FACTORS INFLUENCING THE EFFECTIVENESS OF TSETSE ERADICATION PROJECT IN PATE ISLAND,

LAMU COUNTY,KENYA

BY

MOSES KIPKEMOI CHERUIYOT

A RESEARCH PROJECT REPORT SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF MASTER OF ARTS DEGREE IN PROJECT PLANNINING AND MANAGEMENT OF THE UNIVERSITY OF NAIROBI

2013

DECLARATION

I hereby declare that this research project is my original work and has not been presented for a degree at any other university.

Signature:.. **Date:..**

MOSES KIPKEMOI CHERUIYOT

L50/71622/2011

This research project has been submitted for examination with my approval as the candidate's University supervisor.

Signature:.. **Date:.......................................**

Johnbosco Kisimbii

Lecturer, Department of Extra-Mural studies,

University of Nairobi

ACKNOWLEDGEMENTS

I would like to acknowledge the University of Nairobi fraternity for the opportunity they provided me and the support from all offices and persons during the preparation of this project. Special acknowledgement goes to my supervisor Mr. Johnbosco Kisimbii for forthrightness, guidance and support throughout the whole project. My gratitude goes to Chief Executive Officer, Kenya Tsetse and Trypanosomiasis Eradication Council, Dr Pamela Olet for according me time and encouragement to carry out research in the project area and to Lydia for the tireless efforts in editing the work. I wish to thank Caro and Purity for their support and being the good face of the University of Nairobi Mombasa Campus. God bless you all.

DEDICATION

I dedicate this work to Caesar, Davies and Mary, my beloved children, for your encouragement, motivation, understanding and undivided love during this journey. You have been the reasons to wake up early and face the day with hope and confidence knowing a reward waits. May this work inspire and encourage you as you pursue your future interests and careers. God bless you richly.

TABLE OF CONTENTS

Page

LIST OF FIGURES

Page

LIST OF TABLES

ABREVIATIONS AND ACRONYMS

AAT	African Animal Trypanosomiasis
AECT	The Association for Educational Communications and Technology
AHG	Assembly of Head of State and Government
AU	African Union
DDT	Dichlorodiphenyltrichloroethane
DFID	Department for International Development
DFMO	Difloromethyleornithine
FAO	Food Agricultural Organization
FITCA	Farming In Tsetse Controlled Areas
HAT	Human African Trypanosomiasis
ICIPE	International Centre for Insect Physiology and Ecology
ISCTRC	International Scientific Council for Trypanosomiasis Research and Control
KETRI	Kenya Trypanosomiasis Research Institute
KWS	Kenya Wildlife Service
MSF	Me'dicine Sans Frontier's
OAU	Organization of African Unity
PATTEC	Pan African Tsetse and Trypanosomiasis Eradication Campaign
RTTCP	Regional Tsetse and Trypanosomiasis Control Programme
SIT	Sterile Insect Technique
TND	Tropical Neglected Disease
UNDP	United Nation Development Programme
WHA	World Health Associations
WHO	World Health Organization

ABSTRACT

Tsetse eradication project was initiated in Pate Island in the year 2009 with the objective of eradicating tsetse fly and trypanosomiasis in the Island using combinations of approaches and techniques developed for use outside Kenya Coast. The study is about analysis of the factors influencing the effectiveness of tsetse eradication in Pate Island. It was undertaken to appraise the effectiveness of the project in meeting the objectives three years into the operation. Literature review revealed that community engagement, installation of insecticides targets, spraying of animals, training of farmers and treatment of animals that come down with trypanosomiasis are factors that influence tsetse eradication. The descriptive survey research was employed in the study because it enabled the researcher to generalize its findings to larger population of Pate Island. Tsetse flies were sampled using 20 geo-referenced biconical traps (Challie'r et al, 1977) baited with phenols and acetone where flies were collected for 72 hours at 24 hour intervals. There were no flies caught (n=20). Trypanosome parasite were surveyed by screening blood samples for trypanosomes using Standard Trypanosome Detection Methods (STDM), namely wet, thick, and thin smear examination as well as Haematocrit Centrifugation Technique, Buffy Coat examination. No parasite was detected (n=408). Semi structured questionnaires (n=60) were used to collect data on community engagement, training of farmers and spraying of animals. Data was analyzed using SPSS software and presentation was descriptive and qualitative techniques. Statistical analysis frequency distribution was used. The study established factors that influenced the effectiveness of tsetse eradication were: community engagement, target installation, animal spraying, and training of farmers and treatment of infected animals. The study concluded that the five factors indeed had influence on the effectiveness of the Project. Recommendations made were: community members be involved in project activities, conventional insecticide impregnated target is effective against *Glossina austeni* tsetse fly species, alternative insecticide formulation that would not require use of spray pump would be a better option for Pate farmers, there should be continuous training of farmers on vector and disease control and due diligence be instituted in the use of trypanocides in order to avoid drug resistance.

Key words: *Effectiveness, eradication, tsetse, trypanosomiasis*

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Tsetse flies are large biting flies that inhabit about 10 million Square Kilometers in 37 countries of Sub- Saharan Africa. They belong to the genus Glossina in their own family of Glossinidae. Tsetse fly transmits disease causing parasites known as trypanosomes to both livestock and man. The dilapidating disease in animals is known as African Animal Trypanosomiasis (AAT) or Nagana. In humans it is referred to as Human African Trypanosomiasis or commonly as 'Sleeping Sickness'. An estimated 46 million cattle are at risk of contracting tsetse transmitted Trypanosomiasis and about 155 million cattle are excluded from 9 million km2 fertile and lush pasture lands because of the tsetse infestation.

Livestock not only provide milk and meat for nourishment and manure for fertilization, but also are valuable in crop production as a draught power. Livestock can act as security in terms of savings and hence, provide a vital source of income of the rural poor. Productive livestock keeping is however largely absent in the vast fertile areas of the thirty seven countries, due to the omnipresence of the tsetse fly. Trypanosomiasis causes tremendous loses to cattle, sheep, goats and horses. It deprives the rural population of draught power to improve and increase crop production and reduce output of milk, meat and manure for fertilizers. African Animal Trypanosomiasis (AAT) is fatal to wildlife especially the rhinoceros thereby affecting tourism (Feldman et al, 2005).

Despite the yearly administration of 35 million doses of trypanocidal drugs at $1 per dose (Matioli, 2004), African farmers lose 3 million heads of cattle every year to the disease and annual economic losses are estimated at US$ 7.98 billion (Malele , 2011)

Tsetse prevents the integration of crop farming and livestock keeping, which is crucial to the development of sustainable agricultural system (Feldman & Hendrichs, 1999). The lack of productive livestock, due to the presence of tsetse and Trypanosomiasis, is a key barrier in Africa to significantly improve agriculture. The removal of this barrier would be essential to the alleviation of hunger, food insecurity and poverty (Feldman, 2005). Tsetse fly mainly affects the rural poor and is rightfully considered a root cause of poverty in Africa (Vreysen, 2006).

Human African Trypanosomiasis (HAT), or as is better known, Sleeping Sickness, is a parasitic and potentially fatal neglected tropical disease (NTD) transmitted by tsetse fly to man. Death occurs within six months after infection if it is not treated .Sleeping Sickness patients undergoing treatment suffers some of the most painful experience (MSF, Sleeping sickness report, June 2012) Drugs that are in use for the treatment of the trypanosomiasis were developed over 50 years ago as there has been minimal investment in the development of new drugs.(MSF Human African Trypanosomiasis Facing the challenges caused by neglect: The need for new treatment and diagnostics, 2006)

The presence of tsetse flies causes human beings to abandon their settlements and such depopulations; cessation of farming activities normally leads to thicker growth of bushes and consequent extension of habitat of the tsetse flies (Malele , 2011).

Sleeping Sickness (SS) epidemics in Kenya have occurred during the years between 1901 and 1902 in the Islands of Lake Victoria. In 1910 another SS epidemic occurred in Kuja and Migori Rivers in Nyanza. Between 1959 and 1976, there were outbreaks in Lambwe Valley, Alego and Samia and 1989-91 in Western Province (Wilde BT et al 1989).

The colonial period in Africa witnessed concerted and even military style efforts of eradication of tsetse and trypanosomiasis, ranging from aerial spraying in Zululand and Nigeria, bush clearing of Miombo woodlands in Tanzania, Game elimination in Zimbabwe, and hundreds of gangs of ground sprayers in Kenya and Zambia sequestered in Camps. Newly independent African governments were faced with more competing social priorities that led to dwindling of financial support to tsetse and trypanosomiasis operations.

Attempts to control tsetse and trypanosomiasis Kenya go back to the past 100 years and whose aims were to contain epidemic outbreaks. Between the years 1901 to 1910 work was done in the Lake Victoria Islands and along the Migori River. The advent of Diclorodiphenyl trychloroethane (DDT) started the use of insecticides sprayed to tsetse habitats to kill the flies. Between 1959 and 1962 bush clearing technique was used to remove tsetse flies and allow human settlement in Shimba Hills and as a tsetse barrier along Narok and Bomet Counties. Between 1968 and 1972, under WHO/FAO/UNDP, aerial spraying was conducted in Lambwe Valley following trypanosomiasis outbreak. Regular ground spraying around Lake Victoria in the 1980s, use of targets in Lambwe Valley helped contained the situation. The Government set up camps in outbreak area of Meru, Embu, and the lake Basin (Tsetse and Trypanosomiasis Eradication Strategy, 2011) Between 1999 and 2004 EU funded Farming in Tsetse Controlled Areas Project (FITCA) was implemented in Busia and Bungoma districts in Western Province and in Siaya and Bondo districts of Nyanza Province (Farming in Tsetse Controlled Areas, Kenya Project 1999-2004. Lessons Learned, 2005).

The escalating incidence of trypanosomiasis and non-sustainability of past approaches to control the disease, and accentuates the significance of the disease in Africa's desperate struggle against hunger, poverty and disease, underscoring the urgent necessity to device effective methods of coping with the disease.(PATTEC Plan of Action,2001).

In recognition of the severity of the problem, African Heads of States and Government, during the Summit of the Organization of African Unity (OAU) held in Lome, Togo in July 2000, made the decision - Decision AHG/156(XXXVI) OF THE 36th Assembly of Heads of States and Governments. This was the decision to eradicate tsetse fly and trypanosomiasis in Africa. The Pan African Tsetse and Trypanosomiasis Eradication Campaign (PATTEC) a department at the Commission for Agriculture of the AU was mandated to spearhead the eradication campaign. The member States were mandated to facilitate the creation Focal Points in their respective countries with express mandate to implement PATTEC Action Plans of eradication of tsetse fly and trypanosomiasis scourge from African continent (PATTEC Plan of action, 2001).Kenya is infested by eight species of tsetse flies that are widely distributed in what is referred to as tsetse fly belts. These are the Lake Victoria basin, Narok-Kajiado, Lake Bogoria, Kerio Valley-Turkwell, The central Kenya and the Coastal fly belt. There are isolated fly infested pockets in Moyale, Wajir, Turkana and Mandera. Tsetse flies infestation occurs in all the Counties of the Kenya Coast. This region has a human population of 2.3 million about 1 million cattle, 2 million sheep and goats, over 50,000 camels and over 30,000 donkeys who are at risk of trypanosomiasis.

Trypanosomiasis in livestock is one of the most important restricting economic developments in Kenya Coast today and is a big threat to food security. It limits the amount of crop production by denying access to fertile lands and by restricting the use of draught power. It denies cattle large areas for gracing especially the Tana Delta and forest galleries of Pate Island. Animals are also restricted to gracing for specific hours between midmorning and mid afternoon that coincide with the time when tsetse fly activity is low due to high temperatures. This affects the quality of body condition of the animal and this would determine the market price which usually low compared to animals from tsetse free areas.

Economic loses attributed to tsetse and trypanosomiasis includes the high cost of treatment of animals, animal life, abortion in livestock and loss of milk. The country suffers loss of foreign exchange through importation of drugs, insecticides and the lost opportunity to export livestock and livestock products.

The decision by African political leadership to eradicate tsetse fly in Africa was met with resistance and skepticisms, especially from European. According to Rogers D and S. Randolph, the reasons as to why eradication of tsetse flies is neither feasible, nor desirable are because of, biological, geographical and environmental concerns, institutional weaknesses and logistical constraints, historical reasons and other priorities in rural development (Rogers, Randolph, 2002).

The Commission of the African Union in response acknowledged the challenges but observed that obstacles and negating circumstance have been overcome and that for the first time in history of the war against this disease, a situation has arisen which will permit the effective deployment of all available resources, of all the willing and able players, in a harmonized manner to achieve the intentions and objectives of international action to solve the tsetse and trypanosomiasis once and for all(AHP/DFID workshop proceedings, 2002)

In the PATTEC Plan of Action(2001) tsetse and trypanosomiasis entails identification of zones of tsetse infestation which are isolated from other populations of tsetse species, physically for examples by mountains, water bodies or by limitations in factors connected with preferences or tolerance limits of the fly e.g. food availability, temperature, humidity, natural cover or where the isolation can be achieved by artificial means. Removal of the confined tsetse population one by one creates ever-expanding tsetse-free areas. In general, emphasis is placed on tackling identifiable naturally isolated zones of tsetse infestation, especially those at the periphery of the tsetse belt, to exploit their proximity to tsetse free areas, from which re-invasion would be difficult. Priority is given to areas of high human settlement or agriculture potential. Pate Island fulfills these criteria and that was the reason of choice for the pilot project.

This study provides opportunity to find out how effective the project has been in Pate Island through literature review, field data collection and analysis. It also proposes recommendations to be considered in future in the management of the vector and the parasite.

1.2 Statement of the Problem.

Tsetse and Trypanosomiasis control and eradication projects in Kenya have been successful for only as long as duration of the project life. Tsetse fly population has been brought down to negligible levels and the disease brought under control. But few years after the end of the project, outbreaks of epidemic levels of trypanosomiasis have occurred resulting the mortality of both man and livestock.

Pan African Tsetse and Trypanosomiasis Eradication Campaign, Kenya (PATTEC Kenya) initiated tsetse and trypanosomiasis eradication project in Pate Island in Lamu County in 2009. The project was implemented by way of community sensitization and mobilization, deployment of insecticide impregnated targets throughout the $60km^2$ arable land in Pate Island, equipping and supplying insecticides for livestock spraying to livestock keepers, farmer training on the use spray chemicals and use of technologies, and treatment of animals infected with trypanosomiasis. The ultimate goal is to eradicate tsetse fly and consequently all trypanosomiasis incidences in livestock.

