filtered materials were poured into a test tube and allowed to sediment for five minutes. The supernatant was carefully removed by using pipette and the sediment re-suspended in 5 ml of tap water for 5minutes. Then, the supernatant was discarded and the sediment was stained by adding one drop of methylene blue. Lastly, the sediment was transferred to a microscope slide and covered with a cover slip for microscopic examination at 40 × magnifications (MAFF manual, 1986).

Direct normal saline and iodine wet mount method

This technique used two reagents, normal saline and 1% Lugols' iodine. The process started with preparation of normal saline solution where by adding 9 g of sodium chloride into 991 ml of distilled water to make a total volume of 1000 ml. The salt and distilled water was thoroughly mixed by using stirrer. Direct normal saline and iodine wet mount method was used for detection of live motile trophozoites and cycts of *Entamoeba histolytica*, *Giardia lambria* and *Balantidium coli*. The feacal sample was placed on a small area of clean microscope slide whereby gross fibers and particles were removed. The preparation was finally mounted by Lugols' iodine and examined under microscope at 40 × magnifications. Helminth eggs and protozoan oocysts were identified by using standard identification keys based on their morphological features (Soulsby, 1982; MAFF manual, 1986).

Modified Ziehl-Neelsen (ZN) staining technique

This technique was used for detection of *Cryptosporidium* cysts in faeces.Three reagents were used in preparing ZN stain namely strong Carbol fuschsin, 1% acid methanol and 0.4% Malachite green. The strong Carbol fuschin reagent was prepared by mixing 20 g of basic fuschin powder, 200 ml of absolute methanol, 125 ml liquid phenol and 1675 ml of deionized distilled water. The 1% acid methanol was made by mixing 20 ml of hydrochloric acid and 1980 ml absolute methanol. The last reagent was 0.4% Malachite green which was prepared by adding 2 g of Malachite green powder into 480 ml of deionised distilled water.The staining procedure was done as described by Henriksen and Pohlenz (1981) for detection of *Cryptosporidium* spp cysts in dog feces. Briefly, faecal smears were made directly from the stool sample on microscope slides and air dried. The prepared smears were fixed in concentrated methanol for 3 minutes and stained with strong Carbol fuschin for about 15-20 minutes. Thereafter the stained smears were rinsed thoroughly in tap water and decolorized in acid alcohol (1% HCL in methanol) for 15 seconds. Then were rinsed thoroughly in tap water and counterstained with 0.4% Malachite green for 30-60 seconds. Stained smears were rinsed again in tap water and air dried before examination.The smear added with oil immersion was examined under a microscope at 100x magnification for detection of *Cryptosporidium* oocysts (WHO, 1991). Identification of *Cryptosporidium* oocysts was done according to the morphological characteristics as outlined by Soulsby (1982) and MAFF manual (1986).

3.3.3.1.2 Quantitative analysis of faecal sample

Quantitative analysis of helminth s eggs was done by use of McMaster counting technique to some of the samples which were in large amount. The inadequate samples were not quantitatively analysed because during sampling, little amount of sample was obtained and was only used for qualitative analysis of gastrointestinal parasites. The quantitative analysis involved measuring 3 g of faecal sample and was placed into plastic cups mixed with 50 ml of floatation solution followed by stirring to get the homogenous mixture. Then the fecal suspension was filtered through a tea strainer into a second plastic cup. A filtered sample was taken using a pipette and filled into a McMaster counting chamber and left to stand for five minutes then was examined under a microscope at 10 x 10 magnifications. Eggs of different species were separately counted in the grooved area of both chambers. The egg per gram (EPG) of faeces was calculated by adding the counts of both chambers and multiplied by 50 (MAFF manual, 1986). The guideline to interpretation of helminths eggs counts in dog samples adopted that of sheep as described by Hansen and Perry (1990) with some modifications. Helminths count of 50-100 EPG was grouped as low levels of infestation while >500 EPG was grouped as significant high levels.

3.4 Data Analysis

Quantitative data from questionnaire survey were recorded, edited, coded and analyzed using the Statistical Package for Social Sciences (SPSS) version 20. Data obtained from laboratory analysis of faecal samples were entered in Microsoft Excel 12 (Excel, 2007) and imported to Epi Info software (Epi-info, 2012) for analysis. The analysis in the SPSS and Epi Info softwares involved means, frequencies, standard deviation and cross tabulation. Comparison between categorical variables was done by using Chi Square test at 5% level of significant ($P < 0.05$).

CHAPTER FOUR

4.0 RESULTS

4.1 Demographic Characteristics of Respondents

A total 200 respondents were interviewed and their demographic characteristics are presented in Table 1. The age of respondents ranged between 18 and 71 years in both Mvomero district and Morogoro Municipality. Majority of the respondents had primary level of education. Crop farming is the main source of income and most of the respondents (70%) had an annual income that ranged between 1and 10 million shillings.

Table 1: Demographic Characteristics of Respondents

		Number (%) of respondents in the study districts		
Demographic information	**Category**	**Mvomero (n=100)**	**Morogoro Municipality (n=100)**	**Total (N=200)**
Gender	Male	72 (72.0)	54 (54.0)	126(63.0)
	Female	28 (28.0)	46 (46.0)	74 (37.0)
Age (years)	15-25 years	30 (30.0)	23 (23.0)	53 (26.5)
	Above 25 years	70 (70.0)	77 (77.0)	147 (73.5)
Level of education	No formal education	25 (25.0)	6 (6.0)	31 (15.5)
	Primary school	59 (59.0)	46 (46.0)	105 (52.5)
	Secondary school	12 (12.0)	33 (33.0)	45 (22.5)
	College education	4 (4.0)	15 (15.0)	19 (9.5)
Sources of income	Crop farming	71(71.0)	27 (27.0)	98 (49.0)
	Livestock and poultry keeping	28 (28.0)	22 (22.0)	50 (25.0)
	Trading in livestock and livestock products	7 (7.0)	3 (3.0)	10 (5.0)
	Trading in crops and crop products	8 (8.0)	22 (22.0)	30 (15.0)
	Formal salaried employee	5 (5.0)	39 (39.0)	44 (22.0)
	Shopkeeper	4 (4.0)	25 (25.0)	29 (14.5)
Annual income in Tanzania shilling	Below one milion	45 (45.0)	4 (4.0)	49 (24.5)
	Between 1and 10 milion	53 (53.0)	87 (87.0)	140 (70.0)
	Above 10 million	2 (2.0)	9 (9.0)	11 (5.5)

4.2 General Knowledge on Dog Management Practices

On the experience of keeping dogs, majority of respondents (64.5%) have an experience of more than three years while the average number of dogs kept ranged between one and three. The results shows that dogs are kept for home security purpose and the main source of dogs were neighbors (Table 2). Nevertheless, the main disadvantage of dogs that was mentioned by most respondents (85%) was dog bites and spreading rabies. The results also shows that housing and tethering of dogs was more practiced in urban than in rural areas. For the dogs that were being housed, the dog houses were in a nasty condition (Fig. 3). Also, boys are more involved in taking care of dogs in most of the households than other family members. Most respondents reported that dogs are kept mainly for security purpose and the major disadvantage of keeping them is dog bites and transmission of rabies. Moreover, the results indicate that majority of dog keepers feed their dogs homemade feed and on bare ground (Table 2).

Table 2: General knowledge on dog management practices in Mvomero district and Morogoro Municipality (n=200)

Parameter	Category	Number (%) of respondents in the study districts		
		Mvomero (n=100)	**Morogoro Municipality (n=100)**	**Total (N=200)**
Number of dogs kept	1 - 3	79 (79.0)	82 (82.0)	161(80.5)
	> 3	21(21.0)	18 (18.0)	39 (19.5)
Duration of keeping dogs (years)	1 - 3	42 (42.0)	29 (29.0)	71(35.5)
	> 3	58 (58.0)	71(71.0)	129 (64.5)
Source of dogs	Friends	21(21.0)	28 (28.0)	49 (24.5)
	Neighbors	45 (45.0)	43 (43.0)	88 (44.0)
	Commercial breeders	34 (34.0)	29 (29.0)	63 (31.5)
Purpose of keeping dogs	Herding	20 (20.0)	0 (0.0)	20 (10.0)
	Hunting	13.0	2.0	15 (7.5)
	Home security	99.0	100.0	199 (99.5)
	Companionship	1.0	9.0	10 (5.0)
Disadvantage of keeping dogs	Bites and spread rabies	80.0	90.0	170 (85.0)
	Spread ectoparasites	13 (13.0)	9 (9.0)	21 (11.0)
	Preying on livestock	7 (7.0)	1 (1.0)	8 (4.0)
Dog housing and tethering	Housing/tethering of dogs	39 (39.0)	77 (77.0)	116 (58.0)
	Free roaming	61 (61.0)	23 (23.0)	84 (42.0)
Type of food for dogs	Cooked meat	1 (1.0)	6 (6.0)	7 (3.5)
	Homemade feed	96 (96.0)	85 (85.0)	181 (90.5)
	Commercial feed	1(1.0)	7 (7.0)	8 (4.0)
	Homemade and Commercial Feed	1 (1.0)	7 (7.0)	8 (4.0)
How do you feed your dogs?	In utensils	29 (29.0)	58 (58.0)	87 (43.5)
	On bare ground	56 (56.0)	23 (23.0)	79 (39.5)
	Both of the above	15 (15.0)	19 (19.0)	34 (17.0)
Family members who care dogs	Don't care	60 (60.0)	20 (20.0)	80(40.0)
	Son	21 (21.0)	47 (47.0)	68 (34.0)
	Attendants	5 (5.0)	16 (16.0)	21 (10.5)
	Anybody	13 (13.0)	18 (18.0)	31(15.5)

Figure 3: Some of the dog houses encountered during the study

4.3 Dog Health, Zoonotic Diseases and Access to Veterinary Services

The summary on dog health, zoonotic diseases of dogs and access to veterinary services are summarized in Table 3. The results of this study revealed that majority of the respondents were aware of dog zoonotic diseases (82% in rural and 91% in urban). However, it was found that rabies is the well known disease of dogs and of public health importance compared to parasitic zoonoses (Table 3). A number of veterinary services provided to dogs were mentioned by respondents but vaccination was reported by majority of dog keepers (Table 3). Morogoro Municipality dog keepers reported to get more veterinary services to their dogs as compared to Mvomero and the difference was statistically significant ($P<0.05$). Treatment of dog diseases in both areas of the study is done mostly by livestock field officers (LFO). A number of precautions to prevent dogs from parasitic infestation were listed and the commonly practiced by respondents was cleaning home environment (Table 3).

Table 3: Dog health, zoonoses and access to veterinary services

Parameter	Category	Number (%) of respondents in the study districts Mvomero district (n=100)	Morogoro Municipality (n=100)	Total (N=200)
Do dogs spread diseases?	Yes	82 (82.0)	91(91.0)	173 (86.5)
	No	18 (18.0)	9 (9.0)	27 (13.5)
What are the common diseases to your dogs	Mange	23 (23.0)	16 (16.0)	39 (19.5)
	Helminthosis	19 (19.0)	32 (32.0)	51 (25.5)
	Ectoparasite infestation	48 (48.0)	63 (63.0)	111 (55.5)
Of the dog diseases which also affect humans?	Mange	3 (3.0)	8 (8.0)	11 (5.5)
	Helminthosis	6 (6.0)	10 (10.0)	16 (8.0)
	Allergic dermatitis	11 (11.0)	13 (13.0)	24 (12.0)
	Rabies	80 (80.0)	91 (91.0)	171 (85.5)
Access to veterinary services	Yes	61 (61.0)	80 (80.0)	141 (70.5)
	No	39 (39.0)	20 (20.0)	59 (29.5)
Type of veterinary services provided to dogs	Vaccination	55 (55.0)	77 (77.0)	66 (66.0)
	Dipping/spraying	5 (5.0)	24 (24.0)	29 (14.5)
	Deworming	19 (19.0)	32 (32.0)	51 (25.5)
Who provides the veterinary services	Veterinary Officer	0 (0.0)	22 (22.0)	22 (11.0)
	Livestock field officer	61 (61.0)	56 (56.0)	117(58.5)
	Father and son	3 (3.0)	5 (5.0)	8 (3.5)
	No treatment	36 (36.0)	20 (20.0)	56 (28.0)
Precautions taken to prevent parasites infestation in dogs	Clean & disinfect dog houses	10 (10.0)	16 (16.0)	26 (13.0)
	Cleaning home environment	42 (42.0)	77 (77.0)	119 (59.5)
	Regular deworming every 3 months	11 (11.0)	39 (39.0)	25 (25.0)
	Feeding dogs cooked meat	3 (3.0)	7 (7.0)	10 (5.0)
	Regular dipping every week	20.0	61 (61.0)	81 (40.5)
	Burning affected areas	0 (0.0)	0 (0.0)	0 (0.0)
Sanitations after handling of dogs or dog environment	Do not wash hands	43 (43.0)	46 (46.0)	89 (44.5)
	Wash hands with water only	13 (13.0)	8 (8.0)	21(10.5)
	Wash hands with water & soap	44 (44.0)	46 (46.0)	90 (45.0)

4.4 Respondents' Attitudes towards Dogs

Results on attitude responses show that some of respondents like dogs while others hate dogs because they had the feelings that dogs are dangerous and nuisance animals in the society (Table 4).