At the end of 2010 a total of one thousand one hundred and thirty two insecticide impregnated targets had been deployed, 12 farmer groups had been identified and supported with training and provision of spray chemicals and spray equipment. Infected animals have been diagnosed and proper treatment carried out. Livestock keepers have sprayed their animals and the project officials have been available for back 'stopping. Tsetse fly population has gone down and farmers are reporting few incidences of the disease

Tsetse control projects in Africa and in Kenya particular have never been sustainable. Successfully tsetse freed areas have experienced reinvasions causing trypanosomiasis epidemics as was witnessed in Lambwe valley and Alego in Kenya.

Successful sustained tsetse eradication is affected by the how local community has been sensitized and mobilized so as to continue with the activities even after the project has ended.

Insecticide impregnated targets are prone to vandalism, damaged by wild animals, discoloration, vegetation overgrowth, depletion of chemical attractants and loss of efficacy of the insecticides therefore affecting their performance in tsetse suppression. Poor, inadequate or low number of trained livestock keepers affects the leads to poor use of equipment leading to fly re infestation. Spraying of animals is critical in tsetse eradication as they act as mobile targets in the field. The problem arises when the animals are not sprayed as recommended in terms of frequency, proportions and the skills of applying the spray by the farmers. Treatment of animals suffering from trypanosomiasis is key factor in the eradication of tsetse and trypanosomiasis. This the points at which the infective parasites are cleared from the animal host therefore breaking the transmission cycle from the animal to the fly and back to the animal. No studies could be found in the survey of literature to have been carried out on how the above factors have influenced the effectiveness of the eradication of tsetse and trypanosomiasis in Pate Island and therefore the essence of my study.

1.3 The Purpose of the Study

The purpose of the study is find out factors influencing the effectiveness of tsetse eradication project in Pate Island in Lamu County, Kenya.

1.4 Objectives of the Study

The study was guided by the following objectives:

1. To establish how community engagement has influenced the effectiveness of eradication of tsetse in Pate Island.
2. To determine how insecticide impregnated targets installed has influenced the effectiveness of tsetse eradication in Pate Island.
3. To assess how livestock spraying has influenced the effectiveness of tsetse eradication Pate Island.
4. To determine how training of farmers has influenced the effectiveness of tsetse eradication Pate Island.

5. To establish how animal treatment has influenced the effectiveness of tsetse eradication Pate Island.

1.5 Research Questions

The study was guided by the following research questions:

1. To what extent has community engagement influenced effectiveness of tsetse eradication Pate Island?
2. How has targets installation influenced effectiveness of tsetse eradication in Pate Island?
3. To what extent has livestock spraying influenced effectiveness of tsetse eradication Pate Island?
4. To what extent has training of farmers influenced the effectiveness of tsetse eradication Pate Island?
5. To what extent has treatment of infected animals influenced the effectiveness of tsetse and trypanosomiasis eradication Pate Island?

1.6 Research Hypothesis

The study tested the following research hypothesis:

1. H_o - Involvement of community has no influence on effectiveness of the tsetse eradication.

   H_1- Involvement of community has influence on effectiveness of tsetse eradication.
2. H_o - Insecticide impregnated targets has no influence on effectiveness of tsetse eradication.

   H_1 - Insecticide impregnated targets has influences on effectiveness of tsetse eradication.
3. H_o - Animals spraying has no influence on effectiveness of tsetse eradication.

   H_1 - Animals spraying has influence on effectiveness of tsetse eradication.
4. H_o -Training of farmers has no influence on effectiveness of tsetse eradication.

   H_1 - Training of farmers has influence on effectiveness tsetse eradication.
5. Ho- Treatment of livestock has no influence on effectiveness of tsetse eradication.

   H_1- Treatment of livestock has influence on effectiveness of tsetse eradication.

1.7 Significance of the Study

Tsetse and Trypanosomiasis eradication ultimate goal is to have Pate Island free of tsetse fly. This will create multiplier effect in terms of high livestock productivity and improved crop production therefore ensuring food security.

The study was important to the Project managers because the findings will reveal the how each of the factors in the study would affect the effectiveness of the eradication efforts. It would provide information on the fly densities and infection incidence in animals.

The study showed how the community involvement helped to advance eradication efforts and to ensure sustainability of the project. The study would be beneficial to the community because their roles and responsibilities shall be clarified, and relationship with project team enhanced. To the farmers, the study would enhance their participation in the project implementation and sustainability of the project as it would involve close interaction and exchange of information. The study would act as motivator to the project team as it would indicate areas of excellence and areas where improvements would be needed.

1.8 Scope of the Study

The researcher confined to the study to both human and livestock population of Pate Island in Lamu County. Entomological sampling was conducted on geo-referenced sites within the Island. Parasitological sampling was carried in livestock in six villages of Pate. Interviews were confined to inhabitants of Pate Island and the target groups were the members of the community.

1.9 Limitation of the Study

This Study was limited by the following:

i. Pate Island is quite far with attendant dangers of road and sea travels, provided challenge where some issues required cross checking and clarifications.

ii. Training of enumerators- enumerators had to train within a short period of time. They were from the local Bajuni who are swahili speakers and since the questionnaire was in

English considerable time was spent in translating words to Kiswahili. However this was made easier by selecting Form Four leavers to carry out the interviews.

1.10 Basic Assumption of the Study

This study was based on the following assumptions;

a) There would be conducive environment during the data collection period
b) That the data required for the study would be collected easily and that the area residents would readily be provide any additional information.

1.11 Definition of Significant Terms used in the Study

Community Engagement- In the context of the study, it refers to consulting with community leaders, opening and maintaining communication channels, education, training and participatory planning and implementation of activities.

Effectiveness - the extent to which results are achieved in an exercise.

Eradication - It is defined as the permanent reduction to zero of the worldwide incidence of infection by a specific agent (Molyneux et al., 2004)

Evaluation- is measuring or reviewing elements of success in a systematic and objective way in the project cycle. It focuses on whether the project was effective and achieved its objectives.

Fly Per Trap per Day (FTD) - Measure of density of tsetse fly in a given area using tsetse fly traps

Insecticide Impregnated target- A blue/black cloth measuring 73.3cmx70cm held by metal frames and pivoted on the ground by a metal pole. It is treated with insecticides mostly synthetic pyrethroids. Odours for example acetone and phenols would normally be placed near the target to enhance attractiveness to tsetse.

Spraying of animals- The process of applying insecticide on animal's body using spraying pump.

Trypanosomiasis - Also known as Nagana in livestock and sleeping sickness in human caused parasitic protozoan trypanosomes of the genus trypanosoma transmitted by tsetse flies, a major constrain to livestock production and affects economic development and settlement in tropical Africa.

Tsetse fly - Any of several two-winged bloodsucking African flies of the genus Glossina, often carrying and transmitting pathogenic trypanosomes to human and livestock.

1.12 Organization of the Study

The proposal is organized in five chapters excluding the preliminary pages which contain the title, declaration, dedication abstract, acknowledgement, table of contents, list of figures, list of tables, abbreviations and acronyms and at the back matters containing the references, letter of transmittal and the questionnaire.

Chapter one entails the background and history of tsetse and trypanosomiasis problem in African perspective and how it is linked to economic lose poverty. It provides for reasons why African countries decided for eradiation of the disease and why Pate Island was selected for the project in Kenya Coast

Chapter two provides for literature review on both theoretical and empirical literature on methods and approaches employed in tsetse and trypanosomiasis eradication both at the continental and in Kenya. The chapter ends with a conceptual framework.

Chapter three contains the research design, target population, sampling procedures and sample size, methods of data collection, data validity, data reliability, and data analysis techniques, ethical considerations and operational definitions of variables.

Chapter four contains key findings which include profile of the respondents, tables of descriptive statistics of variables and analysis of factors influencing effectiveness of tsetse eradication.

Chapter five is on summary of findings, discussions, conclusions, recommendations and suggested areas for further research.

CHAPTER TWO

LITERATURE REVIEW

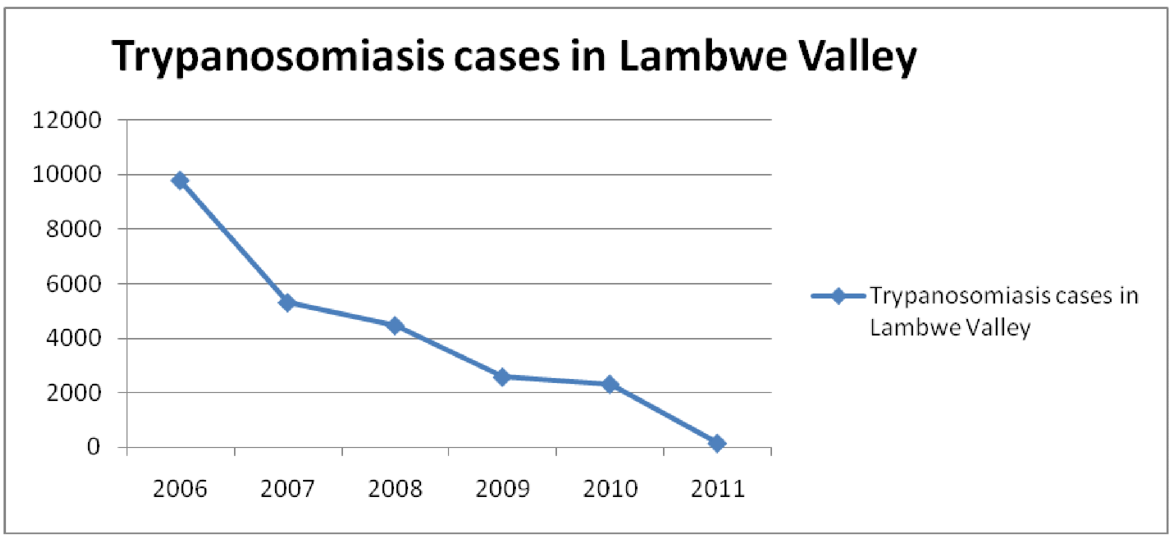
2.1 Introduction

In this section, it explain how community engagement ,installation of insecticide impregnated targets, training of farmers, spraying of animals and treatment of animals have been effective in tsetse and trypanosomiasis eradication in Pate Island ,Lamu county.

2.2 The Kenya situation

Kenya has made strides in attempt to eradicate tsetse and trypanosomiasis in the last eight years. The results of these efforts at the Ruma National Park, Lambwe valley are shown in the graph below. At the start of the project (figure 1) there were over 9000 cases of trypanosomiasis and upon intervention, infections reduced zero by 2011.

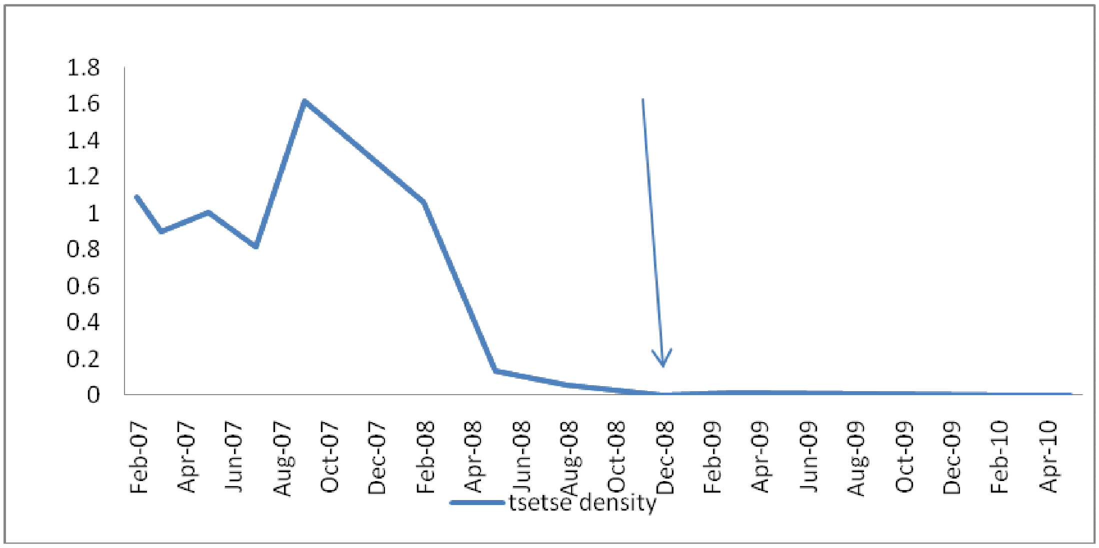
Figure 1: Cases of trypanosomiasis in Ruma National Park



Source: PATTEC Coordinators, Proceedings, Awassa, Ethiopia 2012.

Figure 2 below shows the trend on tsetse fly density reduction with time in Mwea Game Reserve. Tsetse fly density was reduced from FTD of 70 in 2006 to 0 in 2011.

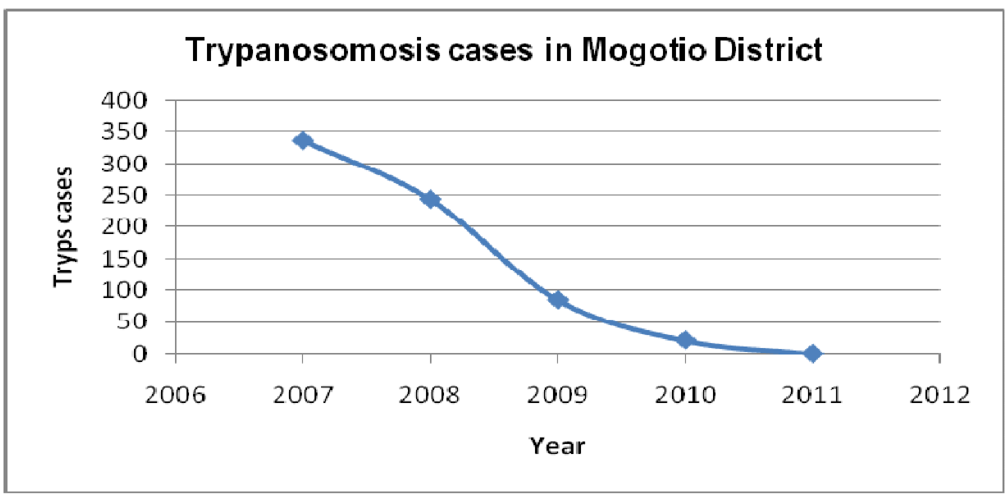
Figure 2: Tsetse fly density in Mwea Game Reserve



Source: PATTEC Coordinators, Proceedings, Awassa, Ethiopia 2012

Figure three below shows that there was significant reduction of Trypanosomiasis from about 300 in 2007 to zero by 2011.

Figure 3: Cases of Trypanosomiasis in Mogotio Lake Bogoria



Source: PATTEC Coordinators, Proceedings, Awassa, Ethiopia 2012

2.3 Community Engagement and Tsetse Eradication

Community is the term that is applied to a settlement scheme, a village, a tribe or a nation sharing a particular interest and self-contained with a well defined social coherence. Community engagement and mobilization aims to harness and focus community development priories towards awareness creation and participation in all the matters relating to eradication of the disease and its vector. Leadership is identified and centers of power are appreciated and consulted for buy-in. This is done through meetings, workshops and training. Several existing groups were identified, reenergized and refocused to include disease control as one of their activities (Somda J et al 26 ISCTRC).

Tsetse control in Kenya has revolved around the manipulation of the habitat, ground application of insecticides, Sequential Aerial Technique and the use of traps and insecticide impregnated target. These interventions have been largely donor or government driven because in most times control activities have occurred during an emergency situation following an outbreak or an epidemic of trypanosomiasis (Wilde B.T et al, 1989).

The participation of local communities is regarded as essential if cost effective and sustainable tsetse control is to be achieved. However, the sustainability of community involvement itself has proved elusive, with projects reporting loss of interest and failures to maintain traps/targets at the end of the project life. There was therefore a need for the greater understanding of the elements of community participation and factors affecting its sustainability and impact on the control of tsetse (DFID, 1998).

According to Somda (2006), the realization that there was need to sustain tsetse eradication efforts beyond project life, led to investigation of the underlying incentive structure for individual in the community to cooperate in the provision of various control methods

In 1994 a team of consultants carrying out feasibility studies for the commencement of Farming In Tsetse Control Areas (FITCA) Project in Western Kenya acknowledged that if tsetse and trypanosomiasis control is to be effective and sustainable it cannot depend on donor and governments, but must depend on communities whose livestock are threatened and who are the primary beneficiaries of tsetse control (FITCA, 1999- 2004).

The challenge posed by tsetse and trypanosomiasis is that it is regarded as a local and public good where the community expect the cost to be borne by external party be it the donor or the government (ISTRC, 1999). Studies in Nguruman, Kajiado on the adoption of tsetse control technologies indicated there were poor rates of uptake of the technologies (Dransfield et al 1990).

Studies have shown that lack of ownership and commitment by the local residents, unmet specific expectations and a community averse to extension contributed towards poor adoption of the intervention measures (ISCTRC, 1999).

2.4 Installation of Insecticide impregnated Targets and Tsetse Eradication

Insecticide impregnated targets are devices made of blue and black cloth, 70cm by 220 cm sprayed with insecticide formulation, strained on a wire frame. Tsetse attracting chemicals, phenols and acetone are placed next to the target to enhance capture of tsetse flies. Tsetse flies are attracted by blue colour and the smell of the attractants, the black colour causes landing effect, where the fly then picks the killer insecticide inducing mortality. About one thousand one hundred and thirty targets have been deployed in a sixty (60) Square kilometers arable part of Pate Island, which is an average of 18 targets per Square kilometer.

2.4.1 Principle of tsetse Targets

Tsetse has a high metabolic rate and feed on vertebrate blood. Their survival therefore depends on detecting and encountering suitable hosts on which to feed. This principle can be exploited in the design of traps and targets which mimic key features of the normal host animals, attracting tsetse in such a way that they can then be captured or killed (FAO Training Manual Vol. V, 1993).

2.4.2 Target development history

Attractive devices for control of tsetse flies were developed by scientist from as early as 1920.They took many forms sizes and designs including traps designed by Harris, Swynnerton, Jack, Morris and Langridge. In 1950s the use of these devices were discontinued in favour of the novel insecticide Dicloro diphenyl trichloroathane(DDT) that was sprayed to the tsetse habitat using knapsack sprayers. In the late 1970s and 1980s, due to environmental concerns over widespread use of chemicals the need to develop environmentally friendly devices was revived through works of Challier and Gouteux who developed the F3 target which is the prototype of the present blue black target (FAO Training Manual Vol. IV, 1992).

2.4.3 Target design

For all tsetse species studied blue and white are the most attractive colours with phthalogen, blue, and royal blue, considered the best. Black promotes a settling or entry response. Targets are made of blue/black polyester material with a dimension of 73.3cm x70cm, held by metal rods and pivoted on the ground by metal pole. The target is impregnated with an insecticide formulated to last for up to seven months in the field. The main chemical used are synthetic pyrethroids, deltamethrin supplied as a 20% suspension concentrate (s.c) being most widely used. The recommended concentration is 0.3% in order to improve persistence at active levels for about 7 months, therefore reducing costs (FAO Training Manual Vol. V, 1993).

Flies are attracted by the blue segments of the target and land on the black segment, quickly succumbing to the insecticide, the effectiveness of the targets can be greatly enhanced by addition of appropriate odour bait. Such baits are usually short chain aromatic compounds such as acetone or octenol (Kuzoe & Schofield, 2004).

2.4.4 Tsetse target function and relationship with trypanosomiasis

Insecticide impregnated targets function by removing individuals from the existing tsetse population. Their efficiency depends on the length of time the device remain operational, and likelihood that individual fly will encounter the device and be killed by it. The length of time the device remains operational depends on a number of factors including resistance to environmental damage for example wind and / damage by large animals, theft, degradation (particularly colour fade, depletion of odour baits, and loss of insecticidal activity). The likelihood that an individual fly will encounter and be killed or captured by the device depends also on the number of targets relative to the local abundance of tsetse and on the particular foraging and dispersal behavior of the target species such as G. morsitans, each fly disperse up to 500 meters in a single day, so that with an average trap density of four traps per km^2, there is likelihood that each fly may disperse sufficiently to encounter at least one trap(Kuzoe and Schofield, 2004).

As trypanosomiasis control tool the target exert downward pressure on tsetse population that would lead a reduction in trypanosomiasis transmission. Overall, the relationship is non-linear, extending from point of less than zero flies to more than zero transmission to a theoretical plateau at which all susceptible hosts would be infected irrespective of increasing fly density. Nevertheless, it is generally held that over practical range of host infection rates, the relationship between tsetse density and trypanosomiasis transmission is sufficiently close to linear to warrant that in reduction of fly density will lead to reduction in the likelihood of transmission. Subsequent analysis of past field data indicated an effectively linear relationship between percentage reduction in man-fly contact and percentage reduction in human sleeping sickness incidence in West Africa. This conclusion also held for data from studies of cattle infection in East Africa, involving *G.morsitans*, *G.swynertoni*, *G.pallidipes, G. fuscipes, G. longipenis and G. brevipalpis*, where the daily probability of infection was linearly correlated with tsetse challenge(apparent fly density x infection rate) (Rogers, 1985).In general therefore, it can be argued that deployment of targets that destroy a proportion of these population will lead to a reduction in trypanosomiasis transmission(Kuzoe & Schofield,2004).

2.4.5 How Insecticide Impregnated target works

Targets have been used extensively in control of tsetse and trypanosomiasis in the.37 countries of Sub Saharan Africa. In Ghibe Valley, South -West Ethiopia, a tsetse control trial using deltamethrin-impregnated targets was started in May 1990. The mean relative density of the main vector, *Glossina pallidepes*, fell from 2.1 flies per day in the 12 months prior to introduction of tsetse control to 0.41 flies per trap per day in the 12 months after tsetse control was initiated. The annual mean prevalence of trypanosomiasis in cattle fell from 32% in the years before tsetse control to 13% in the 2 years following deployment of targets(Leak S et al 1996).

Between 1986 and 1998, Zimbabwe and the countries surrounding it undertook a project called Regional Tsetse and Trypanosomiasis Control Programme to reclaim 20,400km^2 that were tsetse infested. Insecticide impregnated targets were used as barriers in order to protect reinvasion, and also in difficult terrains where aerial spraying could not be conducted.(RTTCP Final report 1998).

Kenya Trypanosomiasis Research Institute (KETRI) scientists demonstrated that insecticide impregnated targets baited with octenol and acetone odours reduced *Glossina pallidepes* tsetse population by 99.9% in Lambwe Valley, Lake Victoria basin in the first year of deployment. In Galana Ranch at the Kenya Coast hinterland the area under insecticide impregnated targets remained free of *G. pallidepes* for a period of three years the trials were running (Opiyo E et al, 1990).

Olkramatian Shompole Community Development Project in Kajiado commenced a tsetse control project in 1991 in about 100km^2 using insecticide impregnated targets. In three years, there was reduced density of flies and incidences of trypanosomiasis in cattle (Dransfield, 1993).

Studies carried out to compare the use of deltamethrin impregnated odour baited targets in Galana Ranch Coastal hinterland and Ruma National Park between tsetse fly population at Ruma National Park in Lambwe valley was reduced by 99% in the first year, while berenil index in cattle had dropped from 6.3 to 0 while in Galana, the area remained free of tsetse in three years with berenil index dropping to 0.07 in a period of 9 months in the second year (Opiyo E et al., 1990).

2.5 Spraying of Livestock and Tsetse Eradication

This is a recently developed technique regarded as modification of the target method whereby, instead of stationary traps or screens, insecticides-treated domestic animals, primarily cattle are used as attractive, mobile, living targets (FAO, 1988).

Synthetic pyrethroids like deltamethrin are commonly used. They have high toxicity against tsetse even with very brief contact, good levels of persistence on the treated animal and low mammalian toxicity which make them safe to apply to the target animal: also, the meat and milk from treated animals may be used for human consumption, even immediately after treatment. The synthetic pyrethroids are supplied in formulations so that they can be applied through dipping, spray-races, hand spraying or as pour-ons (FAO, 1992).

Dipping or spraying is done every two weeks but can be reduced to one week during periods of heavy rainfall. The technique is gained widespread use and that by 1988 over 16000 cattle were being treated (Thomson et al.1991.Torr et al. 1998a). Equally rapid uptake of the technique occurred throughout many tsetse infested countries including: Burkina Faso (Bauer et al., 1992), Ethiopia (Leak et al., 1995), Kenya (Stevenson, 1991), Tanzania (Fox et al., 1991 and Zambia (Chizyuka & Liguru, 1986).

By 1991 Zimbabwe tsetse was controlled through the deployment of *ca* 60,000 targets combined with a barrier of 200,000 insecticide-treated cattle along the NE border with Mozambique. In Tanzania insecticide-treated cattle have been more widely employed attempting to control tsetse. The most successful application of this technology in Tanzania has been in the Kagera region where tsetse has been virtually eradicated from large proportion of Bukoba and Karogwe (Thompson, 1991).

2.6 Training of Farmers and Tsetse Eradication

Farmer training is a very essential element of project implementation. New technologies are being introduced new or improved methods of pest management, record keeping, skills and knowledge in the dynamics of tsetse and trypanosomiasis. A farmer trained to identify the disease transmitting tsetse has to change of attitude so as to embrace the novel way of solving pest and disease management challenges.

Training of farmers is conducted to ensure the farmers understand the importance of livestock spraying, how to mix the chemicals, safe handling and the frequency of spraying. They are trained to manage crush pens and on technologies for tsetse control (FAO, WAR 90-1998-1).

All livestock that come down on trypanosomiasis are treated. Farmers are trained to correctively diagnose the symptoms of the disease before calling the veterinarian to treat the sick animal.
These approaches have been implemented since 2009 with the aim of reducing the tsetse fly population and its eventual eradication and that of the disease it transmits. Three years into the project, it has not been established if the approaches employed in the eradication of the tsetse fly and trypanosomiasis have been effective and worth the effort in Pate Island.
International legitimization for community participation in health programmes came from the Alma Ata Primary Health Care Conference in 1978.The concept of community participation in the control of African trypanosomiasis evolved out of the need for an integrated approach in which some of the responsibilities for sleeping sickness control be devolved to the primary care level(Kuzoe et al 2004).

Considerable resources have been devoted to research and development of tsetse trypanosomiasis control technologies. Major strategies include vector suppression, chemotherapy and use of trypano-tolerant livestock breeds. However, most methods to control tsetse and trypanosomiasis have proved to be neither safe nor sustainable. Such efforts have suffered from four major constrains: (1) they are beyond the economic reach of most countries affected by tsetse;(2) such methods as aerial and ground spraying pollute the environment;(3) parasite resistance to drugs is a major problem, and (4) control methods are largely in the hands of outside agencies, not target users, making sustainable management difficult (CDC UNDP GSSD Academy SIE vol.1 Kenya).

In areas without sleeping sickness, the benefits of tsetse control derive from a reduced risk of animal trypanosomiasis. A diminution in the incidence of trypanosomiasis should reduce the use of trypanocidal drugs and mortality rates and increase the productivity of existing livestock in terms of meat and milk, of take and efficiency of draught power. In addition, the risk of trypanosomiasis affects farmer's livestock management practices, shaping their choices about purchase, sales breeds and overall composition of herd. The evidence from a small number of studies reviewed by Swallow (2000) suggests that farmers in areas of high trypanosomiasis risk raise only24^60% of the number of cattle that are kept by farmers in nearby areas of low risk. (Kamuanga et al, 2001).

A general decline in the capacity and funding of national veterinary institutions means that communities affected by trypanosomiasis are forced to control the disease themselves. Consequently, communities- based initiatives to control tsetse has become one of the major methods of controlling trypanosomiasis. However despite attempt by various communities, the results have been generally disappointing and there are few examples of sustained control of tsetse being achieved by a rural community without significant financial and technical support from/or national governments. The cause of this failure are complex, but at least part of the problem is that rural communities and the organizations that facilitate community-based tsetse control, do not have adequate access to information on how to apply tsetse control technologies(FAO TECA 2013).

2.7 Treatment of sick Animals and Tsetse Eradication

African Animal Trypanosomiasis (AAT) is a disease complex caused by tsetse fly transmitted blood parasites, *Trypanosoma congolense*, *T.vivax*, or *T. brucei brucei*, or simultaneous infection with one or more of these trypanosomes. African trypanosomiasis is most important in cattle but can cause serious losses in pigs, camels, goats, and sheep. Infection of cattle by one of the three African trypanosomes results in sub-acute, acute or chronic disease characterized by intermittent fever, anemia, occasional diarrhea, and rapid loss of condition and often terminates in death, left untreated (PAAT, 2004).

Tsetse flies can acquire trypanosome parasite by feeding on infected people and large domestic and wild animals. When infected tsetse fly bites it injects the parasite into the blood. The parasites multiply and invade the body fluids and tissues (WHO The vector, 2013).

Animal African Trypanosomiasis (AAT) is treated with homidium, isometamidium and diminazene. Human African Trypanosomiasis (HAT) is treated with suramin, pentamidine, melarsoprol and aflornithine (DFMO), or a combination of DFMO and Nifurtimox. Monotherapy can present serious side effects, for example, melarsoprol, the more frequently used drug that is effective for both hemolymphatic and meninggoencephalic stages of the disease, is so toxic that it kills 5% of the patients. No new drug has been developed for HAT since 1970, posing dangers of drug resistance (Kroubi, 2011). The drugs used to treat both HAT and AAT developed over 50 years ago and cases of drug resistance have been reported widely. Technologies to control and eradicate the tsetse fly vector have been developed in the last 100 years and despite this Africa have not been able to solve one her oldest disease. The World Health Organization (WHO) considers African Trypanosomiasis as one of the Tropical Neglected Disease (TND) (WHO/WHA (Report Seventh plenary meeting, 21 May 2004).