Table 4: Distribution of respondents' responses on attitude towards dogs (n=200)

Study area	Variable	Number (%) of respondents' responses				
	Statement asked	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Mvomero district	I like dogs	49 (49.0)	45 (45.0)	4.(4.0)	2 (2.0)	0 (0.0)
	I feel sorry for stray dogs	20 (20.0)	58 (58.0)	18 (18.0)	4 (4.0)	0 (0.0)
	I feel safe when surrounded by dogs	4 (4.0)	25 (25.0)	10 (10.0)	53 (53.0)	8 (8.0)
	I feel happy purchasing food for dogs	18 (18.0)	69 (69.0)	9 (9.0)	3 (3.0)	1 (1.0)
	Use of violence against dogs is acceptable	3 (3.0)	12 (12.0)	14 (14.0)	62 (62.0)	9 (9.0)
	Dogs are dangerous animals	7 (7.0)	56 (56.0)	16 (16.0)	17 (17.0)	4 (4.0)
	Dogs are nuisance	27 (27.0)	50 (50.0)	10 (10.0)	9 (9.0)	4 (4.0)
	Dogs need to scavenge for food among human garbage	2 (2.0)	10 (10.0)	5 (5.0)	74 (74.0)	9 (9.0)
Morogoro Municipality	I like dogs	35 (35.0)	61 (61.0)	1 (1.0)	3 (3.0)	0 (0.0)
	I feel sorry for stray dogs	21 (21.0)	62 (62.0)	3 (3.0)	14 (14.0)	0 (0.0)
	I feel safe when surrounded by dogs	7 (7.0)	26 (26.0)	1 (1.0)	66 (66.0)	0 (0.0)
	I feel happy purchasing food for dogs	22 (22.0)	66 (66.0)	6 (6.0)	6 (6.0)	0 (0.0)
	Use of violence against dogs is acceptable	1 (1.0)	13 (13.0)	5 (5.0)	77 (77.0)	4 (4.0)
	Dogs are dangerous animals	6 (6.0)	45 (45.0)	7 (7.0)	39 (39.0)	3 (3.0)
	Dogs are nuisance	2 (2.0)	29 (29.0)	11 (11.0)	56 (56.0)	2 (2.0)
	Dogs need to scavenge for food among human garbage	0 (0.0)	7 (7.0)	2 (2.0)	87 (87.0)	4 (4.0)

4.5 Respondents' Experience and Behaviour towards Dogs

The results on respondents' experience and behaviour towards dogs are presented in Table 5. It was established that majority of respondents reported to see free roaming dogs with poor body condition and witnessed inappropriate behavior against dogs such as beating and inhuman killing.

Table 5: Distribution of respondents on experience and behavioral questions based on study area (n=200)

Study Area	Variables	Number (%) of respondents responses				
	Statements asked	**Yes**	**Always**	**Sometimes**	**No**	**Not at all**
Mvomero district	Have you seen free roaming dogs in this village?	24(24.0)	64 (64.0)	8 (8.0)	4 (4)	0 (0.0)
	Do you avoid contact with dogs?	34 (34.0)	6 (6.0)	16 (16.0)	42 (42.0)	2 (2.0)
	Do you feel dogs are friendly in this area?	19 (19.0)	2 (2.0)	34 (34.0)	40 (40.0)	5 (5.0)
	Do dogs seem frightened and avoid human contact when approached?	12 (12.0)	3 (3.0)	44 (44.0)	36 (36.0)	5 (5.0)
	Do you feed the dogs?	21 (21.0)	76 (76.0)	3 (3.0)	0 (0.0)	0 (0.0)
	Do dogs scavenge food in this area?	40 (40.0)	21 (21.0)	24 (24.0)	14 (14.0)	1 (1.0)
	Do you feel threatened when a dog approaches you?	41 (41.0)	5 (5.0)	15 (15.0)	35 (35.0)	4 (4.0)
	Have you witnessed inappropriate behavior against dogs?	42 (42.0)	23 (23.0)	9 (9.0)	23 (23.0)	3 (3.0)
	In this area dogs look healthy	2 (2.0)	29 (29.0)	48 (48.0)	19 (19.0)	2 (2.0)
	In this area dogs are well fed	1(1.0)	30 (30.0)	49 (49.0)	19 (19.0)	1 (1.0)
	There are too many stray dogs in this street/village	27 (27.0)	50 (50.0)	10 (10.0)	9 (9.0)	4 (4.0)
Morogoro Municipality	Have you seen free roaming dogs in this village?	22 (22.0)	70 (70.0)	3 (3.0)	4 (4.0)	1 (1.0)
	Do you avoid contact with dogs?	48 (48.0)	17 (17.0)	8 (8.0)	26 (26.0)	1 (1.0)
	Do you feel dogs are friendly in this area?	30 (30.0)	3 (3.0)	18 (18.0)	49 (49.0)	0 (0.0)
	Do dogs seem frightened and avoid human contact when approached?	21 (21.0)	2 (2.0)	31 (31.0)	46 (46.0)	0 (0.0)
	Do you feed the dogs?	15 (16.0)	83 (83.0)	1 (1.0)	1 (1.0)	0 (0.0)
	Do dogs scavenge food in this area?	42 (42.0)	18 (18.0)	16 (16.0)	23 (23.0)	1 (1.0)
	Do you feel threatened when a dog approaches you?	35 (35.0)	28 (28.0)	14 (14.0)	23 (23.0)	0 (0.0)
	Have you witnessed inappropriate behavior against dogs?	30 (30.0)	31 (31.0)	12 (12.0)	27 (27.0)	0 (0.0)
	In this area dogs look healthy	3 (3.0)	38 (38.0)	24 (24.0)	32 (32.0)	3 (3.0)
	In this area dogs are well fed	4 (4.0)	37 (37.0)	24 (24.0)	33 (33.0)	2 (2.0)
	There are too many stray dogs in this street/village	3 (3.0)	45 (45.0)	15 (15.0)	35 (35.0)	2 (2.0)

4.6 General Knowledge, Attitude and Experiences of Respondents towards Dog Management in Mvomero District and Morogoro Municipality

The general knowledge, attitude, practices and experiences of respondents towards dog management in Mvomero District and Morogoro Municipality were assessed and the results are shown in Table 6. Majority (59%) of respondents were found to posses fair to good knowledge on management of dogs and 50.5% were observed to have positive attitude toward dogs. Also, 58% of respondents were found to manage dogs under bad practices and 78% of respondents were observed to have bad experiences on dog management (Table 6).

Table 6: General knowledge, attitude and practices of respondents towards dog management according to the study areas (n=200)

Parameter	**Category**	**Number (%) of respondents in the study districts**		
		Mvomero district (n=100)	**Morogoro Municipality (n=100)**	**Total (N=200)**
General knowledge	Poor Knowledge	61 (61.0)	29 (29.0)	90 (45.0)
	Fair Knowledge	13 (13.0)	6 (6.0)	19 (9.5)
	Good Knowledge	26 (26.0)	65 (65.0)	91 (45.5)
General attitude	Negative attitude	59 (59.0)	40 (40.0)	99 (49.5)
	Positive attitude	41 (41.0)	60 (60.0)	101 (50.5)
General practice	Good practice	24 (24.0)	60 (60.0)	84 (42.0)
	Bad practice	76 (76.0)	40 (40.0)	116 (58.0)
General experience	Bad experience	79 (79.0)	77 (77.0)	156 (78.0)
	Good experience	21 (21.0)	23 (23.0)	44 (22.0)

The results on comparison of respondents' general knowledge, attitudes, practices and experience based on study areas are presented in Table 7. Considering location as a factor of knowledge on dog management, data on general knowledge was compared and there was a significant difference (P= 0.001) between the two areas (Mvomero district as rural areas and Morogoro Municipality urban areas). Dog keepers of Morogoro Municipality had good knowledge of dog management than those of Mvomero district (Table 7).

General data on practices of dog keeping in Mvomero district and Morogoro Municipality were statistically compared. It was observed that, there was a significant difference (P=0.000) between practices of dog keeping in Mvomero district and Morogoro Municipality, whereby majority of respondents in Mvomero district reported bad practices compared to Morogoro Municipality (Table 7).

General data on attitude toward dogs from Mvomero district and Morogoro Municipality were statistically compared. It was found that, there was a significant difference (P=0.007) between attitude of respondents towards dogs in Mvomero and Morogoro Municipality, whereby majority of respondents in Mvomero district showed negative attitude toward dogs as compared to Morogoro Municipality (Table 7).

General information on experiences of respondents about dog management from the two study areas were also compared with no significant difference (P>0.05) between them regarding experience of respondents (Table 7). Majority of respondents reported to have seen free roaming dogs with poor body condition and witnessed inappropriate behavior against dogs such as beating and inhumane killing by community.

Table 7: Comparison of general knowledge, attitude and practices of respondents towards dog management according to the study areas (n=200)

Parameter	**Category**	**Number (%) of respondents in the study districts**			
		Mvomero district	**Morogoro Municipality**	**χ^2 test**	**P value**
General knowledge	Poor Knowledge	61 (61.0)	29 (29.0)	30.671	0.000*
	Fair Knowledge	13 (13.0)	6 (6.0)		
	Good Knowledge	26 (26.0)	65 (65.0)		
General attitude	Negative attitude	59 (59.0)	40 (40.0)	7.221	0.007*
	Positive attitude	41 (41.0)	60 (60.0)		
General practice	Good practice	24 (24.0)	60 (60.0)	26.076	0.000*
	Bad practice	76 (76.0)	40 (40.0)		
General experience	Bad experience	79 (79.0)	77 (77.0)	0.117	0.733
	Good experience	21 (21.0)	23 (23.0)		

* Statistically significant at P<0.05

The results further show that individuals with secondary and college education had good knowledge of dog management compared to other levels of education (Table 8).

Table 8: Relationship between general knowledge on dog management of respondents and their level of education (n=200)

		Number (%) of respondents on the level of knowledge on dog management					
Parameter	**Category**	**Poor**	**Fair**	**Good**	**Total**	**χ^2 test**	**P value**
Education level	Non formal	25 (12.5)	3 (1.5)	3 (1.5)	31 (15.5)	30.854	0.000*
	Primary	49 (24.5)	45 (22.5)	11 (5.5)	105 (52.5)		
	Secondary	12 (6.0)	29 (14.5)	4 (2.0)	45 (22.5)		
	College	4 (2.0)	14 (7.0)	1 (0.5)	19 (9.5)		

* Statistically significant at P<0.05

4.7 Results on Dog Biodata, Clinical Characteristics and Parasitic Infestations

4.7.1 Dog biodata and clinical characteristics

The study dog biodata and clinical examination findings are detailed in Table 9. Records on biodata and clinical examination were done to 400 dogs, 200 from each of the study area namely Mvomero district and Morogoro Municipality. The results indicated that most of the dogs were male with the age range between three months and one year. Local breed dogs (mongrels) constituted the majority of which were kept under confinement system nevertheless most of them (64.3%) had good body condition. Most dog keepers reported to dip their dogs in acaricides/use of ectoparasite control and was established that 30.3% has some pathological skin conditions mostly being dermatitis.

Table 9: Biodata and clinical characteristics of sampled dogs (n=400)

Parameter	**Category**	**Number (%) of dogs examined in the two districts**		**Total (%) of dogs examined**
		Mvomero district (n=200)	**Morogoro Municipality (n=200)**	
Sex	Male	106 (53.0)	108 (54.0)	214 (53.5))
	Female	94 (47.0)	92 (46.0)	186 (46.5)
Age (years)	Young (< 1)	139 (69.5)	120 (60.0)	259 (64.8)
	Adult (> 1)	61 (30.5)	80 (36.0)	141 (35.2)
Breed	Mogrels	198 (99.0)	174 (87.0)	372 (93.0)
	Crosses	2 (1.0)	26 (13.0)	28 (7.0)
Body condition	Good	118 (59.0)	139 (69.5)	257 (64.3)
	Poor	82 (41.0)	61 (32.0)	143 (35.7)
Management system	Free range	122 (61.0)	46 (23.0)	168 (42.0)
	Confined	58 (29.0)	154 (77.0)	212 (58.0)
History of dipping in acaricides/use of ectoparasite control	Yes	86 (43.0)	140 (70.0)	226 (56.5)
	No	114 (57.0)	60 (30.0)	174 (43.5)
Temperature	Normal (37.5°C)	193 (96.5)	193 (95.5)	386 (96.5)
	Below normal	0 (0.0)	4 (2.0)	4 (1.0)
	Above normal	7 (3.5)	3 (1.5)	10 (2.5)
Presence of pathological lesions on the skin	Yes	67 (33.5)	54 (27.0)	121 (30.3)
	No	133 (66.5)	146 (73.0)	279 (69.7)
Type of pathological lesion on the skin	Alopecia	24 (12.0)	11 (5.5)	35 (8.8)
	Dermatitis	37 (18.5)	41(20.5)	78 (19.5)
	Pruritis	10 (5.0)	6 (3.0)	16 (4.0)

4.7.2 Results on ectoprasites of dogs

4.7.2.1 Types of ectoparasites encountered and region of attachment on the dog skin

Table 10 summarizes the results of ectorapasites of dogs encountered in Mvomero district and Morogoro Municipality. A total of 400 dogs were examined for ectoparasites and sampled. The samples for ectoparasite collected were 250 ticks, 278 fleas, 11 lice and 20 skin scrapings for mites. The results on ectoparasites indicated that 83.8% of the examined dogs were infested with four different types of ectoparasites namely ticks (62.5%), fleas (64.5%), mites (3%) and lice (2.5%). Figure 4 A&B shows fleas and tick infestation in dogs. Ticks showed preference of head and neck region and fleas were frequently encountered on abdomen compared to other parts of the body (Table 10).