2.7.1 Limitation of chemotherapy in African Animal Trypanosomiasis

The usefulness of chemotherapy is limited in the field because cattle in contact with tsetse flies are liable to re-infection. If chemotherapy is to be successful, there is need for regular monitoring of the trypanosomiasis in the herd. It is essential to know at which point drug intervention would be appropriate, which species of trypanosome is prevalent and its drug sensitivities. The degree to which these can be determined will depend on the sensitivity of the diagnostic techniques used and the manpower available. It has long been recognized that drug resistance is a major impediment to the effective control of trypanosomiasis and thus improve livestock production (Ilemobade, 1987)

Chemotherapy for trypanosomiasis in cattle, sheep, and goats currently relies on use of salts of three compounds: isometamidium, homidium and diminazene. All the three compounds are closely related chemically and have been available for at least thirty years. Although these drugs have effectively controlled the disease in the field, the prevalence of resistance to each compounds appear to be increasing. There is therefore, an urgent need to develop new compounds chemically unrelated to whose now in use. The development of new drugs, before drug resistance becomes a widespread problem, will help ensure the long-term productivity of domestic livestock in Africa (Workshop Proceedings ILRAD, 1989).

The savanna tsetse groups have high vectoral capacity and with the virulence of the trypanosomes they transmit, chemotherapy is less successful, unless it is combined with tsetse control measures.

2.7.2 Measures aimed at combating drug resistance

The following measures are aimed at combating drug resistance.

2.7.2.1 Change of drugs

When drug resistance became a problem following widespread of use of antricide in Kenya (Whiteside ,1960) homidium compounds were introduced and used extensively between 1954 and 1965 and were withdrawn from general use for two years following widespread drug resistance by T. congolense and replaced by Berenil which had been introduced in the market in 1965. The last drug to be introduced in fight against trypanosomiasis was isometamidium (Samorin) in 1961 for prophylaxis. To date no new drug has been developed.

2.7.2.2 Sanative treatment

The concept of sanative treatment prescribes the use of trypanocides (e.g. Berenil and Homidium) which are chemically unrelated and therefore are unlikely to include cross resistance. One of the pair is used until resistant strains of trypanosomes appear and then the second is substituted and used until the resistant strains have disappeared from cattle and tsetse. (Whiteside,1962).

The treatment regime became effective for ten years before isolates of *T. congolense* and *T. vivax* with multiple resistances to curative tyrpanocides were isolated and subsequently found to be widespread (Ilemobade, 1979). There was no drug to fall back to.

According to Leak (1998) drug resistance in trypanosomiasis is a serious problem. It will continue to remain a critical challenge to the control of the disease until the basic mechanism of resistance is known in the meantime, the judicious use of trypanocides must be insisted upon so as to limit the spread of resistance. While chemotherapy has a place in the short and medium term control of animal trypanosomiasis, greater success will be achieved when combined with tsetse fly control measures. Due to the high cost of developing new drugs and the relatively small market, prospects for the development of new drugs in the near future remain slim.

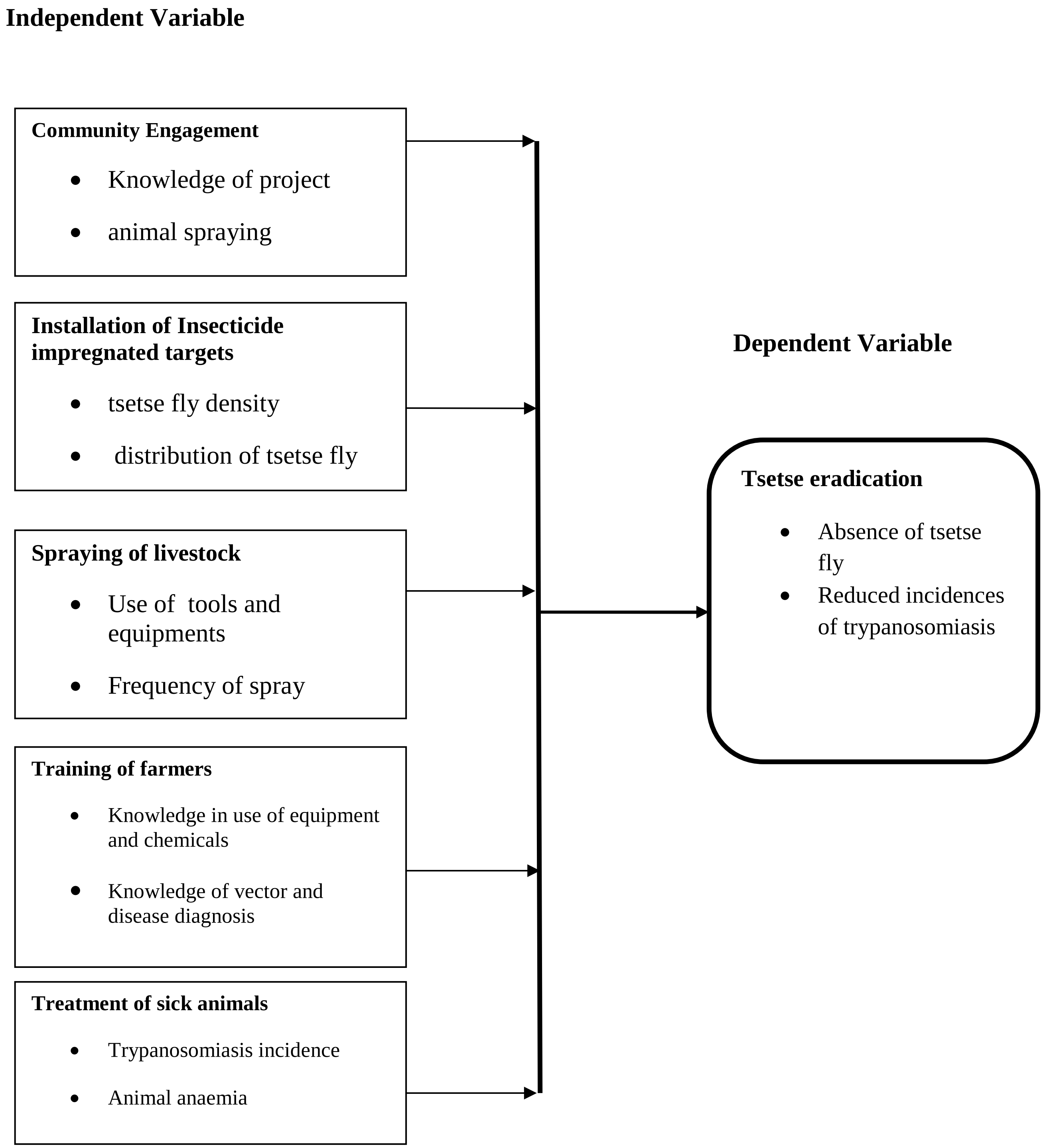
2.8 Conceptual Framework

A conceptual framework explain either graphically or in narrative form the main things to be studied, that is the key factors, constructive or variables, presumed relationships among them. Conceptual framework can be rudimentary or an elaborate theory driven or commonsensical descriptive or casual (Miles M, Huber man M, 1994). According to these authors, there are two things the concept does to researcher. First, it specifies who and what will and will not be studied. Secondly, the conceptual framework assumes some relationships are purely logical.

Conceptual framework is the foundation of parameters or boundaries of the study. The conceptual framework for this study will seek answers to the specific variables identified and the relationships among the independent and the dependent variables and to establish their connectivity to the objectives of the study.

The study of the interplay of the variables shall reveal how these have influenced the effectiveness in the eradication of tsetse and trypanosomiasis in Pate Island, Lamu County. The dependent variable in this study is tsetse and trypanosomiasis eradication and its effectiveness is influenced by various independent variables either singly or as a whole.

Figure 4: Conceptual Framework



The conceptual framework above shows the relationship between the variables of the study that will guide the study. It shows the independent variables (community mobilization, insecticide impregnated targets, spraying of livestock, training of village technicians and treatment of sick animals) affect the dependent variable (tsetse eradication).

2.9 Summary of Literature

Community participation is important in implementation and sustainability of any tsetse control or eradication activity. Often projects have been initiated and implemented as a result of disease outbreak that would demand quick response to reduce fly population as quickly as possible in order to minimize man-fly contact. Poor involvement of communities has led to poor uptake of technologies to sustain the project therefore occasioning failure resulting in recurrence of the disease. Odour baited insecticides impregnated attractive devices include traps and targets have demonstrated that it can reduce tsetse population significantly and thereby braking disease transmission between the vector and man or his livestock. The target exerts downward pressure on tsetse population that would lead to reduction in transmission of trypanosomiasis. Successful use of targets has been demonstrated in Ethiopia, Zimbabwe and in Lambwe valley and Kajiado in Kenya.

Spraying of livestock is similar to the target technology, only that the animal becomes a mobile device unlike the stationary target. Insecticides formulation that is sufficiently lethal to tsetse is applied on the animal either as a dip wash pour-on or in form of spraying. This technology was used successfully as tsetse fly barrier in Zimbabwe that would protect tsetse free area from being re-invaded. Training is an essential part of the implementation of a tsetse control activity. Training includes safe handling of chemicals, equipment target setting and maintenance. The concept of community participation came about in late 1970s where stakeholders felt that there was need for an integrated approach to health care especially sleeping sickness. Kenya treatment of infected animals is usually the preferred choice to most livestock keepers as it is the most convenient method of containing the disease. This has led to sale of counterfeit drugs to pastoralists resulting in the development resistant parasites to drugs that cause mortalities in livestock.

Information on whether combinations of the above technologies used together in an isolated Island in East African Coast work against *Glossina austeni* species of tsetse is yet to be documented, hence this study.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction.

In this chapter the proposed research designed is examined, the location of the study area, the population, sample size, data collection and data analysis procedures that would be used for the research are described in detail.

3.2 Research Design

According to Ngechu (2006) research design is a process of meticulous selection of methods to be used to answer the research question and solve the research problem. The research problem was studied through descriptive survey design. According to Bickman and Rog (1998) descriptive studies are usually the best methods for collecting information that would demonstrate relationships and describe the world as it exist. It answered questions such as "what is" or "what was". Descriptive research design was chosen because it enabled the researcher to generalize the findings to a larger population. AECT (2001) adds that descriptive studies report summary data such as measures of central tendency including the mean, median, deviation from the mean, variation, percentage, and correlation between variables.

3.3 Target Population

Study area is in Pate Island off Lamu archipelago at (2^0 06'S $41^{0.}$03'E) within the Indian Ocean. The Island has human of population of 15000 comprising of 1300 farm families. There are 8,150 heads of cattle, 3,200 goats and about 6000 donkeys (Kenya population Census, 2009).Pate Island falls under L4 agro ecological zone, meaning it is a semi arid area and frequently suffer food and water shortages. Islam is the predominant religion, and whereas men pursue fishing as source of income, the women are the caretakers of livestock (Farm Management Handbook of Kenya, *Vol.II,* Part II/C, SubpartC2) Pate falls under tsetse fly infested belt of the East and

Southern African Coastline, from Djibouti to Mozambique where the predominant species *is Glossina austeni (new stead).*

The proposed study targeted households that are in the clustered villages of Pate, Siyu, Tchundwa, Rasini, Kizingitini and Mbajumwali in Pate Island the Island, the livestock and habitats where tsetse fly reside.

3.4 Sample Size and Sample Procedure

Sample size is influenced by several factors such as the spatial extent for example province or district; hypothesis being tested and the level of statistical significance required (Maitima, 2007). There are two types of measurements that the researcher will use to estimate in analysis: the mean value and percentage value. F or a mean, the required formula is

$$s = (z/e)^2$$

Where:

s = the sample size

z = a number relating to the degree of confidence which is 1.96 for 95% level of confidence.

e = is error to be accepted, measured as proportion of standard deviation (ibid).

For percentages Mugenda and Mugenda (1999) formula for sample size in a survey design based on simple random sample, can be calculated using following formula.

Formula:

$$n = \frac{Z^2pq}{d^2}$$

Key:

n = the desired sample size

z = the standard normal deviation at the required confidence level at 95 %(standard value of 1.96)

p = the proportion in the population estimated to have characteristics being measured

q = 1-p

d = the level of statistical significance or error to be accepted (0.05)

Applying the formula,

$s = 1.96^2(0.5*0.5)/0.05^2 = 384$

A total of 408 heads of cattle, which is about 66 per village, were sampled for trypanosomiasis survey. Ideally pilot surveys are done to capture the variability or the population which can be used to determine the appropriate sample size for full survey. However, in many cases pilot surveys are rare due cost and time constraints. One rough and ready rule is to look at 20 to 30 respondents for each of the major factors considered in the study. The researcher carried out interview survey in 10 randomly selected households in the 6 villages making a total of 60 respondents in Pate Island.

For tsetse survey Alemu (2007) used 15 sites to monitor tsetse population in the 10,500 square Kilometers of the Ethiopian Southern Rift Valley tsetse eradication project. The researcher installed 20 geo referenced tsetse traps at randomly selected sites along transects for tsetse survey.

3.4.1 Trypanosomiasis sampling procedure

Trypanosomiasis incidence was studied by way of collecting blood samples from cattle which are mainly the East African zebu and Boran crosses of all ages and both sexes. Sampling was carried out in five villages where about average of 66 cattle were randomly selected per village based on the body condition of the animal. Veterinary assistants and livestock owners helped to select animals for blood sampling. Every selected animal was physically examined for about 5 minutes in the cattle shed by the technical officers and the cattle owner. The condition of the animal was determined by giving scores on a 1 to 4 (1=very poor, 2=poor, 3=good, 4= excellent) Animal that cored 2 and 1 were sampled for trypanosomiasis investigation (Chikungwa, 2005).

3.4.2. Tsetse fly sampling procedure

Systematic sampling is the most common used pattern of tsetse sampling. Traps were positioned at regular intervals in a transect manner to pass through all vegetation types (FAO, 1992). 20 geo referenced (using hand held Garmin Etrex 12 channel GPS) biconical traps baited with acetone and phenols were deployed along a transect covering open, wood grass land and mangrove vegetation coverage. Flies were harvested every 24 hours for identification, aging, sexing and recording (IAEA, 2006).

3.5 Data Collection Methods

There are two basic approaches in data collection (Maitima et al, 2007). One is conducting a complete census and the other is conducting a survey in a sample of the population or area under study (ibid). Because of time and cost constraints, the researcher used survey approach to collect data. Collection of data on the disease and the vector was done using standardized field methods of blood sampling and use of specially design tsetse fly traps. Data collection for the other factors in the study was by use of well designed highly structured questionnaires to be administered in the households.