Figure 4: Photograph A shows a dog which had heavy flea infestation to the extent that it had developed alopecia. Photograph B shows the dog which had ticks in the ear pinnae

Table 10: Ectoparasites collected and the regions of collection on dogs according to study areas

Region of the body	Number (%) of ectoparasites in Mvomero district				Number (%) of ectoparasites in Morogoro Municipality			
	Ticks	**Fleas**	**Mites**	**Lice**	**Ticks**	**Fleas**	**Mites**	**Lice**
Head & Neck	98 (67.6)	5 (3.7)	0 (0.0)	0 (0.0)	85 (81.0)	0 (0.0)	0 (0.0)	0 (0.0)
Abdomen	19 (13.1)	106 (77.4)	2 (22.2)	8 (100.0)	3 (2.9)	113 (80.1)	0 (0.0)	2 (66.7)
Back	12 (8.3)	26 (19.0)	7 (77.8)	0 (0.0)	11 (10.5)	28 (19.9)	11 (10.5)	1 (33.3)
Legs	7 (4.8)	0 (0.0)	0 (0.0)	0 (0.0)	5 (4.8)	0 (0.0)	0 (0.0)	0 (0.0)
Around genital area	9 (6.2)	0 (0.0)	0 (0.0)	0 (0.0)	1 (1.0)	0 (0.0)	0 (0.0)	0 (0.0)
Total	**145 (100.0)**	**137 (100.0)**	**9 (100.0)**	**8 (100.0)**	**105 (100.0)**	**141 (100.0)**	**11 (100.0)**	**3 (100.0)**

4.7.2.2 Prevalence of ectoparasites

The prevalence of ectoparasites in dogs was 83.8%. The ectoparasites recovery in dogs between the two districts were compared and was found that dogs from Mvomero district were significantly ($P<0.05$) affected by ectoparasites compared to dogs of Morogoro Municipality (Table 11). Two ectoparasites infestation per host was more common in

Mvomero district and Morogoro Municipality than other types of infestations. Five species of ectoparasites were identified, namely *Rhipicephalus sanguineus* (Brown dog tick), *Ctenocephalides canis* (dog flea), *Ctenocephalides felis* (cat flea), *Sarcoptes scarbiae* (mange mites) and *Trichodectes canis* (biting louse) in both study areas, while *Pulex irritans* was found on dogs of Mvomero district only (Table 11). Dogs of Mvomero district were more affected by ticks (74.5%) in particular *Rhipicephalus sanguineus* compared to those of Morogoro Municipality (50.5%) and the difference was statistically significant (p=0.000*).

Table 11: Number of ectoparasite species per host and prevalence of parasites in Mvomero district and Morogoro Municipality (n= 400)

		Number (%) of dogs infested		**χ^2 test**	**P value**
Parameter	**Category**	**Mvomero district (n=200)**	**Morogoro Municipality (n=200)**		
Ectoparasites infestation status	No parasite	24 (12.0)	41 (20.5)	10.906	0.012*
	Single parasite species	73 (36.5)	76 (38.0)		
	Two parasites species	95 (47.5)	82 (41.0)		
	Three parasites species	8 (4.0)	1 (0.5)		
General ectoparasites infestation rates	Ticks	149 (74.5)	101 (50.5)	24.576	0.000*
	Fleas	123 (61.5)	135 (67.5)	1.572	0.210
	Mites	7 (3.5)	5 (2.5)	0.344	0.558
	Lice	8 (4.0)	2 (1.0)	3.692	0.055
	Ectoparasites prevalence	176 (88.0)	159 (79.5)	5.309	0.021*
Ectoparasites infestation according to species	*Rhipicephalus sanguineus*	149 (74.5)	101 (50.5)	24.576	0.000*
	Ctenocephalides canis	95 (47.5)	115 (57.5)	4.010	0.045
	Ctenocephalides felis	30 (15.0)	27 (13.5)	0.184	0.668
	Pulex irritans	3 (1.5)	0 (0.0)	3.023	0.082
	Sarcoptes scabiae	7 (3.5)	5 (2.5)	0.344	0.558

* Statistically significant at $P<0.05$

4.7.2.3 Magnitude of ectoparasite infestations in dogs based on risk factors

A number of risk factors for ectoparasite infestation in dogs were considered as shown in Table 12. The results indicated that dogs of Mvomero district (88.0%) were significantly (P<0.05) infested by ectoparasites than those of Morogoro Municipality (79.5%). Also, dogs with poor body condition (76.5%), managed under free range system (90%) and all dogs that had skin lesions were found to be significantly affected (P<0.05) by ectoparasites than their counterparts (Table 12).

Table 12: Prevalence of ectoparasites infestations based on animal and management risk factors (n= 400)

Risk factor	Category	Number (%) of dogs with ectoparasites	Number (%) of dogs without ectoparasites	χ^2 test	P value
Sex	Male	174 (81.3)	40 (18.7)	2.016	0.156
	Female	161 (86.7)	25 (13.4)		
Age	Young (< 1)	217 (82.8)	45 (17.2)	0.478	0.489
	Adult (> 1)	118 (85.5)	20 (14.5)		
Breed	Mongrels	312 (83.4)	62 (16.6)	0.454	0.501
	Crosses	23 (88.5)	3 (11.5)		
Location of origin	Mvomero district	176 (88.0)	24 (12.0)	5.309	0.021*
	Morogoro Municipality	159 (79.5)	41(20.5)		
Body condition	Good	195 (76.5)	60 (23.5)	27.390	0.000*
	Poor	140 (96.6)	5 (3.5)		
Management system	Free range	208 (90.0)	23 (10.0)	12.388	0.000*
	Confined	127 (75.1)	42 (24.9)		
History of dipping in acaricides/ use of ectoparasite control	Yes	87 (79.1)	23 (20.9)	2.420	0.120
	No	248 (85.5)	42 (14.5)		
Access to veterinary services	Yes	222 (83.8)	43 (16.2)	0.000	0.986
	No	113 (83.7)	22 (16.3)		
Skin lesions	Yes	140 (100.0)	0 (0.0)	41.791	0.000*
	No	195 (75.0)	65 (25.0)		

* Statistically significant at P<0.05

4.7.2.4 Ectoparasite species infestations in dogs based on age, sex and body conditions

Table 13 summarizes the magnitude of ectoparasites species infestation according age, sex and body conditions of the dog. *Rhipicephalus sanguineus* and *Ctenocephalides canis* infestations were very high in dogs with poor body condition in Mvomero district and Morogoro Municipality. Mites and lice infestations were encountered at relatively low levels especially in dogs kept in Morogoro Municipality.

Table 13: Ectoparasites infestation in dogs based on risk factors such as age, sex and body condition in Morogoro Municipality and Mvomero district (n=400)

Study area	Ectoparasites identified	Species identified	Dogs factors considered					
			Age		Sex		Body condition score	
			Young (n=122)	Adult (n=78)	Male (n=108)	Female (n=92)	Good (n=137)	Poor (n=63)
Morogoro Municipality	Ticks	*Rhipicephalus sanguineus*	57 (46.7)	44 (56.4)	56 (51.9)	45 (48.9)	60 (43.8)	41 (65.1)
	Fleas	*Ctenocephalides canis*	72 (59.0)	43 (55.1)	58 (53.7)	57 (62.0)	68 (49.6)	47 (74.6)
		Ctenocephalides felis	13 (10.7)	14 (17.9)	11 (10.2)	16 (17.4)	18 (13.1)	9 (14.3)
	Mite	*Sarcoptes scabiae*	2 (1.6)	3 (3.8)	4 (3.7)	1 (1.1)	2 (1.5)	3 (4.8)
	Lice	*Trichodectes canis*	1 (0.8)	1 (1.3)	2 (1.90	0 (0.0)	2 (1.5)	0 (0.0)
Mvomero district	Ticks	*Rhipicephalus sanguineus*	106 (76.26)	44 (72.13)	80 (75.47)	70 (74.47)	82 (68.91)	68 (83.95)
	Fleas	*Ctenocephalides canis*	65 (46.76)	21 (34.43)	49 (46.23)	37 (39.36)	54 (45.38)	32 (39.51)
		Ctenocephalides felis	20 (14.39)	12 (19.67)	16 (15.09)	16 (17.02)	17(14.29)	15 (18.52)
		Pulex irritans	0 (0.00)	3 (3.8)	2 (1.90)	1 (1.1)	0 (0.0)	3 (4.8)
	Mite	*Sarcoptes scabiae*	5 (3.60)	2 (3.28)	4 (3.77)	3 (3.19)	3 (2.52)	4 (4.94)
	Lice	*Trichodectes canis*	7 (5.04)	1 (1.64)	3 (2.83)	5 (5.32)	1 (0.84)	7 (8.64)

4.7.3 Results on the magnitude and types of gastrointestinal parasites of dogs

The results on the magnitude and types of gastrointestinal parasites of dogs are presented in Table 14. A total of 400 fecal samples from 400 dogs were collected for gastrointestinal parasites examination. It was established that out of 400 dogs examined, 76.8% were infested with different species of gastrointestinal parasites. Seven helminth genera namely *Ancylostoma, Uncinaria, Toxocara, Toxascaris, Ascaris, Taenia* and *Dipylidium* were identified in the faecal samples of examined dogs as shown in Table 14. In addition four genera of protozoan parasites (*Cryptosporidium, Isospora, Cyclospora* and *Entamoeba*) were identified (Table14). Figure 6 shows some of intestinal parasites eggs/oocysts that were identified in faecal samples of the dogs. Comparisons of proportions on gastrointestinal infestation status of dogs of Mvomero district and Morogoro Municipality based on “no parasite genera” identified, “single parasite genus” identified to “five parasite genera” identified established that the differences was statistically significant (P=0.000). The other comparisons of proportions in dog gastrointestinal infestation status for Mvomero district and Morogoro Municipality that the differences were found to be significant (P<0.05) were types of gastrointestinal parasites, infestations by *Ancylostoma caninum* and *Isospora* spp (Table 14).

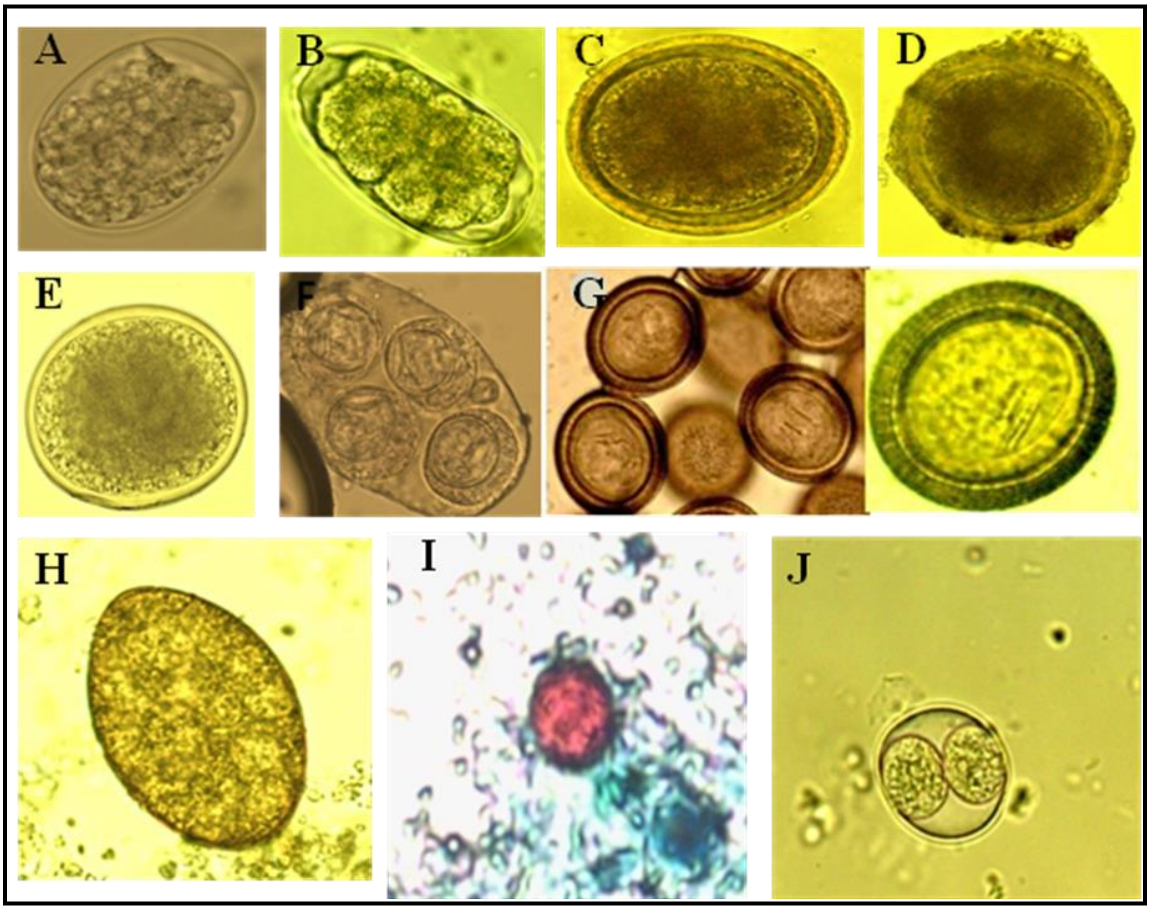

Figure 5: Some of intestinal parasites eggs/oocysts identified in fecal samples of the dogs. Note that A= *Anylostoma caninum* egg., B = *Uncinaria stenocephala* egg., C= *Toxocara canis* egg., D= *Ascaris lumbricoides* egg., E=*Toxascaris leonina* egg., F= *Dipylidium caninum* packet of eggs., G= *Taeniidae* spp eggs., H= *Diphyllobothrium latum* egg., I= *Cryptosporidium* cyst and J= *Isospora* cyst.

Table 14: Gastrointestinal parasites prevalence in dogs of Mvomero district and Morogoro Municipality (n= 200)

Parameter	**Category**	**Number (%) of dogs infested**		**χ^2 test**	**P value**
		Mvomero district	**Morogoro municipality**		
Gastrointestinal infestation status	No parasite genera	27 (13.5)	66 (33.0)	33.348	0.000
	Single parasite genus	58 (29.0)	68 (34.0)		
	Two parasites genera	80 (40.0)	40 (20.0)		
	Three parasites genera	30 (15.0)	24 (12.0)		
	Four parasites genera	3 (1.5)	2 (1.0)		
	Five parasites genera	2 (1.0)	0 (0.0)		
Types of gastrointestinal parasites	Helminthes	159 (79.5)	120 (60.0)	18.022	0.000
	Protozoa	55 (27.5)	35 (17.5)	5.735	0.017
Gastrointestinal spp prevalence	*Ancylostoma caninum*	142 (71.0)	100 (50.0)	18.454	0.000
	Uncinaria stenocephala	46 (23.0)	42 (21.0)	0.233	0.629
	Toxocara canis	29 (14.5)	17 (8.5)	3.537	0.060
	Toxascaris leonina	15 (7.5)	10 (5.0)	1.067	0.302
	Ascaris lumbricodes	6 (3.0)	9 (4.5)	0.623	0.430
	Dipylidium caninum	6 (3.0)	1 (0.5)	3.635	0.057
	Taenia spp	14 (7.0)	10 (5.0)	0.709	0.400
	Diphylobothrium latum	3 (1.5)	0 (0.0)	3.023	0.082
	Troglotrema salmincola	1 (0.5)	0 (0.0)	1.003	0.317
	Cryptosporidium spp	36 (18.0)	26 (13.0)	1.909	0.167
	Cyclospora spp	11 (5.5)	6 (3.0)	1.536	0.215
	Isospora spp	25 (12.5)	7 (3.5)	11.005	0.001
	Entamoeba spp	9 (4.5)	3 (1.5)	3.093	0.079

4.7.3.1 Results on the gastrointestinal parasites and risk factors for infestations in dogs

Table 15 summarizes the proportions of gastrointestinal parasite and the risk factors for infestations in dogs. Ten risk factors for gastrointestinal parasite infestations in dogs were assessed and the results indicated that age, body condition, location of origin, management system and housing system, lack of routine deworming and feeding system were found to be statistically significant (P<0.05) factors for gastrointestinal parasites infestations in dogs (Table 15).

Table 15: Magnitude of intestinal parasites and risk factors for infestations in dogs (n= 400).

Risk factor	Category	Number (%) of dogs with GIT parasites	Number (%) of dogs without GIT parasites	χ^2 test	P value
Sex	Male	165 (77.1)	49 (22.9)	1.641	0.200
	Female	133 (71.5)	53 (28.5)		
Age	Young (< 1)	206 (78.6)	56 (21.4)	6.805	0.009
	Adult (> 1)	92 (67.7)	46 (33.3)		
Breed	Mongrels	282 (75.4)	92 (24.6)	2.459	0.117
	Crosses	16 (61.5)	10 (38.5)		
Location of origin	Mvomero district	173 (86.5)	27 (13.5)	21.055	0.000
	Morogoro Municipality	134 (67.0)	66 (33.0)		
Body condition	Good	178 (69.8)	77 (30.2)	8.166	0.004
	Poor	120 (82.8)	25 (17.2)		
Management system	Free range	184 (79.7)	47 (20.3)	7.644	0.006
	Confined	114 (67.5)	55 (32.5)		
History of deworming	Yes	44 (44.9)	54 (55.1)	59.872	0.000
	No	254 (84.1)	48 (15.9)		
Access to veterinary services	Yes	202 (76.2)	63 (23.8)	1.232	0.267
	No	39 (28.9)	96 (71.1)		
Dog feeding	Yes	288 (74.0)	101 (26.0)	1.603	0.205
	No	10 (90.0)	1 (9.0)		
Feeding system	In a container	123 (63.7)	70 (36.3)	22.769	0.000
	Throw on ground	175 (84.5)	32 (15.5)		

4.7.3.2 Results on different species of helminthes and protozoan parasites in dogs based on age, sex and body conditions

The different species of helminths and protozoan parasites against age, sex and body condition of dogs in Mvomero district and Morogoro Municipality are shown in Table 16a & b. Parasites such as *Toxocara canis*, *Cryptosporidium* and *Isospora* were more frequent encountered in young than in adult dogs in Mvomero district and Morogoro Municipality.

Table 16a: Gastrointestinal parasites infestation in dogs based on age, sex and body condition in Mvomero District (n=200)

Group of GIT parasite	Species identified	Number (%) of dogs with different species of helminthes and protozoan gastrointestinal parasites					
		Age		Sex		Body condition score	
		Young (n=139)	Adult (n=61)	Male (n=106)	Female (n=94)	Good (n=119)	Poor (n=81)
Helminthes	*Ancylostoma caninum*	81 (58.2)	37 (60.7)	70 (66.1)	48 (51.1)	68 (57.1)	50 (61.7)
	Uncinaria stenocephala	22 (15.8)	14 (23.0)	20 (18.9)	16 (17.0)	20 (16.8)	16 (19.8)
	Toxocara canis	26 (18.7)	1(1.6)	11(10.4)	16(17.6)	17 (14.3)	10 (12.4)
	Toxascaris leonina	8 (5.8)	7 (11.5)	8 (7.6)	7 (7.5)	7 (5.9)	8 (9.9)
	Ascaris lumbricodes	5 (3.6)	0 (0.0)	4 (3.8)	1 (1.1)	5 (4.2)	0 (0.0)
	Dipylidium caninum	4 (2.9)	2 (3.3)	4 (3.8)	2 (2.2)	2 (1.7)	4 (4.9)
	Taeniidae spp	12 (8.6)	2 (3.2)	9 (8.5)	6 (6.4)	7 (5.9)	7 (8.6)
	Diphylobothrium latum	0 (0.0)	2 (3.2)	2 (1.9)	0 (0.0)	0 (0.0)	2 (2.5)
	Troglotrema salmincola	1 (0.7)	0 (0.0)	0 (0.0)	1(1.1)	0 (0.0)	1 (1.2)
Protozoa	*Cryptosporidium* spp	30 (21.5)	6 (9.84)	19(17.9)	17(18.1)	22 (18.5)	14 (17.3)
	Cyclospora spp	11 (7.9)	1 (1.6)	5 (4.7)	7 (7.5)	8 (6.7)	4(4.9)
	Isospora spp	22 (15.8)	3 (4.9)	12 (11.3)	13 (13.8)	15 (12.6)	10 (12.4)
	Entamoeba spp	8 (5.8)	1 (1.6)	4 (3.8)	5 (5.3)	5 (4.2)	4 (4.9)

Table 16b: Gastrointestinal parasites infestation in dogs based on age, sex and body condition in Morogoro Municipality (n=200)

Group of GIT parasite	Species identified	Number (%) of dogs with different species of helminthes and protozoan gastrointestinal parasites					
		Age		Sex		Body condition score	
		Young (n=122)	Adult (n=78)	Male (n=108)	Female (n=92)	Good (n=137)	Poor (n=63)
Helminthes	*Ancylostoma caninum*	65 (53.3)	35 (44.9)	62 (57.4)	38 (41.3)	66 (48.2)	34 (54.0)
	Uncinaria stenocephala	33 (27.0)	9 (11.5)	26 (24.1)	16 (17.4)	30 (21.9)	12 (19.0)
	Toxocara canis	11 (9.0)	6 (7.7)	7 (6.5)	10 (10.9)	9 (6.6)	8 (12.7)
	Toxascaris leonina	10 (8.2)	7 (11.7)	4 (3.7)	6 (6.5)	8 (5.8)	2 (3.2)
	Ascaris lumbricodes	6 (4.9)	3 (3.8)	7 (6.5)	2 (2.2)	4 (2.9)	5 (7.9)
	Dipylidium caninum	0 (0.0)	1 (1.3)	1 (0.9)	0 (0.0)	0 (0.0)	1(1.6)
	Taeniidae spp	5 (4.1)	5 (6.41)	5 (4.63)	5 (5.43)	4 (2.92)	6 (9.52)
Protozoa	*Cryptosporidium* spp.	25 (20.5)	1 (1.3)	15 (13.9)	11(12.0)	19 (13.9)	7(11.1)
	Cyclospora spp	2 (1.6)	4 (5.1)	3 (2.8)	3 (3.3)	4 (2.9)	2 (3.2)
	Isospora spp	5 (4.1)	2 (2.6)	3 (2.8)	4 (4.3)	7 (5.1)	0 (0.0)
	Entamoeba spp	1 (0.8)	2 (2.6)	3 (2.8)	0 (0.0)	2 (1.5)	1 (1.6)

4.7.3.3 Results on mixed infection of gastrointestinal parasites in dogs based on age, sex and body conditions

Table 17 shows the result of dog gastrointestinal parasites mixed infestations based on age, sex and body condition. It was established that the commonly encountered mixed infestation was *Ancylostomum caninum* and *Uncinaria stenocephala*. High prevalence of mixed infestation was found in adult dogs compared to young ones.

Table 17: Prevalence of mixed infestation of gastrointestinal parasites according to age, sex and body condition of dogs of Mvomero district (n=400)

Study area	**Species identified**	**Number (%) of dogs with mixed species of gastrointestinal parasites**					
		Age		**Sex**		**Body condition score**	
		Young (n=139)	**Adult (n=61)**	**Male (n=106)**	**Female(n=94)**	**Good (n=119)**	**Poor (n=81)**
Mvomero District	*Ancylostoma caninum & Uncinaria stenocephala*	5 (3.6)	21 (34.4)	19 (17.9)	7 (7.5)	15 (12.6)	10 (12.4)
	Ancylostoma caninum & Cryptosporidium spp	14 (10.1)	3 (4.9)	10 (9.4)	7 (7.5)	8 (6.7)	9 (11.1)
	Ancylostoma caninum & Toxocara canis	13 (9.4)	4 (6.6)	9 (8.5)	8 (8.5)	5 (4.2)	11 (9.2)
	Ancylostoma caninum & Uncinaria stenocephala & Cryptosporidium spp	3 (2.2)	1 (1.6)	2 (1.9)	2 (2.1)	3 (2.5)	1 (1.2)
	Ancylostoma caninum & Uncinaria stenocephala & Taeniidae spp	4 (2.9)	2 (3.3)	2 (1.9)	4 (4.3)	1 (0.8)	5 (6.2)
	Ancylostoma caninum & Isospora spp	3 (2.2)	1 (1.6)	2 (1.9)	2 (2.1)	1 (0.8)	3 (3.7)
	Acylostoma caninum & Toxascaris leonine & Cryptosporidium spp	4 (2.9)	1 (1.6)	1 (0.9)	4 (4.3)	4 (3.4)	1 (1.2)
	Ancylostoma caninum & Toxocara canis& Taeniidae spp	2 (1.4)	1 (1.6)	2 (1.9)	1 (1.1)	0 (0.0)	3 (3.7)
	Ancylostoma caninum & Dipylidium caninum	0 (0.0)	2 (3.3)	2 (1.9)	0 (0.0)	0 (0.0)	2 (1.7)
	Ancylostoma caninum & Ascaris lumbricoides	3 (2.2)	1 (1.6)	2 (1.9)	2 (2.1)	3 (1.5)	1 (1.2)
	Toxocara canis & Ancylostoma caninum & Uncinaria stenocephala	3 (2.2)	1 (1.6)	1 (0.9)	3 (3.2)	1 (0.5)	3 (3.7)
Morogoro Municipality	*Ancylostoma caninum & Uncinaria stenocephala*	12 (9.8)	8 (10.3)	14 (13.0)	6 (6. 5)	13 (9.5)	7 (11.1)
	Ancylostoma caninum & Cryptosporidium spp	5 (4.1)	0 (0.0)	3 (2.8)	2 (2.2)	4 (2.9)	1 (1.6)
	Ancylostoma caninum & Toxocara canis	6 (4.9)	1 (1.3)	3 (2.8)	4 (4.4)	3 (2.2)	4 (6.4)
	Ancylostoma caninum & Uncinaria stenocephala & Cryptosporidium spp	6 (4.9)	4 (5.1)	5 (4.6)	5 (5.5)	7 (5.1)	3 (6.4)
	Ancylostoma caninum & Uncinaria stenocephala & Taeniidae spp	5 (4.1)	2 (2.6)	1 (0.9)	4 (4.4)	2 (1.5)	3 (6.4)
	Ancylostoma caninum & Entamoeba spp	0 (0.0)	2 (2.6)	2 (1.9)	0 (0.0)	0 (0.0)	2 (3.2)
	Ancylostoma caninum & Ascaris lumbricoides	3 (2.5)	0 (0.0)	3 (2.8)	0 (0.0)	0 (0.0)	3 (6.4)
	Toxocara canis & Ancylostoma caninum & Uncinaria stenocephala	5 (4.1)	2 (2.6)	6 (5.6)	1 (1.1)	3 (2.2)	4 (6.4)
	Ancylostoma caninum & Uncinaria stenocephala	12 (9.8)	8 (10.6)	14 (13.0)	6 (6. 5)	13 (9.5)	7 (11.1)
	Toxocara canis & Ancylostoma caninum & Uncinaria stenocephala	5 (4.1)	0 (0.0)	3 (2.8)	2 (2.2)	4 (2.9)	1 (1.6)

4.4.4 Statistical relationship between prevalence of parasites and risk factors

In this study it was found that there was a statistical significance between the prevalence of some parasites and some risk factors.Young dogs were found to be more affected by *Toxocara canis*, *Cryptosporidium* and *Isospora* compared to adults and the differences in infection rates were statistically significant (P<0.05). Poor body conditions in dogs was the predictor (P<0.05) for parasitic infestations. Moreover, it was found that dogs from Mvomero district were significantly (p<0.05) infested with different parasites compared to those screened in Morogoro Municipality (Table 18).

Table 18: Proportional comparisons of parasitic infestations in dogs based on selected risk factors (n=400).