3.5.1 Trypanosomiasis data collection

Screening for trypanosomes involved blood collection obtained by jugular venipucture into vacutainer tube containing salt of Ethylene- Diamine-Tetra Acetate (EDTA) as an anticoagulant. Each of the tubes were filled up to ¾ of its length and immediately kept cool in ice packed cool boxes, before field laboratory examination.

3.5.2 Tsetse fly data collection methods

Biconical trap developed by (Challier et al, 1977) is widely used in Africa for sampling many species of tsetse flies (Rogers et al, 1994). It is made of blue and black polyester material on the lower cone while the upper cone is covered by white netting. A metal wire separates the two cones and a centre metal rod supports the structure. Flies are collected by a cone placed at the top exit hole. Trapping sites were carefully selected Biconical traps baited with acetone and phenols were installed on a previously cleared ground and are left for 72 hours. Flies were collected every 24 hours, identified, aged, sexed and recorded(IAEA, 2007).Ideally absolute population density could be estimated, but in practice this is often not possible. So instead the relative population density was determined, that is the number of flies per trap per day (FTD). Such measures are used to compare apparent densities in different localities or at different times of seasons but more importantly before and after eradication intervention (FAO, 1992). Generally tsetse flies concentrate in dense vegetation in the dry season and extend into more open areas during the rains. In order not to miss out on the presence or absence of tsetse flies, systematic sampling in which transects are cut to pass all vegetation types and traps were positioned at regular intervals.

3.6 Data Collection Procedures

The data for this study were collected using three approaches. Blood samples were collected from random sample of average of 66 animals from 6 villages selected to make a total of 408. Tsetse sampling was conducted by erecting tsetse traps in a line transect that would capture all possible tsetse habitat. Data for the other factors under the study were collected by of suitable questionnaire modified from related research and modified by the researcher. In the questionnaire Likert scale was used to determine levels of responses to various questions.

3.6.1 Trypanosomiasis collection procedures

In the laboratory the blood samples were screened for trypanosomes using Standard Trypanosome Detection Methods (STDM) namely wet, thick, and thin smear examination as well as the Haematocrit Centrifugation Technique, Buffy-Coat examination as described in (Sewell and Brooklesby, 1990). Blood collected were centrifuged at 1200 revolution per minute (rpm). After centrifugation the PCV level was measured using haematocrit capillary reader. Blood samples that have a PCV of less than 25 were subjected to microscopic examination using the dark ground phase contrast technique (Murray et al, 1977). Thick and Buffy coat examination will be carried out as described by (Paris et al 1982) and thin smears will be prepared from the EDTA preserved blood. Trypanosome positive samples were stained with Giemsa for species identification at 1:10 dilution for 30 minutes as per standard methods and slides were examined under the microscope at magnification of x100 under oil immersion (Murray et al 1983). Blood smears were done via cutting the centrifuged blood containing capillary tube 1mm above and below the Buffy coat layer using a diamond tipped pencil, so as to include plasma and red blood cells in the blood smear. The blood then were expressed on to the clean glass slide, mixed well and covered with a clean cover slip glass. Examination were done under 40x objective and 10 x eye piece magnifications, using dark ground Buffy Coat technique (Murray et al., 1977). Records were entered in a specially design record sheet.

3.6.2 Tsetse fly data collection procedures

The first fly collection was done 24 hours after deployment. The collecting cage was carefully removed and any fly that may not have entered the cage was caught and counted. Life flies would attempt to escape during the counting but this may be solved by exposing them to chloroform or put in a cool box and covered in wet cloth in order to immobilize them. Fly cages were checked for flies at the same time each day for collection from the traps, preferably at the time when they were inactive, like early in the morning. Cages were checked for holes every day before putting them on the trap, and odours replenished when necessary. Tsetse flies were to be identified in terms of species, aged in terms of teneral or non-teneral, sexed as males or females. The information was entered in a specially designed entomological field data sheet. A column is provided in the data sheet to record any other insect that may have been trapped in the cage.

3.7 Validity of Research Instruments

According to Mugenda and Mugenda (1999) validity is the accuracy and meaningfulness of inferences, which are based on the research results. It is the degree to which results obtained from the analysis of the data actually represent the phenomenon. In order to establish the validity of the instruments the researcher sought opinions from his supervisor and lectures in the department. The research questionnaire was pilot tested before being administered so as to ascertain its accuracy and the results being true representation of the respondents. In the case of trypanosomes survey in animals the study used Standard Trypanosome Detection Methods (STDM) namely wet, thick, and thin smear examination as well as the Haematocrit Centrifugation Technique, Buffy-Coat examination as described in (Sewell and Brooklesby, 1990), hence the results can be compared to any in the world. On tsetse survey, standard biconical trap baited with phenols and acetone was used. This trap is used universally for survey of all tsetse species.

3.8 Reliability of Research Instruments

According to Shanghverzy (2003) reliability refers to the consistency of measurement and is frequently assessed using the test-retest reliability method. Reliability was increased by including many similar items on a measure, by testing a diverse sample of individuals and by using uniform testing. The research questionnaire was designed to ensure there were no ambiguities and was easily understood by the enumerators as well as the respondents. The results could therefore be relied upon as representation of the position of the Island population. On trypanosome parasite surveys the Standard Trypanosome Detection Methods as described by Sewell and Brooklesby, 1990, are the most reliable methods to be used in any trypanosomiasis survey. Tsetse fly survey trap has been developed by scientific experts on tsetse fly from as early as 1920. In order to enhance it efficiency, tsetse attractants, phenols and acetone were used as baits. The results obtained from use of biconical trap are comparable to those from any tsetse fly infested areas of Africa.

3.8 Data Analysis Technique

Before processing the responses, the completed questionnaires were edited for completeness and consistency of the data was coded to enable categorization of responses. Quantitative and qualitative data were collected and subjected to statistical analysis. The findings were represented in tables. The Likert scale was used to analyze the mean score and standard deviation, this would influence the effectiveness of the project in the eradication of tsetse in Pate Island. Statistical Package of Social Science (SPSS) was used for tabulations, means and other central tendencies. The research hypothesis was tested by use of chi-square, correlation and regression to be able to identify any relationships between the variables of the study. Tables were used to summarize responses for further analysis and to facilitate comparison.

3.9 Ethical Consideration.

Aware of the information that may come from the respondents by way of this study the researcher endeavored to respect the confidentiality of the population. The researcher maintained integrity and operated within the confines of law and the subject of study.

3.10 Operational Definitions of Variables

The researcher attempted to show the relationship among independent variables and dependent variables. Table 3.1 below summarizes the key variables that guided the study.

Table 3.1 Operational Definition of Variables

Variable	Indicators	Measure	Scale	Data Analysis Tools
Dependent Variable	1) Absence tsetse fly	Number of Flies per Trap per Day	Ratio	Mean
Eradication of Tsetse and Trypanosomiasis	2) No incidence of trypanosomiasis	Number of Animals Infected with trypanosomiasis	Ratio	Mean
Independent Variable Community	1) Knowledge of project	Source of knowledge	Interval Scale	Mean
Engagement	2) Engagement In project activities	proportion of members using technologies	Nominal	Mean
Installation of Insecticide Impregnated Targets	1) Tsetse fly density 2) Fly Distribution	Number of Flies per Trap per Day	Nominal Scale	Mean
		Extent of fly coverage	Nominal	Mean
Spraying of	1) Use of tools and equipment	proportion of farmers using tools	Nominal Scale	Mean

Livestock Sprayed	2) Frequency of spray	animals per month Number of times Animals are sprayed	Nominal Scale	Mean
Training of farmers	1) Knowledge of use of Equipments and Chemicals	Number of trained people	Nominal Scale	Mean
	2) Knowledge of Disease diagnosis	Proportion of farmers with knowledge	Interval Scale	Chi-square test
Treatment of Animals	1) Trypanosomiasis incidence	Number of trypanosome infected animals	Nominal Scale	Mean
	2) Animal anemia	Packed Cell Volume	Ratio	Mean

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND INTERPRETATION

4.1 Introduction

The study investigated factors influencing the effectiveness of tsetse and trypanosomiasis eradication in Pate Island in Lamu County. This was done due to the fact that intervention measures were instituted to eradicate tsetse and trypanosomiasis in Pate Island and there has not study to ascertain their effectiveness. Similar projects are however being implemented in the country employing same approach. Data yielded numerical values and characteristics of the sample population. The data is presented using frequency distribution tables and percentages. Relationships between variables are tested to determine their correlations.

4.2 Response Rate

Interviews were administered to 60 respondents from six villages of Pate Island by enumerators. A total of 60 questionnaires were collected giving a response rate of 100%.

4.3 Demographic Characteristics of the Respondents

The study wanted to find out the residential distribution, age, educational level, occupation and number of cattle owned by the respondents. The characteristics of the respondents in terms of their residential location, age, educational levels and their occupations were collected and can be relied upon as true representation of the population of Pate Island. The data obtained would help in profiling the respondents based on their characteristics. The results of their residential distributions, age, educational level occupation and number of cattle owned are presented in Tables 4.3.1, Table 4.3.2, Table 4.3.3, Table 4.3.4 and Table 4.3.5 respectively.

Table 4.3.1 Residential Respondents Distribution

Village	Frequency	Percentage
Pate	13	21.7%
Siyu	12	20%
Tchundwa	12	20%
Kizingitini	11	18.3%
Rasini	12	20%
Total	**60**	**100%**

Interviews were conducted in six villages of Pate Island. 21.7% were from Pate, 20% were from Siyu, 20% were from Tchundwa, 18.3% were from Kizingitini and 20% were from Rasini. The sampled population was fairly distributed among the main villages of the Island. This data is important because it shows that there was no bias in representation by the respondents and that the data can be relied upon to make generalization for the entire population.

Table 4.3.2 Age Distribution of the Respondents

Age Bracket	Frequency	Percentage
18-25	1	1.7%
26-35	15	25%
36-45	21	35%
46-55	14	23%
56-65	6	10%
66-above	3	5%
Total	**60**	**100%**

The respondents distribution according to their age were as follows: 1.7% were between 18 and 25 years,25% were between 26 and 35 years, 35% were between 36 and 45 years, 23% were between 46 and 55 years,10% were between 56 and 66 years and 5% were above 66 years. The results show that the average age of the farmers lies in the 36-45 brackets. This age bracket is relevant to the study because they form the active group in the community responsible for the uptake and sustenance of new ideas of improvement livestock production through disease control.

Table 4.3.3 Education Profile of the Respondents

Level of Education	Frequency	Percentage
Madrasa	12	20%
Primary	36	60%
Secondary	12	20%
Total	**60**	**100%**

The results show that 20% of the respondents attained Madrasa level of education, 60% were primary school level, and 20% attained secondary level. This is relevant to the study because it shows the capacity of the respondents to understand the concepts of tsetse eradication and respond to questions correctly during the interview.

Table 4.3.4 Respondents Occupation

Occupation	Frequency	Percentage
Farmer	39	65%
Teacher	3	5%
Mixed farmer	1	1.7%
Farmer/teacher	2	3.3%
Health worker	1	1.7%
Chief	2	3.3%
Business	10	16.7%
Shopkeeper	2	3.3%
Total	**60**	**100%**

Out of 60 interviews conducted, 65% of the respondents were farmers. These were followed by business people who formed 16.7% of the respondents. Teachers came third with 5%%, while farmer cum teacher, shopkeepers and chiefs formed 3.3% of the respondents. The results are valid to the study because of the representation of large percentage of the farmers among the respondents therefore lending credence to data obtained.

Table 4.3.5 Number of Cattle owned

Cattle owned Bracket	**Frequency**	**Percentage**
1-10	39	65%
11-20	6	10%
21-30	3	5%
None	11	20%
Total	**60**	**100%**

The results show that 65% of the respondents owned cattle on the1 to 10 brackets, 10% owned cattle between 11 and 20, whereas 5% owned cattle on the 21to 30 bracket. However 20% of the respondents did not own cattle although they owned other livestock. This is relevant to the study because it seeks information from people affected by the disease and the vector.

4.4 Community Engagement and Tsetse Eradication

The study sought to find out how the community learned about tsetse eradication and ways in which they are engaged in tsetse eradication. Table 4.4 and Table 4.5 below show how the respondents learned about tsetse eradication and ways in which the community are engaged in tsetse eradication.

Table 4.4 How the Respondents learned about tsetse eradication

Source of knowledge	Frequency	Percentage
Invited to Baraza	7	11.7%
Neighbour	3	5%
Extension Officer	4	6.7%
Training	8	13.3%
Tsetse targets	24	40%
Livestock spraying	13	21.7%
None response	1	1.7%
Total	**59**	**100%**

The results show that 40% of the respondents learned about tsetse eradication upon seeing tsetse targets that had been installed in the field. 21% of the respondents learned through spraying of livestock while 10% learned by way of being invited to baraza. This study is valid because it shows the level of awareness among the population, indicating that visual presence of tsetse targets in the field contributed most to awareness creation.

Table 4.5 Engagement of Respondent in Tsetse Eradication

How farmer is engaged in tsetse Eradication	Frequency	Percentage
Animal spraying	52	86.7%
Target servicing	7	11.7%
Dip committee	1	1.7%
Total	**60**	**100%**

The study sought to establish how the engagement by community had contributed towards tsetse eradication. The results as shown on table 4.6 indicate that a high percentage of 86.7% of the respondents were engaged in animal spraying while only 7% were involved in servicing the targets. The relevance of the study is that when many members of the community participate in animal spraying, there would be large proportion of animals treated with insecticides moving about killing tsetse flies thereby reducing their population hence breaking diseases transmission. The study carried out surveys to establish the prevalence of the trypanosome parasites and to find out the tsetse fly population density and distribution. The results as shown by Table 4.12 and Table 4.6 indicate that there were no parasites circulating in livestock and there were no tsetse flies caught. The absence of the disease and the absence of the tsetse fly were the indicators of the dependent variable of this study. The study therefore was not able to test the hypotheses using chi square test but by t test.

Data was analyzed based on the hypotheses where the null hypothesis H_o was that involvement of community does not influence effectiveness of the tsetse eradication project and the alternative hypothesis H_1 was that involvement of community has influence effectiveness of tsetse eradication project. A one tailed mean t test was carried out on spraying of animals by the farmers.

Table 4.6 Summary results of t -test analysis for farmer engagement in tsetse eradication

How the farmers spraying of animals in tsetse eradication	
t value	20.109
df	69
Sig. (2-tailed)	.000
Mean difference	1.200
Alpha	0.05

Test interpretation:

H_o - Involvement of community does not influence effectiveness of the tsetse eradication project.