Type of GIT parasite	Species of parasite	P values of proportional comparisons of parasites infections in dogs				
		Breeds	**Body condition**	**Age**	**Sex**	**Location (Mvomero district & Morogoro Municipality)**
Helminths	*Ancylostoma caninum*	0.125	0.070	0.506	0.022	0.016
	Uncinaria stenocephala	0.584	0.443	0.157	0.761	0.450
	Toxocara canis	0.293	0.293	0.001	0.332	0.111
	Toxascaris leonina	0.601	1.000	0.464	0.114	0.302
	Ascaris lumbricodes	0.021	0.094	0.663	0.291	0.277
	Dipylidium caninum	0.482	0.703	0.995	0.812	0.057
	Taeniidae spp	0.632	0.148	0.901	0.946	0.400
Protozoa	*Cryptosporidium* spp	0.543	0.846	0.000	0.013	0.217
	Isospora spp	0.420	0.570	0.018	0.847	0.001
	Cyclospora spp	0.253	0.794	0.637	0.869	0.148
	Entamoeba spp	0.794	0.102	0.917	0.981	0.079
Ectoparasites	Mites	0.724	0.026	0.053	0.914	0.558
	Lice	0.398	0.114	0.094	0.822	0.055
	Ticks	0.009	0.000	0.284	0.525	0.000
	Fleas	0.025	0.000	0.231	0.544	0.125
Intestinal parasites	Protozoa	0.289	0.777	0.000	0.035	0.023
	Helminths	0.346	0.022	0.041	0.114	0.000
Ticks	Degree of ticks infestation	0.018	0.000	0.463	0.693	0.000

4.5 Egg Per Gram (EPG) Count of Helminths in Faecal Sample of Dogs

Table 19 shows the results for EPG that involved 67 samples (34 samples from Mvomero district and 33 samples from Morogoro Municipality). The overall mean EPG was 887 ±

516 with the helminth egg count ranging between 100 and 2000. All the 67 faecal samples examined for EPG showed significantly high levels of helminths eggs which is an indication of heavy infestation. Helminths species wise EPG showed the highest counts were observed in *Ancylostoma caninum* for the samples collected in dogs of Mvomero distinct. However, there was no significant different (P>0.05) between the EPG count for dogs of Mvomero district and Morogoro Municipality (Table19).

Table 19: Species of helminths and the mean count of eggs (EPG) in infested dogs of Mvomero district and Morogoro Municipality (n=67)

Helminths species	Mvomero District n=34				Morogoro Municipality n= 33				
	No. positive samples assessed	**Mean EPG**	**Min.**	**Max.**	**No. positive samples assessed**	**Mean EPG**	**Min**	**Max**	**P value**
Ancylostoma caninum	20	950.0 ± 525.66	100	2000	26	665.4 ± 445.37	100	1600	0.0703
Uncinaria stenocephala	9	277.8 ± 148.14	100	500	4	200.0 ± 81.65	100	300	0.4220
Toxocara canis	3	133.3 ± 57.74	100	200	1	300.0 ± NA	300	300	0.1573
Toxascaris leonina	2	100.0 ± 0.00	100	100	2	100.0 ± 70.71	100	200	0.3173

NA=Not Applicable

Table 20 summarizes the intensity of EPG count of helminths, whereby high burden was observed in *Ancylostoma caninum* infestations.

Table 20: Egg burden (%) in dog faecal samples based on eggs per gram of faeces count (n=67)

Helminths species	Low %	Moderate %	High %
Ancylostoma caninum	4 (6.0)	9 (13.4)	33 (49.3)
Uncinaria stenocephala	3 (4.5)	8 (11.9)	1 (1.5)
Toxocara canis	2 (3.0)	2 (3.0)	0 (0.0)
Toxascaris leonina	3 (4.5)	1 (1.5)	0 (0.0)
Total burden	12 (18.0)	20 (29.9)	34 (50.8)

Low: 50-100 EPG, moderate: 100> -500 EPG, high: >500

4.6 Magnitude of Zoonotic Gastrointestinal Parasites

In this study eleven genera of zoonotic gastrointestinal parasites were identified in fecal samples of dogs included helminths and protozoan parasites. *Ancylostoma*, *Uncinaria* and *Toxocara* were the frequently encountered helmiths, while *Cryptosporidium* was the commonly found protozoan parasites. The overall prevalence of zoonotic intestinal parasites was found to be much higher in dogs of Mvomero district than those of Morogoro Municipality as indicated in Table 21.

Table 21: Prevalence of zoonotic intestinal parasites identified during analysis of fecal samples

Type of parasites	**Species of zoonotic parasites**	**Mvomero district n=200**	**Morogoro Municipality n=200**
		Prevalence	**Prevalence**
Helminthes	*Ancylostoma caninum*	142 (71.0)	100 (50.0)
	Uncinaria stenocephala	46 (23.0)	42 (21.0)
	Toxocara canis	29 (14.5)	17 (8.5)
	Ascaris lumbricodes	6 (3.0)	9 (4.5)
	Dipylidium caninum	6 (3.0)	1 (0.5)
	Taeniidae spp	14 (7.0)	10 (5.0)
	Diphyllobothrium latum	3 (1.5)	0 (0.0)
	Troglotrema salmincola	1 (0.5)	0 (0.0)
Protozoa	*Cryptosporidium* spp	36 (18.0)	26 (13.0)
	Cyclospora spp	11 (5.5)	6 (3.0)
	Entamoeba spp	9 (4.5)	3 (1.5)
	Overall prevalence of zoonotic parasites	169 (84.5)	126 (63.0)

CHAPTER FIVE

5.0 DISCUSSION

This study was conducted to assess the knowledge, attitude and practices of dog keepers on dogs' management and established the epidemiology of parasitic infestations in dogs of Mvomero district and Morogoro Municipalty. Results indicated that majority (59%) of dog keepers had fair to good knowledge on management of dogs, whereby 50.5% showed positive attitude towards dogs. Most of the dogs were managed under poor conditions and majority of respondents (78%) had bad experiences with dogs. The results of this study indicated that majority of the study dogs (83.8%) were infested with ectoparasites namely ticks, fleas, mites and lice. It was further established that gastrointestinal parasites in particular helminths and protozoan parasites had affected most dogs and some of these were zoonotic parasites. The involved risk factors for gastrointestinal parasite infestations were age, body condition, location of origin, management system and housing system, lack of routine deworming and feeding system. This kinds of results, calls for integrative approaches on creating public awareness on dog management practices in Mvomero district and Morogoro Municipality and other areas in Tanzania in order to safeguard the health of dogs and the humans. Otherwise, dogs will continue to be mismanaged, disvalued, disregarded and suffer from different kinds of diseases which some of them can be shared to people.

This study established that majority of the dog keepers were male with primary education and had an experience of keeping dogs for more than three years while the average number of dogs kept ranged between one and three which mostly were local breeds (mongrels). Although most dog keepers reported to confine or tether their dogs the dog houses were poorly designed that caused a lot of suffering to dogs which is violation of animal welfare. However, dogs of Mvomero district were managed under free range system compared to those of Morogoro Municipality (P=0.000). The reasons are poor knowledge of dog husbandry and poverty of most dog keepers in Mvomero district (Table 1). Nevertheless, most of dog keepers in Mvomero district are pastoralists, who keep large number of dogs to assist in herding and guarding of livestock and this may be the reason for high number of dogs managed under free range system (Table 2). Different from Morogoro Municipality, dogs were kept for the security purpose and in small proportion for companion (Table 2) of which majority were under confinement. Similar observations have been reported in different studies in Tanzania and Ethiopia (Ernest *et al*., 2009; Kiflu *et al*., 2016).

It was also established that boys age from 10 to 15 years were the members of family who involved most in caring dogs in terms of feeding, cleaning of their houses or chaining and providing any other required services to dogs (Table 2). Leaving all the dog care to children may predispose them to a risk of contrasting zoonotic diseases of dogs including parasitic infections. The reason why sons are mostly responsible in caring dogs is still unknown; maybe it is a tradition of most African communities. Hands hygiene plays a crucial role in preventing the risk of acquiring infections. This study revealed that majority of the respondents reported to wash their hands after handling dogs although they used only water which may not be sufficient in prevention of diseases. The reasons for this are majority (59%) of respondents were found to posses fair to good knowledge on management of dogs and 86.5% were aware of dog zoonoses (Table 3). The results of the current study are consistent with the observation by Kiflu *et al*. (2016) in Ethiopia, who reported that most dog keepers do wash their hands after being in contact with dogs. On the other hand it is in disagreement with other studies carried out in other places (Westgath *et al*., 2008, Overgaauw *et al*., 2009, Gebremichael *et al*., 2013), which reported that majority of dog owners do not wash hands after having direct contact with dogs. The proportion of hands washing documented in this study is still unsatisfactory; therefore sanitary education to dog keepers is necessary for safeguarding public health.

Furthermore, it was found that cleaning, disnfecting of dog house and associated pieces of equipment were uncommon practice among visited dog keepers (Table 3 and 12), which may contribute to the presence of parasites in the environment and increased risk of infestation to dogs and humans. Reasons for not using disinfectants may be related with negligence, negative attitude towards dogs and illiteracy among the dog keepers in the areas of the study. This finding is in agreement with other studies carried out elsewhere which reported poor hygienic practices in some households that keep dogs (Gebremichael *et al*., 2013; Asmare and Mekuria, 2013; Kiflu *et al*., 2016).

Moreover, majority (90.5%) of dog keepers feed their dogs with homemade feed in particular kitchen scraps, mixture of maize bran and sardines and the feeding system was by throwing the feed on the ground (Table 15). Feeding dogs a homemade diet is related to economic status of most visited households, whereby majority of dog keepers were not able to afford to buy meat or commercial feeds. The study showed that, only 5.5% of respondents got an average annual income above ten million Tanzanian shillings, which indicate that only few individuals can buy good feeds for their dogs. Nevertheless, the freely roaming dogs were rarely provided with feed, they mostly scavenged for feed from waste disposal areas like dumps, picking feed leftovers from homestead areas and sometimes hunting wild animals like rodents and hares. This observation is inconsistency with other studies elsewhere which reported that some of dog owners feed their dogs raw or cooked meat/offal (Asmare and Mekuria, 2013; Kiflu *et al*., 2016).

Moreover, the results revealed that, 86.5% respondents knew that there are transmissible diseases between dogs and humans in particular rabies but very few reported helminthes and mange infestations (Table 3). This is likely associated with lack of government education programs related to dog parasitic zoonoses in comparison to rabies. There were several campaigns of rabies conducted in Tanzania which probably attributed to public awareness on this viral disease (e.g. Tokomeza Kichaa Cha Mbwa). This observation is similar to the studies by Kiflu *et al*. (2016) in Ethiopia and Asmare and Mekuria (2013) which observed that most dog owners were aware of rabies compared to parasitic zoonoses. Generally, there is a need to develop national disease control program and creating public awareness towards zoonoses from animals.

The present study found that, most dog keepers reported different health problems to their dogs in particular ectoparasite infestation and rabies (Table 3). Concomitantly most of the dogs do not get routine veterinary services except vaccination against rabies which is practiced during rabies campaigns only. There was no controlled breeding of dogs since it was established that mating was haphazardly done and the born pappies in most cases had no owners especially in Mvomero district. Several reasons may be considered like, lack of awareness on routine care of dogs' diseases apart from rabies, negative attitude toward dogs; some respondents reported to just hate dogs (Table 4). Also, some societies like Maasai in Mvomero district, don't believe that dogs may suffer from diseases like other animals (Personal observation, 2017). This is similar to findings from other studies which documented poor veterinary services provided to dogs by their owners (Ugbomoiko *et al*., 2008; Kiflu *et al*., 2016). Therefore, there is a need of creating public awareness on good dog husbandry to control dog diseases including the zoonotic ones. It was further found that, there was a significant difference ($P<0.005$) between the accessibility of veterinary services in Mvomero district and Morogoro Municipality (Table 2 and 3). The main reason is that Morogoro Municipality is an urban area whereby veterinary shops, clinics, dog dips and other veterinary services are readily available compared to Mvomero district which most of it is rural areas. These findings are in agreement with other studies conducted in various places which reported that veterinary services exist in urban areas in comparison to rural areas (Ugbomoiko *et al*., 2008; Kiflu *et al*., 2016).

Interestingly, majority (59%) of respondents in the current study had fair to good knowledge on dog management and their importance since practices like dog housing, feeding, control of ectoparasites and regular deworming were reported to be done especially in Morogoro Municipality. Most of them reported that dogs mainly are used in guarding nevertheless, some reported vices of dogs like biting, spread of diseases and prey livestock. Also, the study found that, 58% of respondents poorly managed their dogs, whereby husbandry practices in Morogoro Municipality are better in comparison with Mvomero district ($p<0.05$). This is related to the level of education, whereby most respondents from Mvomero district were illiterate compared to those from Morogoro Municipality (Table 1). This finding agrees with the previous studies carried out in different areas (Gebremichael *et al*., 2013; Kiflu *et al*., 2016). Therefore, creating communities awareness on dog management especially in rural areas is crucial for the dogs and public health.

In addition, 50% of respondents had positive attitude towards dogs and dog keepers from Morogoro Municipality, showed positive attitude toward dogs compared to those from Mvomero district ($P=0.007$). In Mvomero district the negative attitude towards dogs was reported to be due to natural hatred in particular to free roaming dogs which always appeared in poor body conditions. Some reported to witness inappropriate behavior against dogs such as beating and assassinations. This observation is probably attributed by stray dogs that prey on livestock (goats and sheep), cause dog bites and spread rabies as reported by most respondents (61.0%) from Mvomero district (Table 2). Therefore, free roaming dogs were also considered as nuisance and dangerous in the society especially children. This may have further contributed to negative attitude towards dogs that was observed during this study. Education about dog husbandry is required in both areas of study but with more effort in rural communities.