H_1- Involvement of community has influence effectiveness of tsetse eradication project.

Since p-value is less than 0.05 level of confidence, the null hypothesis is rejected and alternative hypothesis is accepted. Involvement of the community influenced the effectiveness of tsetse eradication in Pate Island.

4.5 Installation of Insecticide Impregnated Targets and Tsetse Eradication

The study sought to determine how insecticide impregnated targets had influenced tsetse eradication in Pate Island. This factor was done by determining the density and distribution of tsetse flies. Table 4.6 below shows the results of the study. Of the 20 geo-referenced trapping sites there was no tsetse fly captured. The study is relevant because the fly density is an indicator of the effectiveness of all the control approaches

Table 4.7 Tsetse Density and Distribution Survey

Site	Coordinates	Day1	Day2 [Capture]	Day3	Spp.	Male		Female		Total	Flies dissected	Biting flies
						T	NT	T	NT			
1	SO2˚03´56.90” E041˚06´28.23”	0	0	0	0	0	0	0	0	0	0	0
2	SO2˚03´56.23” E041˚06´07.46”	0	0	0	0	0	0	0	0	0	0	0
3	SO2˚03´54.15” E041˚05´49.99”	0	0	0	0	0	0	0	0	0	0	0
4	SO2˚03´55.74” E041˚05´49.99”	0	0	0	0	0	0	0	0	0	0	0
5	SO2˚03´58.57” E041˚05´38.09”	0	0	0	0	0	0	0	0	0	0	0
6	SO2˚04´00.5” E041˚05´31.08”	0	0	0	0	0	0	0	0	0	0	2
7	SO2˚04´03.99” E041˚05´25.89”	0	0	0	0	0	0	0	0	0	0	0
8	SO2˚04´07.74” E041˚05´19.22”	0	0	0	0	0	0	0	0	0	0	0
9	SO2˚04´10.11” E041˚05´12.65”	0	0	0	0	0	0	0	0	0	0	0

Site	Coordinates	Day1	Day2	Day3	Spp.	Male		Female		Total	Flies dissected	Biting flies
			[Capture]									
10	SO2˚04′12.38” E041˚05′09.31”	0	0	0	0	0	0	0	0	0	0	0
11	SO2˚07′52.3” E040˚59′09.8”	0	0	0	0	0	0	0	0	0	0	2
12	SO2˚08′11.7” E040˚59′28.8□	0	0	0	0	0	0	0	0	0	0	0
13	SO2˚07′54.8” E040˚00′11.1”	0	0	0	0	0	0	0	0	0	0	0
14	SO2˚07′46.7” E041˚00′31.4”	0	0	0	0	0	0	0	0	0	0	0
15	SO2˚07′36.8□ E041˚00′47.4”	0	0	0	0	0	0	0	0	0	0	0
16	SO2˚07′18.5” E041˚01′17.7”	0	0	0	0	0	0	0	0	0	0	0
17	SO2°07ˈ14.5″ E041°01ˈ26.4″	0	0	0	0	0	0	0	0	0	0	0
18	SO2°07ˈ06.6″ E041°01ˈ35.0″	0	0	0	0	0	0	0	0	0	0	0
19	SO2°07ˈ01.7″ E041°01ˈ47.6″	0	0	0	0	0	0	0	0	0	0	0
20	SO2°06ˈ50.9″ E041°01ˈ57.0″	0	0	0	0	0	0	0	0	0	0	0
Total		0	0	0	0	0	0	0	0	0	0	4

T= Teneral (young unfed flies) NT= No teneral (mature flies) Spp= tsetse fly species

Table 4.8 Summary of the t-test based on farmer's perception of the influence of the insecticides impregnated targets on tsetse eradication

t-test	
t value	9.880
DF	46
Sig. (2tailed)	.000
Mean difference	3.809
P-value	0.05

Test interpretation:

H_o - Insecticide impregnated targets do not influence effectiveness of tsetse eradication project.

H_1 - Insecticide impregnated targets influences effectiveness of tsetse eradication project.

P-value calculated is less than 0.05 it therefore shows that there is significance difference of means and for this purpose the null hypothesis is rejected and that alternative hypothesis is accepted. Installation of insecticide impregnated targets had influence in the effectiveness of tsetse eradication in Pate.

4.6 Livestock spraying and Tsetse Eradication

The study also sought asses how livestock spraying had influenced tsetse eradication. The results are shown in table 4.7 below shows the frequency of spraying by the respondents. Those spraying twice a month command 65% of the sample followed by those that spray three times a month at 13.3% same as those who once a month at 13.3%. 8.3% of respondents do not spray their animals. The results of these findings are valid because low frequencies of spraying mean that few tsetse flies are killed on contact with animals that have not been sprayed.

Table 4.9 Frequency of Spraying

Spraying Interval	Frequency	Percentage
Do not spray	3	7.4%
Once	10	12.9%
Twice	22	30.0%
Three times	37	52.1%
Total	**60**	**100%**

Data was analyzed using t-test to test the hypothesis based on the frequency the farmers spray their animals where the null hypothesis H_o is that animals spraying has no influence on effectiveness of tsetse eradication and the alternative hypothesis, H_1 is that animals spraying has influence in the effectiveness of tsetse eradication.

Table 4.10 Summary of the test for animal spraying

t-test	
t value	43.00
df	21
Sig.(2-tailed)(p)	.000
Mean difference	1.955
Alpha value	0.05

Test interpretation: Hypotheses H_o - Animals spraying has no influence on effectiveness of tsetse eradication.H_1 - Animals spraying has influence in the effectiveness of tsetse eradication.

Computed p-value of 0.000 is less than alpha value of 0.05 therefore the null hypothesis is rejected in favour of the alternative hypothesis. It is concluded that spraying of animals influenced the effectiveness of tsetse eradication in Pate Island.

4.7 Training of farmers and Tsetse Eradication

The study sought to determine how training had influenced the effectiveness of tsetse eradication. Table 4.8, Table 4.9 and table 4.10 show results of the proportion of respondents using spray pump equipment, those that are able identify tsetse and those that are able to diagnose cases of trypanosomiasis in animals.

Table 4.11 Sharing Use of Spray Pump

Do you share Spray pump	Frequency	Percentage
Yes	58	96.7%
No	2	3.3%
Total	**60**	**100%**

Results in Table 4.9 show the percentage of respondents when asked if they use equipments that cause reduction in fly population. 96% of the respondents use spray pumps while only 3.3% do not. This study is relevant because it reveals that the farmers have taken up the technology introduced through training.

Table 4.12 Percentage of Respondents who could identify tsetse fly

Can you identify a tsetse fly	Frequency	Percentage
Yes	58	96.7%
No	2	3.3%
Total	**60**	**100%**

The results on Table 4.9 shows the proportions of the respondents on being asked whether they can identify a tsetse fly. A large percentage of 96.7% were able to identify. This study is valid to the study because it indicates that the respondents knew the vector of the disease.

Table 4.13 Percentage of Respondents who could diagnose trypanosomiasis in animals

Can you diagnose animal Trypanosomiasis	Frequency	Percentage
Yes	50	83.3%
No	10	16.7%
Total	**60**	**100%**

The results in table 4.10 show the percentage of respondents who could diagnose trypanosomiasis in animals. 83.3% were able while 16% were not able to diagnose. The study is valid because it is an indicator of training capacity of the respondents.

Data was analyzed using Chi-square was done to determine if there was relationships between farmers ability to identify the vectors and be able to diagnose a sick cases indicators of influence of training on the effectiveness of tsetse eradication. The test was based on the following hypotheses;

H_o -Training of farmers does not influence effectiveness of tsetse eradication.

H_1 - Training of farmers has influence effective tsetse eradication.

Table 4.14 Summary of Chi-square Analysis based on farmer ability to identify tsetse and diagnose trypanosomiasis case

Test between rows and columns (Chi-square):	
Pearson Chi-square	10.606
df	1
Assymp.sig. (2-sided)(p-value)	.001
Alpha	0.05

Test interpretation:

H_o -Training of farmers does not influence effectiveness of tsetse eradication.

H_1 - Training of farmers has influence effective tsetse eradication.

The computed probability value (p) is lower than significance alpha value=0.05, then the null hypothesis H_O is rejected and alternative hypothesis H_1 is accepted. Training of farmers influenced the effectiveness of tsetse eradication.

4.8 Treatment of trypanosome infected animals and Tsetse Eradication

The study also sought to find out if treatment had influenced tsetse eradication. Table 4.11 below shows results obtained when parasitological surveys were carried out in Pate Island.

Table 4.15 Parasitological Survey

Location	Coordinates	No. of cattle Examined	Mean PCV	PCV<25%	+ve	Tv	Tc	Tb
Pate	S02^0 08'22.9" E040^{0}59'45.6"	86	27.2	25.58%	0	0	0	0
Siyu	S02^{0}06'17.9" E041^{0}03'42.8"	121	28	62%	0	0	0	0
Tchundwa	S02^{0}04'36.2" E40^{0}08'58.6"	65	25	38%	0	0	0	0
Mbajumwali	S02^{0}04'41.7" E41^{0}08'11.5"	27	25	51%	0	0	0	0
Kizingitini	S02^{0}04'20.9" E041^{0}08'41.5"	59	25.5	42%	0	0	0	0
Rasini	S02^{0}03'17.5"	50	28	20%	0	0	0	0
Total		**408**	**26.55**		**0**	**0**	**0**	**0**

PCV=Packed Cell Volume, Tv=*Trypanosoma vivax*, Tc=*Trypanosoma congolense* Tb=*Trypanosoma brucei*, +ve=Positive for infection

Blood sampling results are shown on Table 4.11 above, where out of 401 animals sampled no parasite was seen. The PCV values are indicative of anaemic condition of the animal associated with parasitic infection or general malaise. Siyu had the highest percentage of animals at 62% with PCV of less than 25% with Rasini 20% showing the lowest percentage of animals with low PCV. The data is valid for the study as this determines the presence or absence of the parasites circulating in the livestock and their magnitude. The results also provides for the determination of the dependent variable in the study.

Owing to the zero detection of the parasite in the animals the study sought to get the perception of the respondents on how they rank major diseases obtaining in their livestock. Table 4.15 below show how the respondents ranked the disease prevalence in the Island

Table 4.16 Percentage Respondents on Ranking of diseases

Disease/ Ranked frequency	Very high%	High%	Moderate%	Low%
Liver flukes	46.7	10.0	3.3	3.3
Tick borne	21.7	16.7	15	3.3
FMD	13.3	13.3	11.7	3.3
Mastitis	1.7	15.7	8.3	3.3
Black Quarter	0	5.7	0	7.3
Anthrax	3.3	3.3	5	3.3
RVF	0	6.7	6.7	0
LSD	8.3	6.7	10	10
Rabies	1.7	1.7	1.7	5.0
Trypanosomiasis	1.7	3.3	6.7	3.3

According to the respondents 1.7% of them ranked trypanosomiasis as very high compared to 46% of the respondents who ranked liver flukes as very high.

Data was analyzed to test the hypothesis on treatment of animals as a factor influencing tsetse eradication using t-test where the null hypothesis, Ho- was that Treatment of livestock has no influence on tsetse eradication and that alternative hypothesis, H_1- Treatment of livestock has influence effectiveness of tsetse eradication, alpha is 0.05.

Table 4.17 Summary of t test based on the farmer perception of trypanosomiasis and tsetse eradication

Test for comparative means on ranking of trypanosomiasis	
t-value	3.296
df	59
Sig. (2-tailed)(p)	0.002
Mean difference	0.517
Alpha	0.05

Test interpretation:

Ho- Treatment of livestock has no influence on tsetse eradication.

H_1- Treatment of livestock has influence effectiveness of tsetse eradication.

P-value 0.002 computed is less than alpha value of 0.05, null hypothesis is rejected and alternative hypothesis is accepted. Treatment of livestock against trypanosomiasis is a factor that influences tsetse eradication.

CHAPTER FIVE

SUMMARY OF FINDINGS, DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter represents the summary of the findings of the data collected, discussions, conclusions and proposed recommendations. The findings were based on five objectives of the study one of which was to establish ways in which community engagement has influenced the effectiveness of eradication of tsetse and trypanosomiasis in Pate Island. The second was to determine how insecticide impregnated targets installed had influenced tsetse eradication. The third was to assess how livestock spraying had influenced tsetse eradication. The study also sought to determine how training of farmers had influenced tsetse eradication. The fifth objective was to establish how animal treatment influenced the effectiveness of tsetse and trypanosomiasis eradication in Pate Island.

5.2 Summary of Findings

The response rate of the study was 100% with all the villages of Pate being well represented. The interviews captured high percentage farmers but there were business people workers and public administrators who provided the data. The age brackets of the respondents exhibited standard normal distribution curve where the majority of the respondents were in the 36-45 age bracket at 35%. Majority of the respondents at 60% had primary level of education.

The study sought to establish ways in which the community engagement had influenced tsetse eradication. The study found out this factor influenced tsetse eradication since 86% participated in animal spraying and servicing of targets activities that impact negatively on tsetse population. Majority of people leaned of tsetse eradication though seeing tsetse targets in the field.

The study sought to establish whether insecticide impregnated targets had influenced tsetse and trypanosomiasis eradication. The results showed that there were no tsetse flies catches during the surveys. Insecticide Impregnated targets may have contributed to the collapse of the tsetse population.

The study sought to assess whether spraying of livestock influenced the effectiveness of tsetse eradication. The study revealed that 91% of the respondents spray their animals with 58% spraying twice a week. With large number of people participating it means that high number of animals are covered resulting in pressure being exerted on the tsetse population.

The study sought to determine whether training of farmers had influence on the effectiveness of tsetse eradication. The study revealed the 96.7% of the respondents shared spray pumps, 96.7% were able to distinguish a tsetse fly and 83.3% were able to diagnose a trypanosomiasis case in animals. This shows that training had been taken up well by the respondents and has contributed to the effectiveness of the eradication efforts.

Finally the study sought to establish whether treatment of trypanosome infected animals had influence in the effectiveness of tsetse eradication. The study revealed that were no trypanosome parasites circulating among the livestock indicating there was exerted pressure on its population by use of drugs and other factors.

5.3 Discussions

This study found out that engaging the local communities in activities geared towards eradication had influenced the effectiveness of the eradication efforts. According to ISCTRC (1999) lack of ownership and commitment by the local residents, unmet specific expectations and community averse to extensions contribute towards poor adoption of the intervention measures.

Studies carried out in sleeping sickness areas concluded that among the factors influencing individual and community participation in tsetse control include the knowledge of tsetse, Human African Trypanosomiasis and control measures (Sindato C, Kimbita E.N, Kibona SN, 2008). In Cote' de'Ivore studies indicated that 80% of farmers were willing to contribute both money and labour to tsetse and trypanosomiasis control (Koffi P et al, 2009). Findings in East and West Africa (Goutex et al, 1990; Swallow et al, 1994,; Echesah et al 1997; Mugalla, 2000; Kamuanga et al., 2001) concluded that where there is evidence of animal trypanosomiasis and where people are previously aware or made aware of the problem, the majority will indicate general interest in the solution. According to Barret K and Okali C (1998), positive social impacts of community control operations were recorded in Lambwe Valley in Kenya, where the level of community involvement was greatest of all the DFID programmes considered.

The findings in this study concur with other studies in that the farmers were willing to participate in tsetse eradication especially when they gain knowledge on the problem.

The study found out that insecticide impregnated targets installed in the Island were a factor influencing the effectiveness of tsetse and trypanosomiasis. Tsetse surveys revealed total absence of the fly which is a departure from data captured during baseline surveys conducted in 2009 where the fly density was recorded at 1.3 Flies per Trap per Day.

Insecticide impregnated targets have been used extensively in Africa for control and eradication of tsetse. Notable is the reclamation of 20, 400km^2 tsetse infested areas of Zimbabwe and the countries surrounding in the years between 1986 and 1998. Recent use of targets in Kenya was at the Mwea Game Reserve where the population of tsetse flies densities dropped from the FTD of 1.2 in February 2007 to 0 by December 2008. In Lake Bogoria Conservancy insecticide impregnated targets were installed in 2007 when at the time trypanosomiasis cases were all time high of over 300, but by 2011trypanosomiasis cases had dropped to 0. The effectiveness of this technology however relies on regular maintenance, servicing, replacement of stolen or destroyed ones and general support from the local community. This study is consistent with the literature.

The third factor under the study was to determine how spraying of animals contributed influencing the effectiveness of tsetse eradication in Pate Island. Spraying cattle for the control of Ector-parasite has been practiced in Africa since the discovery of insecticidal compounds that could be tolerated by animals when applied. However use of animals as mobile targets came about after years of research on the behavioral characteristics of the tsetse fly and the development of synthetic pyrethroids. It works the same way as stationery targets but with the advantage of its mobility and as a natural host to tsetse. The pyrethroids have high toxicity against tsetse even with very brief contact, good level of persistence on the treated animal and low mammalian toxicity which make them safe to apply to the target animal. Use of spraying animals in Africa has been practiced in Cote de' Ivore, Zimbabwe Ethiopia and Kenya (Thomson et al, 1991). In Zimbabwe over 200,000 cattle were treated with insecticide and were used effectively as a barrier to protect tsetse free areas from re-invasion. In Kenya it has been used in

Lambwe Valley and in areas surrounding the Meru National Park with great success. The results of the study are in consistence with the literature. According to Achia G, 2012, effe3cdtive tsetse control would be achieved if 20% of the cattle population is regularly sprayed.

Farmers training were one of the important factors influencing the effectiveness of tsetse eradication. Training is an essential element in community based social programmes for the reason that at the end of the project cycle the local community would be able to sustain activities. Ownership of projects by the beneficiaries begins when they are taken through the concepts and that would lead guide them in understanding their role and responsibilities. Training provides farmer with basic skills that include identification of the vector, early detection symptoms of trypanosomiasis, use of equipment like the spray pump, restraining animals, basics elements of the workings of traps and targets. Training causes change of attitude towards a new concept of disease control and provides opportunity for exposure and forum for exchange of ideas, so that the livestock keeper moves away from use of ethno veterinary practices and embrace scientifically proven, easy to use technologies.

According to Bouyer F et al, (2011, there are five factors that cause smallholders in developing countries to be reluctant to technologic innovations. these are (i) the relative advantage brought by the innovation in comparison to the initial situations (ii) its compatibility with the current system,(iii) its complexity,(iv) it's 'triability' in the farmers context, and (v) it's 'observabilty'(possible to observe technique used by other farmers). This study concurs with literature to the extent that Pate farmers encountered technology that may have been 'triable', simple and observable and therefore easy to adopt.

Treatment of infected animals was an important factor that influenced the effectiveness of tsetse and trypanosomiasis eradication in Pate. Chemotherapy intervention is the only choice for an animal that has come down on trypanosomiasis. Indeed 87.3% of the respondents admitted the use of veriben (diminazene) a trypanocidal drugs that is active to all stages of the trypanosome parasites in mammals. Absence of trypanosomes circulating in the animal hosts is a strong indicator of the efficiency of control exercise. This would involve suppression of the tsetse in the filed by use of regularly serviced targets, regular spraying of animals, farmer education and general support from the community. Africa imports 35 million doses of trypanocidal drugs worth over US$ 7.98 billion annually. In Kenya where 60% of the range land is tsetse infested, 23% of her livestock are at risk of infection. Kenya imports trypanocidal drugs worth over ksh 40 million per annum. This study concurs with literature on the use of trypanocidal drugs as form of trypanosomiasis control.

5.4 Conclusions

The study sought to establish how the community's engagement influenced the effectiveness of tsetse eradication. The study found out that spraying of animals was what the majority members of the community participated, a factor that is critical in tsetse suppression where failure of which would reduce effectiveness of eradication exercise.

The study found out that installation of insecticide impregnated targets was a factor that influenced effectiveness of tsetse eradication and with improvement on the longevity of the active ingredient and colour retention to last for up to one year the technology would a good option.

The study sought to find out if livestock spraying in influencing tsetse eradication. The study found out that spraying had added advantage of killing all ecto-parasites including tick lice and irritant biting flies therefore farmers adopted the technology easily.

The study also sought to determine whether training of farmer influenced tsetse eradication. The study found out that training of farmers was a factor influencing tsetse eradication as it provided practical ways of identifying and solving disease problems.

The study sought to establish how animal treatment influenced tsetse and trypanosomiasis eradication. The study found out that this was important influence as results indicated complete absence of the parasite in the livestock.

5.5 Recommendations

The study makes the following recommendations based on the findings of this study:

1. For effective implementation of projects on livestock disease control at the community level, members should engage in project activities.

2. Insecticide impregnated insecticides targets initially designed for *Glossina pallidepes* has demonstrated its effectiveness against *Glossina austeni*; therefore it is recommended for use in areas infested by this species.
3. Although spraying of animals was popularly used, its shared use is not sustainable, therefore an insecticide formulated in a way that individual farmer can administer alone would be a preferred choice.
4. Training of farmers should be continuous exercise during the lifetime of the project. This is because of; (i) laxity of farmers when their animals no longer come down on the disease when history has shown that there would always be resurgence of tsetse, (ii) low level of literacy and poor exposure may work against their technology adoption rate.
5. Although at the time of the study there were less use of trypanocides, there is always danger of misuse of drugs or use of counterfeit drugs. There is a need to closely monitor use of trypanocides in order to avoid drug resistance.

5.6 Suggestions for Further Research

This study was conducted in Pate Island, a fairly isolated area that provided ideal environment for objective study. It is suggested that a similar study be done in the mainland where there would be more than one tsetse species, larger area of treatment, larger population of animals and people.

REFERENCES

African Union (2002). Statement from the Commission of the African Union to the AHP/DFID Special workshop on: “Tsetse Control – The next 100 Years” *10th September 2002* Edinburgh, United Kingdom

Ahmed B, S.N. Okiwelu ,and P. M. Dede (2007). Prevalence of Trypanosome Infections in Ruminants in the Southern Guinea Savanna, Nigeria. *African Journal of Biomedical Research, Vol. 10 (2007); 67 - 72*

Barrett K and C. Okali. Partnerships for tsetse control - community participation and other options **.**World Animal Review 90-1998/*1 http://www.fao.org/docrep/.*

Barrett K and Christine Okali (1998).community participation in the management of tsetse: A comparative assessment of impact and sustainably

Bealby K.A., Connor R.J. and Rowlands G.J. (1996) *Trypanosomosis in Goats in Zambia.* ILRI (International Livestock Research Institute),Nairobi, Kenya. 88 pp.

Bopp M and Judie Bopp (2004) Welcome to the Swamp: Addressing Community Capacity in Eco-health Research and Intervention .*EcoHealth 1 (Suppl. 2), 24–34, 2004*

Bourn David, Ian Grant, Alexandra Shaw and Stephen Torr (2005). Cheap and safe tsetse control for livestock production and mixed farming in Africa. *Aspects of Applied Biology 75, 2005*

Bouyer F, Hamadou S, Adakl H, Lancelot R, Stachurski F,et al.(2011) Restricted Application of Insecticides: A Promising Tsetse Control Technique, but what do Farmers think of it? *PloS Negl Top Dis 5(8): e1276 do: 10.137/journal.pntd.0001276*

Brightwell, Bob Dransfield, Ian Maudlin, Peter Stevenson, and Alexandra Shaw (2001) Realit vs. rhetoric – a survey and evaluation of tsetse control in East Africa. *Agriculture and Human Values 18: 219–233, 2001*

Brightwell.R R.D. Dransfield, P. Stevenson and B. Williams3 Changes over twelve years in populations of *Glossina pallidipes* and *Glossina*, *longipennis* (Diptera: Glossinidae) subject to varying trapping pressure at Nguruman, south-west. Kenya.*Bulletin of Entomological Research* (1997) 87, 349–370

Chikungwa, P. (2005) The diagnostic capacity of veterinary field staff in the Nkhotakota District of Malawi. Department of Animal Health & Livestock Development, Central Veterinary Laboratory, P.O. Box 527, Lilongwe, Malawi. *Special issue 2005*

Clerix J, Vlirghe E, Asselman V, Van de Casteele S, Maes MB, Lejon V(2012) Human African Trypanosomiasis in a Belgian traveller returning from Maasai Mara, Kenya, February 2012 . EuroSurveill.2012; 17(10):pii=2011

Department of Technical Co-operation International Atomic Energy Agency (1997) Eradicating Tsetse Fly on Zanzibar Island. *Poster*

DFID Animal Health Programme (2003) Recent advances in livestock keeper-based tsetse Control: The way forward .Report of a workshop 21–23 October 2003, Nairobi, Kenya

Dräger N(2010) Tsetse fly control and Trypanosomiasis in Africa, quo vadis? Lutte contre la mouche tsé-tsé et la trypanosomiase en Afrique : où va-t-on ? Bull. *Soc. Pathol. Exot.*

Dransfield R.D, Brightwell R, Kyorku C and Williams,B(1990) Control of setse (Glossinidae) Population using traps at Nguruman, South West Kenya. *Bulletin of Entomological Research*

FAO(n.d).Technologies and Practices for Small Agricultural produce(TECA) .Tsetse control: How to deploy a target*: http://teca.fao.org/technology/tsetse-control-how-deploy-target*

FAO. (1982) *Training Manual for Tsetse Control Personnel. Volume 1*, Edited by Pollock J.N. Tsetse biology, systematic and distribution, techniques. Rome. Food Agricultural Organization of the United Nations.

FAO. (1992) *Training Manual for Tsetse Control Personnel, Volume 2,* Edited by Pollock J.N Ecology and behaviour of tsetse. Rome. Food Agricultural Organization of the United Nations

FAO. (1986) *Training Manual for tsetse Control Personnel, Volume 3,* Edited by Pollock J.N. Control methods and side effects. Rome. Food Agricultural Organization of the United Nations

FAO. (1992) *Training Manual for tsetse Control Personnel ,Volume 4,*edited by B.S.Hursey &J.H.N. Slingenberg. Use of attractive devices for tsetse survey and control. Rome. Food Agricultural Organization of the United Nations

FAO. (1993) *Training Manual for tsetse Control Personnel Volume 5*.Insecticides for tsetse and trypanosomiasis control using attractive bait techniques. Rome. Food Agricultural Organization of the United Nations

FAO. (1998) A Field Guide for Diagnosis, Treatment and Prevention of African Animal Trypanosomiasis, edited by Boyt W.P. Rome. Food Agricultural Organization of the United Nations

FITCA Kenya project (September 2005) Farming in Tsetse Controlled Areas. Kenya Project 1999-2004. *Lessons Learned*

Girma Zeleke(2011) Preliminary survey on tsetse flies and trypanosomosis at grazing fields and villages in and around the Nech Sar National Park, Southern Ethiopia. *Ethiop.Vet. J., 2011, 15 (1), 59-67*.

Giuliano Cecchi,Raffaele C. Mattioli,Jan Slingenbergh,Stéphane de la Rocque and Udo Feldmann (2008) Standardizing land cover mapping for tsetse and trypanosomiasis decision making. *Food and Agriculture Organization of the United Nations Rome, 2008*

Gouteux, J.P. D. Siida(1990) Community participation in the control of tsetse flies .Large scale trials using the pyramid trap in the Congo. *Trop. Med. Parasit. 41 (1990) 49-55*

Hargrove J.W., S.J. Torr and H.M. Kindness (2003).Insecticide-treated cattle against tsetse (Diptera: Glossinidae): what governs success

Hargrove, J. W. (2003) Tsetse eradication: sufficiency, necessity and desirability. Research report, DFID Animal Health Programme, Centre for Tropical Veterinary Medicine, University of Edinburgh, UK. Glossinidae) and trypanosomosis in sub Saharan Africa.*Rev.Soc.Entomol.Argent.65(12):121,206.http://www.eurosurveillance.org/ViewArticle.aspx?Article=201*

IEAE Buletin vol 26, no 26 International Scientific Council for Trypanosomiasis Research and Control(2011), 31st Conference, Bamako, Mali. *Proceedings*

ILCA/ILRAD (988) Livestock production in tsetse affected areas of Africa. Nairobi. The African Trypanotolerant Livestock Network. Proceedings of a meeting held 23-27 November 1987 Nairobi, Kenya

Ilemobade, A.A (1979). Drug sensitivity of mouse infective Trypanosoma vivax isolates in cattle and sheep. In*: Proceedings of the 16th meeting of International Scientific Research*

Council for Trypanosomiasis Research and Control ISCTRC. Yaounde, Cameroun*. No. 111. pp. 251-253.*

Kamuanga M, H. Sigue, B. Swallow, B. Bauer and G. d'Ieteren1(2001) Farmers' Perceptions of the Impacts of Tsetse and Trypanosomosis Control on Livestock Production: Evidence from Southern Burkina Faso. *Tropical Animal Health and Production, 33 (2001) 141^153*

Kamuanga Mulumba (2003) Socio-Economic and Cultural Factors in the Research and Control of Trypanosomiasis. PAAT technical and scientific series 4 ISSN 1020-7163.

Kroubi M, Karembe H, Betbeder D(2011).Drug delivery systems in the treatment of African trypanosomiasis infections. Expert Opin. Drug Deliv. 2011 Jun; 8(6):735-47

Kuzoe (2005).Strategic Review of Traps and Targets for Tsetse and African Trypanosomiasis control .Special Programme for Research and Training in Tropical Diseases.