The current study has established the prevalence of 83.8% of ectoparasites in dogs where ticks, fleas, mites and lice were encountered. Dogs of Mvomero district were more (88.0%) affected by the ectoparasites than those of Morogoro Municipality (79.5%) (Table 11). Such high infestation rate reflects that dogs were poorly managed and routine parasite control rarely existed. Elsewhere, study by Kumsa and Mekonnen (2011) reported higher infection rates of up to 99.5%. Other studies reported variable prevalence of ectoparasites infestation in dogs being 60.4% in Nigeria (Ugbomoiko *et al.*, 2008), 63% and 51.3% in Brazil (Costa *et al.*, 2013) which all reflect that the parasitic infestation in dogs is a worldwide problem. Variation in occurrences and magnitude of ectoparasite among different studies can be associated with differences in climatic conditions, presence of infective stages of parasites in the environment, husbandry practices and sampling period of the year.

Rhipicephalus sanguineus, the brown dog tick or kennel tick is the most common ixodid tick affecting dogs worldwide (González *et al*., 2004; Xhaxhiu *et al*., 2009; Klimpel *et al*., 2010; Arong *et al*., 2011; Kumsa *et al*., 2011). In the present study it was found that dogs of Mvomero district were more affected by ticks (74.5%) in particular *Rhipicephalus sanguineus* compared to those of Morogoro Municipality (50.5%) and the difference was statistically significant (p=0.000). High tick infestation in dogs of Mvomero district compared to those of Morogoro Municipality is an indication of poor husbandry practices, such as lack of regular use of acaricides and free ranging of dogs as reported by majority of respondents (Table 3). A recent study carried out in Nigeria by Oguntomole and others (2018) reported *Rhipicephalus sanguineus* infestation rate ranging from 0.3% up to 80%. Elsewhere there have been reported various prevalence of *R. Sanguineus* in dogs; 100% in Brazil (González *et al*., 2004), 0.6% in Albania (Xhaxhiu *et al*., 2009), 73% in Argentina (Klimpel *et al*., 2010) and 40.58% in Nigeria (Arong *et al*., 2011). *Rhipicephalus* spp have been also reported to parasitize humans (Dantas-Torres, 2008) and may transmit *rickettsial* disease and *visceral leishmaniasis* (Zanatta-Countiho *et al*., 2007).

Furthermore, this study found that among the examined dogs, 64.5% had flea infestation and mostly *Ctenocephalides* spp. This is a high rate of infestation and is due to poor dog husbandry practices such as lack of regular cleaning and disinfecting dog premises and lack of regular dog bathing as observed during the current study (Table 3). Flea infestation in dogs causes pruritus, self-inflicted trauma and flea allergy dermatitis (Kumsa and Mekonnen, 2011). Almost all dogs that were observed to have skin lesions (Table 9) had fleas' infestation and their body condition was poor. These effects and many others show that the fleas are important parasites to dog health and welfare which need to be controlled. Nevertheless, fleas' infestation in dogs is of public health significance in Morogoro in view of their high population and possibility of transmitting pathogen. It has been reported that *Ctenocephalides* spp are the vectors of bacterial agents such as *Yersinia pestis* that can cause human plaque (Kilonzo *et al*., 2006; Kumsa and Mekonnen, 2011), also an intermediate host of *Dipylidium caninum* a zoonotic tapeworm (Zanatta-Countiho *et al*., 2007). High prevalence of *Ctenocephalides* spp infestation of up to 90% in dogs has been reported in North-Eastern of Tanzania (Haule *et al*., 2013). Other studies have reported the prevalence of *Ctenocephalides* spp to be: 73.8 – 82.9% in Ethiopia (Kumsa and Mekonnen, 2011) and 4.17 – 31.25% in Turkey (Aldemir, 2007). Differences of *Ctenocephalides* spp infestations in dogs between areas may be due to management practices, seasonality and geographical distribution of the parasites.

Other species of ectoparasites found to infest dogs in this study were *Sarcoptes scabiei* (3.0%) and *Trichodectes canis* (2.5%). The detection of *Sarcoptes scabiei* in dogs implies a significant risk for *Sarcoptic mange* infection to other dogs and their owners in the study areas. The mite is transmissible to humans after being in direct contact with infected animals for prolonged time (Bandi and SaiKuMar, 2013). Although, it was documented that, the animal scabies in humans presents with a transient and self limiting infections, it is necessary to safeguard the public health through application of proper control measures. Also, *Trichodectes canis* infestation was found in ten dogs, so it can be speculated that a higher infestation rate might be among other dogs, if more dogs were involved in the study. This calls for further studies in the areas to explore more details on parasitism in dogs.

Worldwide, the gastrointestinal parasites of dogs receive significant attention because apart from affecting dogs, majorities have a potential of infesting humans (Gracenea *at al*., 2009). In the current study it was established that the prevalence of gastrointestinal parasites was 76.8%. The degree of helminths and protozoan parasites infestation in dogs of Mvomero district was 79.5% and 27.5% and in Morogoro Municipality was 60.0% and 17.5%, respectively. This is a high infestation rate in dogs in Tanzania suggestive of lack of routine veterinary services aimed at controlling the parasites. Nevertheless, poor dogs' husbandry practices that were observed further give evidences of presence of gastrointestinal parasites like helminths and protozoa. Similar high enteric parasitic infestation rate (59.3%) in dogs in Tanzania has been reported by Swai *et al*. (2010).

Elsewhere, Abere *et al*. (2013) in Ethiopia reported prevalence up to 89% of gastrointestinal parasites infestation in dogs. Other prevalence of intestinal parasites infestation in dogs recorded are; 76.0% in South Africa (Minnaar *et al*., 2002), 71% in Spain (Martinez-Moreno *et al*., 2007), 68.4 -72.5% in Nigeria (Ugbomoiko *et al*., 2008; Mahmuda *et al*., 2012), 26.9% in Bacerlona Spain (Gracenea *et al*., 2009), 62.5% in Ghana (Johnson *et al*., 2015) and 30% in Egypt (Awadallah and Salem, 2015) which all reflect that the problem of parasitic infestation in dogs is big and wide spread in the world. The differences in prevalence of gastrointestinal parasites may arise due to variation in environmental conditions that are favorable for the perpetuation of the parasite, abundance of infected definitive hosts, stocking rate, type of food and feeding system of animals and inherent characteristics such as animal immunity. The prevalence of gastrointestinal parasites in dogs of Morogoro region may therefore reflect the real situation of parasitism in other areas of Tanzania where few or no studies have been conducted.

This study found that hookworm eggs (*Ancylostoma* spp) were the predominant parasites in both areas of the study as they accounted for up to 71.0% in dogs of Mvomero district and 50.0% in Morogoro Municipality. This suggests that this group of intestinal parasites is the most common in dogs of Mvomero district and Morogoro Municipality and probably other areas surrounded Morogoro region. Other studies in Tanzania by Muhairwa *et al*. (2008) and Swai *et al*. (2010) reported similar species of helminthes of dogs at more or less the same magnitude of infestation (57 – 67.2%). Similarly, studies by Bwalya *et al*. (2011) in Zambia, Asmare and Mekuria, (2013) and Abere *et al*. (2013) in Ethiopia, Johnson *et al*. (2015) in Ghana, reported prevalence of *Ancylostoma* spp eggs (46.8–78.9%) in faecal samples of dogs. The differences in prevalence of the intestinal parasites may depend on the common parasites circulating in the environment, season of the year and management practices of dogs where the study was conducted. In general it indicates that hookworms are the most common species of intestinal parasites that infest dogs in Morogoro.

For the first time, this study reports occurence of two fish parasites in dog faeces in Tanzania namely *Diphyllobothrium latum* (1.5%) and *Troglotrema salmincola* (0.5%). These helminths species have been reported in dogs in areas where feeding of raw or fresh fish products is common (Amissah *et al*., 2016). Considering that majority of dogs sampled were fed home diet made up of maize bran and sardines, this may account to this infection. Furthermore, these fish parasites were found in dogs of Mvomero district, whereby most of dogs are free roaming, scavenging for foods in different places including ponds and river where they might feed on raw infested fish. Probably this can also contribute to the presence of fish parasites in the dogs. Normally, the *Diphyllobothrium latum* and *Troglotrema salmincola* exists in cystic form when are in the fish muscles and when the infested fish is ingested by carnivores like dogs, the parasite develop into adult stage that starts laying eggs. With the current results, further studies are recommended using bigger sample size and reduce the error rate lower than 5% which was used in this study.

The detection of *Taeniidae* eggs (6.0%) in dog faecal samples is worth mentioning. Despite of feeding homemade feed, it seems that free roaming dogs get access to condemned raw meat or carcasses. Echinococcosis is endemic in some parts in Tanzania with high prevalence reported in slaughter animals and causes high condemnation rate of edible offal (Nonga and Karimuribo, 2009). A recent study carried out by Swai *et al*. (2016) in Tanzania, reported high prevalence (73.2%) of *Taenia* spp infection in stray dogs. Taking into consideration of the results in combination with prevalence of *hydatidosis* recorded in livestock, which is transmitted through dogs, it can be assumed that dogs in Tanzania might be reservoirs for human infections. Elsewhere, the reported prevalence are; 1.1% in Nigeria (Sowemimo, 2009) and 23.87% in Ethiopia (Abere *et al*., 2013).

Other intestinal parasites eggs identified in faecal samples of dogs were *Uncinaria stenocephala* (22.0%), *Toxocara canis* (11.5%), *Toxascaris leonina* (6.3%), *Ascaris lumbricoides* (3.8%), and *Dipylidium caninum* (1.8%). Some of these parasites were reported previous in Tanzania by Muhairwa *et al*. (2008) and Swai *et al*. (2010). Elsewhere, in Nigeria (Ugbomoiko *et al*., 2008), Ethiopia (Abere *et al*., 2013), Japan (Kimura *et al*., 2013), Iran (Sardarian *et al*., 2015), Ghana (Johnson *et al*., 2015%) and Zambia (Siwila, 2016) also reported similar species of gastrointestinal parasites in dogs at variable levels of infestation. The differences in magnitudes may be associated with climatic conditions, management systems, breeds and local circulating parasites in the study areas.

In the present study, four genera of protozoan parasites were isolated in faeces of dogs, namely *Cryptosporidium* spp (15.5%), *Isospora* spp (8.0%), *Cyclospora* spp (4.3%), and *Entamoeba* spp (3.0%). These parasites were also reported in various studies conducted elsewhere (Fayer *et al*., 2001; Muhairwa *et al*., 2008; Scorza *et al*., 2011). The overall prevalence of protozoan parasites was 22.5%, whereby high prevalence was observed in dogs of Mvomero district (27.5%) than those of Morogoro Municipality (17.5%). This might be due to the free ranging husbandry to which Mvomero dogs were subjected to. In this system dogs are free to roam, scavenge for food and they can even feed on human faeces and dead animals. This may culminate protozoa infections in the community as these dogs continually excrete oocysts in the environment.

Egg count per gram of faeces is significant in estimating the helminths burden and in assessing the worth of treatment. High egg count documented in the current study (50.8% of dogs had >500 EPG) highlights a possible danger of infection to humans. High intensity was observed in *Ancylostoma caninum* infestations (49.3%). This result of intestinal parasites intensity in dogs found in the present study revealed a very lofty level of infestation comparable with studies elsewhere. A study by Rodríguez-Vivas *et al*. (2011) reported that 42.3% of dogs had worm egg intensity of greater than 550 EPG of faeces. This study disagrees with observation by Mukaratirwa and Singh (2010) in South Africa, who presented intensities of 50-500 EPG of faeces in 26.4% of dogs and small proportion 6.7% of dogs had more than 500 EPG of faeces. Egg count per gram of faeces of other species of parasites were found at very low intensities probably due to an intermittent shedding of eggs and an inhomogeneous distribution of worm eggs in a faecal sample (Nijsse *et al*., 2014).

Several studies addressing epidemiology of parasites infestations in domestic dogs were conducted worldwide. Geographic location, seasonality, demographics and husbandry were identified as the possible risk factors for parasitism (Gaunt and Carr, 2011; Wang *et al.*, 2012). Therefore, the potential risk factors for occurrence and maintenance of parasitic infestation in dogs of Mvomero district and Morogoro Municipality were assessed in this study. The current study observed that young dogs were significantly (P<0.000) more exposed to intestinal parasites infestation than adult dogs. *Toxocara canis, Cryptosporidium* spp and *Isospora* spp infestations was more frequent common in young dogs than adult. Higher prevalence of intestinal parasites infestation in puppies than adult dogs were previously reported by Senlik *et al*. (2006), El-Gayar (2007), Abere *et al*. (2013) and Alam *et al*. (2015). Perhaps, immature immunity of puppies compared to adult dogs may account for the higher magnitude of gastrointestinal parasites infestation in young dogs (Paul and Carlin, 2010).

Considering the study area, it was found that dogs of Mvomero district were significantly (P<0.05) exposed to parasitic infestations compared to those of Morogoro Municipality. This is attributed by differences in dog husbandry and accessibility to veterinary services between rural and urban areas. Majority of dogs in Mvomero district are managed under free range system as reported in this study (Table 9). It was observed that, dogs from Mvomero district do not receive attention from their owners and in most cases rarely or never received ant-parasitic prophylactic measures (Table 3). The free ranged dogs have high probability of being infested by parasites compared to the confined one. This observation agrees with other studies conducted elsewhere (Overgaauw, 1997; Hamnes *et al*., 2007; Ugbomoiko *et al*., 2008; Soriano *et al*., 2010; Amissah *et al*., 2016) which observed high infestation rate of parasitism in rural dogs compared to urban dogs. Generally, this implies that urban dog keepers may have good knowledge of dog keeping and easy access to veterinary services (such as clinics, veterinary shops and dog dips) which do not exist in rural areas.

The results of this study also found that free-ranging dogs were significantly (p=0.05) infested with parasites compared to those under confinements. The high infestation rate recorded in free- ranging dogs may be due to poor veterinary attention and also because of their scavenging habits, which expose them to natural infestation more than confined dogs. This is similar to the reports in previous studies (Overgaauw, 1997; Hamnes *et al*., 2007; Ugbomoiko *et al*., 2008; Sowemimo, 2009; Soriano *et al*., 2010; Abere *et al*., 2013; Amissah *et al*., 2016) in which high infestation rate on gastrointestinal parasites was recorded in stray dogs compared to housed one.

Furthermore, the results of this study showed that, dogs fed by throwing feed on ground were significantly exposed to intestinal parasites infestations than those fed in containers ($p<0.05$). It has been reported that most gastrointestinal parasites are soil transmitted, so the habit of feeding dogs by throwing food on ground might have been contributed to the high infestation rate of gastrointestinal parasites in the areas. This finding is attributed by poor knowledge of dog keeping among the dog owners.

Given the high level of parasites infestation in dogs and the potential zoonotic importance, the overall prevalence of zoonotic intestinal parasites was established based on areas of the study. The study recorded a prevalence 84.5% in dogs of Mvomero district and 63.0%) in those of Morogoro Municipality. The frequently found parasites were *Ancylostoma caninum* (60.5%), *Uncinaria stenocephala* (22.0%), *Toxocara canis* (11.5%) and *Cryptosporidium* spp (15.5%). Other zoonotic species include *Taenia* spp (6.0%), *Cyclospora* spp (4.3%), *Ascaris lumbricoides* (3.8%), *Entamoeba* spp (3.0%) and *Dipylidium caninum (*1.8%). These parasites were also reported in previous studies worldwide (Anteson and Corkish., 1975; Overgaauw., 1997; Muhairwa *et al*., 2008; Zewdu *et al*., 2010). Considering the magnitude of parasites infestations documented in this study and the close intimate of dogs and their owners, it implies that there is a high risk of transmitting zoonotic intestinal parasites to other animals and humans. This calls for concerted efforts on creating public awareness on the risk of contrasting parasitic zoonoses from dogs in the areas of study.

Toxocara canis, a zoonotic round worm was found in 11.5% of dogs. This worm is a potential cause of visceral larvae migrans and ocular *Toxicariosis* diseases in humans. Sowemimo (2009) in Nigeria, Rodríguez-Vivas *et al*. (2011) in Mexico, Abere *et al*. (2013) in Ethiopia, and Jonhson *et al*. (2015) in Ghana reported, 33.8%, 6.2%,39.79% and

22.0% *Toxocara canis* infestations, respectively. *Dipylidium caninum*, a zoonotic tapeworm was found in 1.8% of examined dogs. Dogs, cats and wild carnivores are the definitive hosts, although human becomes occasional host. Sowemimo (2009) in Nigeria, Rodríguez-Vivas *et al*. (2011) in Mexico, Abere *et al*. (2013) in Ethiopia, and Jonhson *et al*. (2015) in Ghana reported a prevalence of 4.1%, 2.3%, 29.75% and 13.1% *D. caninum* infestation in dogs, respectively. In addition, detection of *Cryptosporidium* spp, *Cyclospora* spp, *Entamoeba* spp and *Ascaris lumbricoides* infestation in dogs was probably related to coprophagia habit of dogs, whereby dogs eat faeces of other animals including humans because of poor sanitation (Awadallah and Salem, 2015).

5.2 Conclusions and Recommendations

5.2.1 Conclusions

According to the findings of the current study, the following conclusions were made:

i. Dogs of Mvomero district were managed under free range system compared to those of Morogoro Municipality.
ii. Poor hygienic husbandry was observed whereby; cleaning, disnfecting of dog houses and associated equipments are uncommon practice among dog keepers.
iii. Majority (90.5%) of dog keepers feed their dogs a homemade feed and the feeding system is done by throwing the feed on the ground.
iv. Majority of the dog keepers knew that there are transmissible diseases between dogs and humans (82% in Mvomero district and 91% in Morogoro Municipality) in particular rabies.
v. Most respondents do not give necessary veterinary services to their dogs; majority reported that their dogs are routinely vaccinated against rabies.

vi. Dog keepers of Morogoro Municipality were found to have good knowledge on dog management and positive attitude toward dogs compared to those of Mvomero district.

vii. General prevalence of ectoparasites infestations on dogs was 83.8%, whereby dogs of Mvomero district were significantly more affected by ectoparasites than those of Morogoro Municipality.

viii. The overall prevalence of gastrointestinal parasites was 76.8%, whereby dogs of Mvomero district were significantly more affected by intestinal parasites than those of Morogoro Municipality.

ix. Hookworm eggs (*Ancylostoma* spp) were the predominant parasites in both study areas of as they accounted for up to 71.0% in dogs of Mvomero district and 50.0% in Morogoro Municipality.

x. For the first time in Tanzania, two fish parasites were found in dog faeces, though at low prevalence, namely *Diphyllobothrium latum* (1.5%) and *Troglotrema salmincola* (0.5%).

xi. Age, study area, management system, housing system, lack of routine deworming and feeding system were found to be risk factors for intestinal parasitism.

xii. The overall prevalence of zoonotic intestinal parasites based on study area; 84.5% in dogs of Mvomero district and 63.0% in those of Morogoro Municipality. *A. caninum*, *Uncinaria* and *Cryptosporium* spp were the commonly found zoonotic gastrointestinal parasites.

5.2.2 Recommendations

Based on the conclusions made, it is therefore recommended that:-

i. Integrative approaches on creating public awareness on dog management practices in Mvomero district and Morogoro Municipality and other areas in Tanzania is recommended in order to safeguard the health of dogs and the humans.

ii. Health education particularly on sanitary measures is necessary in order to safeguard the communities from dogs' zoonoses.

iii. There is a need of developing a national disease control program in accordance to parasitic zoonoses of dogs.

iv. Enforcement of regulations on dog husbandry among dog keepers in Morogoro region is recommended in order to safeguard health of animal and human being from the risk of parasitism.

v. Further studies are recommended to establish more information about parasitic infestation in dogs including humans in the study areas in order to implement an appropriate prevention and control measures.

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APPENDICES

Appendix 1: Permission letter from SUA

Appendix

CLEARANCE PERMIT FOR CONDUCTING RESEARCH IN TANZANIA

SOKOINE UNIVERSITY OF AGRICULTURE
OFFICE OF THE VICE-CHANCELLOR
P.O. Box 3000 CHUO KIKUU, MOROGORO, TANZANIA
Phone: 255-023-2640006/7/8/9, Direct VC: 2640015; Fax: 2640021;
Email: vc@suanet.ac.tz; vc2004sua@yahoo.com

Our Ref. SUA/DRPSG/R/126/3/93 18 August, 2017

Municipal Director,
P.O. Box 166,
MOROGORO

Re: UNIVERSITY STAFF, STUDENTS AND RESEARCHERS CLEARANCE

The Sokoine University of Agriculture was established by University Act Number 7 of 2005 and SUA Charter of 2007 which became operational on 1st January 2007 repealing Act Number 6 of 1984. One of the mission objectives is to generate and apply knowledge through research. For this reason the staff and researchers undertake research activities from time to time.

To facilitate the research function, the Vice-Chancellor of the Sokoine University of Agriculture (SUA) is empowered to issue research clearance to both staff, students and researchers of SUA onbehalf of the Government of Tanzania and the Tanzania Commission for Science and Technology.

The purpose of this letter is to introduce to you **Ms. Amina Issae** a bonafide **MSc. (Public Health and Food Safety)** student with registration number **MPH/E/2016/0007** of SUA. By this letter **Amina** has been granted clearance to conduct research in the country. The title of the research in question is **"Assessment of knowledge Attitudes and Management Practices of dogs and Aassessment of Parasitic Infestation in Mvomero District and Morogoro Municipality."**.

The period for which this permission has been granted is from **September, 2017 to December 2017.** The research will be conducted in **Morogoro Municipality**

Should some of these areas/institutions/offices be restricted, you are requested to kindly advice the researcher(s) on alternative areas/institutions/offices which could be visited. In case you may require further information on the researcher please contact me.

We thank you in advance for your cooperation and facilitation of this research activity.

Yours sincerely,

Prof. Raphael T. Chibunda
VICE-CHANCELLOR

VICE CHANCELLOR
SOKOINE UNIVERSITY OF AGRICULTURE
P. O. Box 3000
MOROGORO, TANZANIA

Copy to:- **Ms. Amia Issae - Researcher**

Appendix 2: Permission letter from Morogoro Municipality

Appendix 2

HALMASHAURI YA MANISPAA MOROGORO

Simu/Fax Na: 023 – 2614727

Barua pepe: info@morogoromc.go.tz

Tovuti: www.morogoromc.go.tz

Unapojibu tafadhali taja:

Ofisi ya Mkurugenzi wa Manispaa,
S.L.P 166,
MOROGORO,
TANZANIA

KUMB. NA V10/MMC-11/37

25 Sept, 2017

AFISA MTENDAJI
KATA YA ...MAGA.............
S.L.P166
MOROGORO

YAH: KUMTAMBULISHA Ms AMINA ISSAE

Mtajwa hapo juu ni Mwanafunzi wa MSc kutoka Chuo Kikuu cha Sokoine cha Kilimo (SUA). Atakuwa kwenye Kata yako kwa ajili ya kufanya utafiti juu ya"Assessment of Knowledge Attitudes and Management Practices of dogs and Assessment of Parasitic infestation in Morogoro Municipality"

Kwa barua hii naomba umpokee na kumpatia ushirikiano.

Chamzhim.M.M.O
Kny: Mkurugenzi wa Manispaa
MOROGORO

Kny: MKURUGENZI MANISPAA
MOROGORO

Nakala: Mkurugenzi Manispaa
MOROGORO — Aione kwenye jalada

" Afisa Mifugo
Kata ya...MAGA................

Appendix 3: Permission letter from Mvomero district

JAMHURI YA MUUNGANO WA TANZANIA
HALMASHAURI YA WILAYA MVOMERO
(Barua zote zitumwe kwa Mkurugenzi Mtendaji Wilaya)

SIMU NA. O23 - 261 3223
Fax Na. 023 -261 3007
Unapojibu Tafadhali taja

Kumb.Na.MVDC/D.30/15/VOL IV/54

Ofisi ya Mkurugenzi Mtendaji (W),
Halmashauri ya Wilaya ya Mvomero,
S.L.P. 663
Morogoro.
6//09/2017

Watendaji wa Kata.
Kata za :Dakawa,Mkindo,Doma,
Mangae na Melela.

YAH: KIBALI CHA KUFANYA UTAFITI NDUGU AMINA ISSAE KUTOKA CHUO KIKUU CHA KILIMO SOKOINE.

Husika na kichwa cha habari hapo juu

Namtambulisha ndugu Amina Issae kutoka Chuo Kikuu cha Kilimo Sokoine (SUA) kuja kufanya utafiti katika kata yako kuhusu '***Wafugaji wa Mbwa juu ya uelewa na mtazamo kuhusu mbwa na magonjwa yanayosababishwa na vimelea kwa mbwa***"

Utafiti huo utaanza Septemba 2017 hadi Disemba 2017.

Naomba apewe ushirikiano wa kutosha ili aweze kukamilisha utafiti wake.

FAHoza.

FITINA A. HOZA
Kny: Mkurugenzi Mtendaji (W)
MVOMERO

Nakala: Amina Issae.

K.Y: MKURUGENZI MTENDAJI
HALMASHAURI YA WILAYA
MVOMERO

Appendix 4: Data collection tool

QUESTIONNAIRE SURVEY ON: Knowledge, Attitudes and Practices of dog owners on dog management and zoonoses in Mvomero and Morogoro Municipality, Tanzania

A. DOGS' OWNER DEMOGRAPHIC DATA

Date of interview (dd /mm/ yy) ……… ………………………………………………..
Village/Street …………………………. Ward ……………. District…………………
Name of head of Household…………………. Sex …0= Male ☐ 1= Female ☐
Age (years) ……….........

Respondent's data

1. What is your name (Optional) …………………………………… ……………
2. Sex? (Circle the correct answer)
   0) Male
   1) Female
3. How old are you? (Years) ………………………………………
4. What is your marital status? (Circle the correct answer)
   1) Single
   2) Married
   3) Divorced
   4) Widow
5. What is your education level? (Circle the correct answer)
   1) Non formal education
   2) Primary school
   3) Secondary education
   4) College

6. What is the occupation of the household head?
   1) Crop farming
   2) Livestock and poultry keeping
   3) Trading in livestock and livestock products
   4) Trading in crop products
   5) Other non agricultural business
   6) Formal salaried employee
   7) Shopkeeper
   8) Others……………….

7. What is the average annual income of the household head from the main economic activity?... ……………………………..

   1. Below 1, 000 000
   2. Between 1,000, 000 and 10, 000, 000
   3. Above 10, 000 000

B. INFORMATION ON KNOWLEDGE OF DOG MANAGEMENT PRACTICES

1. How many dogs do you have? Tick (√) where applicable on the following

1)	One	
2)	Two	
3)	Three	
4)	More than three	

2. How long have you been keeping dogs (years)? Tick (√) where applicable on the following

1)	Below one year	
2)	Between one and three	
3)	Above three years	

3. What is the source of dogs? Tick (√) where applicable on the following

1)	Friend	
2)	Neighbors	
3)	Commercial breeder	
4)	Others (specify)	

4. What is the purpose of keeping dogs? Tick (√) where applicable on the following

1)	Herding livestock	
2)	Hunting	
3)	Security	
4)	Companion	
5)	Others	

5. How do you manage your dog(s)? Tick (√) where applicable on the following

1)	Kenneled full time	
2)	Kenneled during the day and free on night	
3)	Tethered on chain during the day and free during night	
4)	Free roaming	
5)	Left free within the fence and well controlled gate	
6)	Kenneled within the fence	

6. Who is responsible for the following activities? Tick (√) where applicable

		Housing of dogs	Feeding of dogs	Dipping of dogs	Cleaning house and associated equipments
1)	Husband				
2)	Wife				
3)	Boy				
4)	Girl				
5)	Salaried				
6)	Others				

7. What do you feed to your dogs? Tick (√) where applicable on the following

1)	Cooked meat	
2)	Raw meat	
3)	scavenging	
4)	Homemade diet	
5)	Commercial feed	
6)	Table scraps	
7)	Others (specify)	

8. How do you feed your dog (s)?

1)	In utensils	
2)	On bare ground	
3)	Both of the above	

9. Do you have access to any veterinary service? 1= Yes ( ) 0= No ( )
10. If YES above tick (√) against veterinary services for your dog (s)

4)	Dipping	
5)	Vaccinations	
6)	Deworming	
7)	Spaying/neutering	
8)	Other services	

11. Who is responsible for treating dogs? Tick (√) where applicable on the following

1)	Veterinary officer	
2)	Livestock field officer	
3)	Agriculture field officer	
4)	Private Vet service provider	
5)	Husband	
6)	Wife	
7)	Boy	
8)	Girl	
9)	Salaried	
10)	Others (specify)	

12. What types of medications do you know given to dogs? Tick (√) where applicable on the following

1)	Antibiotics	
2)	Antihelmintic	
3)	Anticoccidial	
4)	Others (specify)	

13. What precautions do you undertake to control/prevent parasitic infestation in dogs? Tick (√) where applicable on the following

1)	Cleaning the environment	
2)	Cleaning and disinfecting dogs house	
3)	Regular dipping or spraying dogs acaricides after every one week	
4)	Feeding dogs cooked meat	
5)	Deworming of dogs after every four months	
6)	Burning the affected areas	
7)	Others	

14. What do you do after handling dogs? Tick (√) where applicable on the following

1)	Nothing	
2)	I wash hands with water only	
3)	I wash hands with water and soap	
4)	Other	

C. INFORMATION ON DOG DISEASES AND ZONOSES

15. Do you think dogs can spread diseases? 1=Yes ( ) 0=No ( )
16. Have your dog (s) ever experienced any disease 1=Yes ( ) 0=No ( )
17. If answered yes above, what diseases/signs of dogs do you encounter? Mention them in order of importance
    1) ……………………………………………………………………….
    2) ………………………………………………………………………..
    3) …………………………………………………………………………
    4) ………………………………………………………………………
    5) …………………………………………………………………….
    6) ……………………………………………………………………….

18. Of the diseases/signs mentioned in the question above, mention the ones which you know that can spread to human being.
    1) ……………………………………………………………………………
    2) ……………………………………………………………………………
    3) ……………………………………………………………………………

D. ASSESSMENT OF ATTITUDES TOWARDS DOGS

Tick the appropriate number (1= Strongly agree, 2= Agree, 3= Neutral, 4= Disagree and 5= Strongly disagree)

		1	2	3	4	5
1)	I like dogs					
2)	I feel sorry for stray dogs					
3)	I feel safe when surrounded by dogs					
4)	I feel happy purchasing food for dogs					
5)	The use of violence against dogs is acceptable					
6)	In general dogs are dangerous animals					
7)	There are too many stray dogs in this village/street					
8)	Dogs need to scavenge food around the street/village					

E. INFORMATION ON OPINIONS TOWARD DOGS AND DOGS' MANAGEMENT

1. Do you think dogs are better managed in this village? 1=Yes ( ) 0= No ( )
2. If answered Yes/No why?..
3. Is there any need of keeping dog (s)? 1=Yes ( ) 0= No ( )
4. If answered Yes/No why?...
5. What are the disadvantages of keeping dogs?
   1) …………………………………………………………
   2) …………………………………………………………
   3) …………………………………………………………
   4) …………………………………………………………

F. INFORMATION ON EXPERIENCES AND BEHAVIUORAL RESPONSES TOWARDS DOGS

Write 1=Yes, 2= Always, 3= Sometimes, 4=No, 5= Not at all

		1	2	3	4	5
1	Have you seen free roaming dogs in this village?					
2	Do you avoid contact with dogs?					
3	Do you feel dogs are friendly in this area?					
4	Do dogs seem frightened and avoid human contact when approached?					
5	Do you feed the dogs?					
6	In this village/street dogs are well fed					
7	In this village/street dogs look healthy					
8	In this area dogs succumb from diseases					
9	In general dogs are nuisance					
10	Do dogs scavenge food in this area?					
11	Do you feel threatened when a dog approaches you?					
12	Have you witnessed inappropriate behavior against dogs?					

DOGS' BIODATA

No of dogs	**ID/Name**	**Breed**	**Age**	**Body condition**	**Clinical signs**	**Body temperature**	**History of treatment**

Appendix 5: Dodoso la ufugaji wa mbwa

Dodoso la kupima uelewa, mitazamo na vitendo vya wafugaji wa mbwa juu ya taratibu za ufugaji na magonjwa ya kuambukiza kutoka kwa Mbwa katika Wilaya ya Mvomero na Manispaa ya Morogoro, Tanzania

A. TAARIFA BINAFSI ZA MFUGAJI

Tarehe ya usaili (siku /mwezi/ mwaka) ………
………………………………………………..
Kijiji/Mtaa …………………………. Kata ……………. Wilaya …………………
Jina la mkuu wa kaya …………………. Jinsi … Me☐ Ke ☐
Umri (miaka) ……….........

Taarifa za mhojiwa

1. Taja majina yako (Hiari) . ..…………………………………… ……………
2. Jinsi yako ni ipi? (zungushia duara jibu lako)
   a) Me
   b) Ke
3. Una umri wa miaka mingapi? ………………………………………
4. Hadhi yako kindoa ni ipi? (zungushia duara jibu lako)
   a) Hujao/hujaolewa
   b) Umeoa/umeolewa
   c) Umeachika
   d) Mgane/mjane
5. Kiwango chako cha elimu ni kipi? (zungushia duara jibu lako)
   a) Sijasoma
   b) Shule ya msingi
   c) Kidato cha nne
   d) Kidato cha sita
   e) Chuo
6. Unafanya kazi gani? ……………………………………………………….
7. Kipato chako cha mwaka ni shilingi ngapi?...

B. TAARIFA ZA UELEWA JUU YA UFUGAJI WA MBWA

8. Unafuga mbwa wa ngapi?………………………………………………………….
9. Una muda gani tangu uanze ufugaji wa mbwa?…………………………………………….
10. Chanzo cha mbwa wako kipi? Weka alama ya vema panapohusika (√)

5)	Rafiki	
6)	Jirani	
7)	Umenunua	
8)	Vinginevyo (Taja)	

Dhumuni la kufuga mbwa ni lipi? Weka alama ya vema (√) panapohusika hapo chini

a)	Kusadia kuchunga mifugo	
b)	Kuwinda	
c)	Ulinzi	
d)	Urafiki	
e)	Vingine (taja)	

11. Unafugaje mbwa wako? Weka alama ya vema (√) panapohusika hapo chini

a)	Unamfungia kwenye banda muda wote	
b)	Unamfungia bandani mchana na kuwa huru usiku	
c)	Unamfunga mnyororo mchana na kuwa huru usiku	
d)	Unamuacha huru muda wote na kuzura mtaani	
e)	Unamuacha huru ndani ya uzio wenye geti	
f)	Unamfungia kwenye banda ndani ya uzio	

12. Nani anafanya shughuli zifuatazo? Weka alama ya vema (√) panapohusika hapo chini

		Kufungia mbwa	Kumpatia chakula mbwa	Kumuogesha mbwa	Kusafisha banda na vyombo vya chakula vya mbwa
a)	Mume				
b)	Mke				
c)	Mvulana				
d)	Msichana				
e)	Mhudumu				
f)	Vingine (taja)				

13. Mbwa wako unampatia chakula cha aina gani (√) weka alama ya vema hapo chini

1)	Nyama iliyopikwa	
2)	Nyama mbichi	
3)	Anaokoteza majalalani	
4)	Chakula cha kutengeneza nyumbani	
5)	Chakula cha dukani	
6)	Mabaki ya mezani	
7)	Vinginevyo (taja)	

14. Unamlishaje mbwa wako chakula?

1)	Kwenye bakuli	
2)	Unamrushia kwenye udongo	
3)	Vyovyote vile	

15. Unapata huduma za mifugo? Ndiyo ( ) Hapana ( )

16. Weka alama ya (√) kwenye huduma unayopata kwa ajili ya mbwa wako?

a)	Kuogesha	
b)	Chanjo	
c)	Dawa za kuua minyoo	
d)	Kuhasi	
e)	Huduma nyingine ………..	

17. Mbwa wako anatibiwa na nani anapougua? Weka alama ya vema (√) panapohusika hapo chini

a)	Daktari wa mifugo	
b)	Mume	
c)	Mke	
d)	Mtoto wa kiume	
e)	Mtoto wa kike	
f)	Mhudumu	
g)	Vinginevyo (taja)………	

18. Mbwa wako unampatia aina ipi ya matibabu? Weka alama ya vema (√) panapohusika hapo chini

a)	Antibayotiki	
b)	Dawa za kuua minyoo	
c)	Anticoccidia	
d)	Nyingine (taja) ………	

19. Ni tahadhari zipi unazochukua kuzuia magonjwa ya vimelea kwa mbwa wako? Weka alama ya vema (√) panapohusika hapo chini

a)	Kusafisha mazingira	
b)	Kusafisha banda la mbwa kwa dawa za kuua vimelea	
c)	Kuogesha mbwa kila baada ya wiki moja	
d)	Kumpa mbwa chakula kilichopikwa	
e)	Kuwpatia mbwa dawa za kuua minyoo kila baada ya miezi minne	
f)	Vingine (taja)	

20. Unafanya nini baada ya kumshika mbwa wako katika kumhudumia?

a)	Sifanyi kitu chochote
b)	Naosha mikono kwa maji tu
c)	Naosha mikono kwa maji na sabuni
e)	Vinenginevyo…….

C. TAARIFA ZA MAGONJWA YA MBWA

21. Unafikiri mbwa anaweza kusambaza magonjwa? Ndiyo ( ) Hapana ( )
22. Mbwa wako huwa anaugua? Ndiyo ( ) Hapana ( )
23. Kama jibu ni ndiyo hapo juu, magojwa gani anaugua?
    a) ……………………………………………………………………….
    b) ………………………………………………………………………..
    c) …………………………………………………………………………
    d) ………………………………………………………………………

24. Kwa magonjwa uliotaja hapo juu ni yapi yanaambukiza kwa binadamu?
    a) ……………………………………………………………………………
    b) ……………………………………………………………………………
    c) ……………………………………………………………………………

D. TATHMINI JUU YA MTAZAMO WA JAMII KUHUSU UFUGAJI WA MBWA

Weka alama ya vema kwenye jibu sahihi (1= nakubaliana kabisa, 2= nakubaliana, 3= upande wowote, 4= sikubaliani and 5= sikubaliani kabisa)

		1	2	3	4	5
1	Napenda mbwa					
2	Najisikia vibaya kuona mbwa wanazurura mitaani					
3	Nahisi nipo salama ninapokuwa nimezungukwa na mbwa					
4	Najisikia furaha kununua chakula kwa ajili ya mbwa					
5	Vitendo vya ukatili dhidi ya mbwa vinakubalika					
6	Mbwa ni mnyama hatari					
7	Katika mtaa huu/ kijiji hiki wapo mbwa wengi					
8	Mbwa wanastahili kuokoteza vyakula majalalani					

E. MAONI YA MHOJIWA KUHUSU UFUGAJI WA MBWA

1. Unadhani mbwa wanatunzwa vizuri katika kijiji hiki/ mtaa huu? 1= Ndiyo ( ) 0= Hapana ( )
2. Kama jibu ni Ndiyo/Hapana Kwanini?……………………………………
3. Upo umuhimu wa kufuga mbwa? 1=Ndiyo ( ) 0= Hapana ( )
4. Kama jibu ni Ndiyo/Hapana Kwanini?...
5. Taja hasara za kufuga mbwa
    a) ……………………………………………………………………….
    b) ………………………………………………………………………..
    c) …………………………………………………………………………
    d) …………………………………………………………………………

F. TAARIFA ZA UZOEFU NA TABIA ZA WATU JUU YA UFUGAJI WA MBWA

Andika 1=Ndiyo, 2= siku zote, 3= Wakati mwingine, 4=Hapana, 5=Hapana kabisa

		1	2	3	4	5
1	Umewahi kuona mbwa anayezura hapa kijijni/ mtaani?					
2	Hupendi kukutana na mbwa koko?					
3	Unafikiri mbwa wanaurafiki na watu ktk eneo hili?					
4	Mbwa wa eneo hili wanaogopa watu?					
5	Unampatia mbwa chakula?					
6	Mbwa wa eneo hili wanapatiwa lishe bora?					
7	Mbwa wa eneo hili wanaonekana wenye afya nzuri?					
8	Mbwa wa eneo hili wanaonekana wenye magonjwa?					
9	Mbwa wanaleta usumbufu kwenye jamii?					
10	Mbwa wa eneo hili wanaokoteza vyakula majalalani?					
11	Unapatwa na hofu mbwa anapokusogelea?					
12	Umewahi kushuhudia vitendo vya ukatili dhidi ya mbwa?					

TAARIFA ZA MBWA

Idadi ya mbwa	ID	Kabila	Umri	Hali ya afya	Dalili za ugonjwa	Joto la mwili	Historia ya Matibabu