Leak SG, Peregrine AS, Mulatu W, Rowlands GJ, D'Ieteren G (1996) Use of insecticide impregnated targets for the control of tsetse flies (Glossina spp.) and trypanosomiasis occurring in cattle in an area of south-west Ethiopia with a high prevalence of drug-resistant trypanosomes*. 1996 Trop.Med Int Health Oct;1(5):599-609.*

Leak Stephen,Dejene Ejigu,Marc J.B.Vreysen(2008)Collection of Entomological Baseline Data for Tsetse Area-Wide Integrated Pest

Malele Imna (2011) Fifty years of tsetse control in Tanzania: challenges and prospects for the future. *Tanzania Journal of Health Research* DOI *Volume 13 (Suppl 1), December 201 http://dx.doi.org/10.4314/thrb.v13i5.9*

Marc Artzrouni and Jean-Paul Geutoux(2003)Estimating tsetse population parameters: Application of a mathematical model with a density - dependence. *Medical and Veterinary Entomology (2003), 17; 272-279*

MaitimaJML, Rodreguez.M.Kshatriya and S.Mugatha(2007) Guidelines for assessing environmental and socio-economic impacts of tsetse and trypanosomiasis interventions. International Research Institute (ILRI). Nairobi, Kenya

Miles M.B, A. Michael Huberma(1994). Qualitative Data Analysis: An Expanded Sourcebook

Ministry of Livestock Development (2011) Strategy for Tsetse and Trypanosomiasis Eradication in Kenya 2011-2021.

MSF(2006) Human African Trypanosomiasis Facing the challenges caused by neglect: *The need* *for new treatment and diagnostics*

Mugenda O, Mugenda A (1999) Research Methods: Quantitative and Qualitative Approaches. Nairobi, Acts Press, 1999

Muriuki G.W, T.J. Njoka and R.S. Reid(2003) Tsetse, Wildlife and Land-cover Change in Ruma National Park, South-western Kenya. *J. Hum. Ecol., 14(4): 229-235 (2003)*

Ngechu M (2006). Understanding the Research Process and Methods. Nairobi, Kenya

Office International des Epizooties (2009) Trypanosomosis(Tsetse- transmitted) Aetiology Epidemiology Diagnosis Prevention and Control References

Okoth JO, Omare-Okurut A, Eboyu F (1998) The use of theatre to mobilize and sensitize rural communities to participate in tsetse control in Bugiri district, Busoga, Uganda: a case study. Ann Trop Med Parasitol.1998 Jan; 92(1):127-8

Oluwafemi, R. A.1, Ilemobade, A. A. and Laseinde, E. A. O. (2007) The impact of African animal trypanosomosis and tsetse on the livelihood and well-being of cattle and their owners in the BICOT study area of Nigeria. *Scientific Research and Essay Vol. 2 (9), pp. 380-383, September 2007*

Onditi S J, Silayo R S, Kimera S I, Kimbita E N and Mbilu T J N K 2007: Preliminary studies on prevalence and importance of goat trypanosomosis in selected farms in Morogoro District, Tanzania. *Livestock Research for Rural Development. Volume 19, Article #65. http://www.lrrd.org/lrrd19/5/ondi19065.htm*

Opiyo E.A, A. R. Njogu and J. K. Omuse(1990) Use of impregnated targets for control of Glossina pallidipes in Kenya. *International Journal of Tropical Insect Science/ Volume 11/Issue03/ June 1990.$_{pp}$417-425*

Pan African Tsetse and Trypanosomiasis Eradication Campaign (PATTEC) (2001). Plan of Action.

PATTEC (AU) Strategic Plan on Advocacy for African Trypanosomiasis 2008-2011

Perkins, J.S. and L. Ramberg (EDS)(2003) Environmental Recovery Monitoring of Tsetse Fly Spraying Impacts in the Okavango Delta – 2003. Final Report. *Okavango Report Series, No. 3, May 2004. Harry Openheimer Okavango Research*

Rogers D.J, G.Hendrickx and J.H.W.Slingernberg(1994) Tsetse Flies and their Control. *Rev.sci.tech.int Epiz, 1994, 13(13), 1075-1124*

Ross K (2005) Sample design for Educational survey Research. http://www.sacmeq.org and http://www.unesco.org/iiep

Rutto J.J & Julia Wairimu Karuga (2009) Research Articles Temporal and spatial epidemiology of sleeping sickness and use of geographical information system (GIS) in Kenya .*J* . *Vector Borne Dis* 46, March 2009, pp. 18–25

Shaw A.P.M (2003).Economic Guidelines for Strategic Planning of Tsetse and Trypanosomiasis Control in West Africa. *http://www.fao.org/docrep/006/y4972E/y4972e00.htm#Contents*

Shaw Alexander, Steve Torr, Charles Waiswa and Tim Robinson (2007) Comparable Costing of Alternatives for Dealing with Tsetse: Estimates for Uganda. PPLPI Working Paper No. 40. http://www.fao.org/ag/pplpi.html

Sindato C, Kimbita EN, Kibona SN.(2008)Factors Influencing individual and community participation in the control of tsetse and human African trypanosomiasis in Urambo District Tanzania.Tanzan J Health Res. 2008 Jan;10(1):20-7.

Somda J, Kamuanga M, Tollens E. (2006) Prospective analysis for community participation in trypanosomosis control in the Gambia. Trop Anim Health Prod. 2006 3-1

Stanny Geerts(2011) The struggle against tsetse flies and animal trypanosomiasis in Africa lecture at the academic session of 6 October 2011 , Institute of Tropical Medicine, Antwerp. *www.kaowarsom.be/documents/57-58 (2011-2012)/GEERTS.pdf*

Teddy Nakato and Ayansina Ayanlade(2009).Mapping the Distribution of Tsetse Flies in Eastern Uganda .7th FIG Regional Conference Spatial Data Serving People: Land Governance and the Environment – Building the Capacity Hanoi, Vietnam, 19-22 October 2009

Vreysen Marc J.B (2006). Prospects for area-wide integrated control of tsetse flies (Diptera:Glossinidae) and trypanosomosis in sub-Saharan Africa. http://www.scielo.org.ar/pdf/rsea/v65nl-2/v65nl-2a01.pdf

Warnes M.L,P.Vandenbossche, J.Chihiya, D. Mudenge, T.P.Robins, W. Shereni and V. Chadenga(1999) Evaluation of insecticide-treated cattle as a barrier to re-invasion of tsetse to cleared areas in northeastern Zimbabwe. Medical and Veterinary Entomology(1999) 13, 177±184

Wellde BT, Chumo DA, Waema D, Reardon MJ,Smit5h DH(1989).A history of sleeping sickness in Kenya. *Ann Trop Med Parasitol.* 1989 Aug;83 Suppl 1:1-11.

Whiteside EF (1962) The control of cattle trypanosomiasis with drugs in Kenya: Methods and costs. East Afr Agr J 6773:

Whiteside F.F (1960).Symposium on animal trypanosomiasis 1960 No. 45 pp. 81-116 pp

WHO (October 2010). African trypanosomiasis (sleeping sickness) Fact sheet N°259

WHO/CDS/CSR/EPH/(2002*) Human African Trypanosomiasis. Treatment and Drug Resistance Network for Sleeping Sickness.* Geneva, Switzerland. Report of the Sixth Steering Committee Meeting 28-29 May 2002. World Health Organization of the United Nations.

Wilson S.G, K. R. S. Morris, I. J. Lewis & E. Krog(1963)'The Effects of Trypanosomiasis on Rural Economy*With Special Reference to the Sudan, Bechuanaland and West Africa. *Bull. Org. mond. Sante' Bull. Wid Hlthi Org. 1963, 28, 595-613*

APPENDICES

APPENDIX I: Entomological Data Sheet

LOCATION: ____________________

DATE SET: ____________________ DATE EMPTIED: _________________

TEAM LEADER: __________ TRAP DESIGN: ___________________

Site	Coordinates	Species	Male		Female		Total	No. Diss.	Other biting flies
			T	NT	T	NT			

REPORT BY: ___________________________ ***SIGNATURE***: ___________________

APPENDIX II: Parasitological Data Sheet

ANIMAL TRYPANOSOMIASIS PREVALENCE SURVEY SHEET
DATA SHEET
(PARASITOLOGICAL)

Project name: ___________________
District: _______________________
Division: _______________________
Location: _______________________
Sub-location:__________________
Season: ________________________
Species: ________________________

GPS Coordinates: _________________________
Altitude: ________________________________
Date: ___________________________________
Village: _________________________________

Sample name	Livestock owner	Breed	Sex	Age	Body condition	PCV	Tb	Tc	Tv	T.s/c	T.ev	Mixed infections	Remarks
Total													
Prevalence													

Key

Code= unique identifier of location for x and y coordinates; X=cord=longitude=Eastings
Ycoord=latitude=Southings; Livestock owner=Name of farmer
No. of samples=number of animals samples; PVC=Packed Cell Volume
Tb = number of positives for trypanosome bruccei; Tc=number of positives for trypanosome congolense
TV=number of positives for trypanosome T.vivax;=T.s/c=Nanomonas in pigs

T.ev=T.evansi:Total=+ves=sum(Tb+Tv+T.s/c+T.ev+mixed infections
Prevalence=% Total trypanome positives/Total samples
Village= sampling site
Duration in herd= specific time the animal has taken in the herd
NB; also report other TBD parasites and worms infestation in the remarks column

Body condition

1. Very poor
2. Poor
3. Good
4. Excellent

APPENDIX III: Research Questionaire

1. Background information

1.1 Farmer's Name [______________________________]

1.2 Sex [________________________________]

1.3 Age [1=18-25, 2=26-35, 3=36-45, 4=46-55, 5=56-65, 6=65and above__]

1.4 Occupation [________________________________]

1.5 Education [1=madrasa, 2=primary, 3=secondary, 4=post secondary____________________]

1.5 Marital status [1=married, 2=not marreid, 3=widow, 4=widower________]

1.6 County [________________________________]

1.7 Location [________________________________]

1.8 Sub-location [________________________________]

1.9 Village [________________________________]

1.10 Respondents Name [________________________________]

1.11 Age [________________________________]

1.12 Sex [________________________________]

1.13 Education [________________________________]

1.14 Religion [________________________________]

1.15 Relationship to the farmer [________________________________]

1.16 Interviewers Name [________________________________]

1.17 Number of animals owned [cattle________] [Goats_____] Donkeys]

1.18 Date of interview [____ ___________/_________]

2. C**ommunity Engagement**

2.1 How did you learn about tsetse and trypanosomiasis eradication? [___________]

1= invited to a Baraza by project officials 2=Neighbour 3= Extension Officers 4=your group members 5=Training by project 6=Tsetse Targets 7=Livestock spraying 8= other (specify) [__________________]

2.2 In what way are you engaged in tsetse and trypanosomiasis eradication? [__________]

1= animal spraying 2= targets servicing, 3= crush pen committee member, 4= Dip committee member

2.3 How do you rank the way the project has involved members of your community 1 highest, 5 lowest

Table 1 Rank involvement with project

Rank	Involvement code	Rank	Involvement code
1		4	
2		5	
3			

5= Excellent, 4= very Good, 3= Good, 2= Fair 1= poor

2.4 How do you allocate your resources (income) among your needs? - In a descending order of importance

[____________________]

1=Food 2=Animal feed 3=Health 4=Animal health 5=School fees 6=Contributions (harambee) 7=Leisure & social function 8=Clothing 9=Tsetse & Trypanosomiasis control 9=other livestock diseases 10=other (specify) [________________]

2.5 What social network do you belong to? Rank in order of importance (1 highest 10 lowest)

Table 2 Rank Social network

Rank	SN-code	Rank	SN- code	Rank	SN-code	Rank	SN-code
1		4		7		10	
2		5		8			
3		6		9			

1=Fishing Cooperative 2=Crush Pen Committee 3=Farmers SACCO 4=Farmers organization/Association 5=Women Group 6=Tsetse & Trypanosomiasis eradication group 7=Dip committee 8=other (specify) [________________]

2.6 Do you share community facilities as pertains to tsetse eradication?

a=pasture [____________] 1 Yes 2 No

b=crush pens [____________] 1 Yes 2 No

c=cattle dips [____________] 1 Yes 2 No

d=spraying pump [____________] 1 Yes 2 No

e=others specify [____________] 1 Yes 2 No

3. **Tsetse and Trypanosomiasis**

3.4 Which seasons (months of the year) are tsetse densities and trypanosomiasis most prevalent; indicate appropriately.

4=High 3=moderate 2=low 1=none

Table 3 Seasonal trends

Season (months in the year)	**Tsetse**	**Trypanosomiasis**
January		
February		
March		
April		
May		
June		
July		
August		
September		
October		
November		
December		

Respondent to give comment based on his/her observations

____

3.2 Identify 6 major diseases in your farm; give your answer in descending order of significance;

Table 4 Rank diseases

Rank	**Livestock disease code**	**Rank**	**Livestock disease code**	**Rank**	**Livestock disease code**
1		3		5	
2		4		6	

1=liver flukes (helminthosis) 2=Trypanosomiasis 3=Tick-borne diseases 4=Foot &mouth diseases 5=mastitis 6=black quarter 7==anthrax 8=rift valley fever 9=lumpy skin diseases 10=rabies 11=other (specify) ______________________________

3.3 Name and rank the major methods which you use in tsetse and trypanosomiasis control on your farm1 highest 9 lowest

Table 5 Rank Tsetse control methods

Rank	**Tsetse control -code**	**Rank**	**Tsetse control -code**	**Rank**	**Tsetse control -code**
1		5		9	
2		6			
3		7			
4		8			

1=mechanical (bush-clearing) 2=targets 3=livestock movement 4=crop farming intervention 5=pour-ons 6= dipping 7=spraying 8=indigenous technical methods 9=other (specify) ______________________

Table 6 Rank Trypanosomiasis control method

Rank	**Trypanosomiasis control -code**	**Rank**	**Trypanosomiasis control -code**
1		4	
2		5	
3		6	

1= Trypanocidal drugs 2= Tsetse control 3=Ethno Veterinary Practice

6= other (specify) ______________________

Training

3.4 Are you able to differentiate a tsetse fly and other flies? [__________] 1=Yes, 2= No

3.5 Are you able to tell an animal infected with trypanosomiasis? [________] 1= Yes, 2=No

3.6 If yes what are 2 major symptoms shown by trypanosomiasis infected animal

[____]

3.7 What facilities and tools do you have in handling your livestock and livestock diseases?

[____]

1= milking shed 2=Dip 3=hand pump/sprayer 4=crush pen 5=cattle boma

6=syringe 7=ropes 8=other (specify) _______________________

3.8 In terms of spraying, how many times do you spray your animals per month?

[_______________________]

1= Do not spray 2= Once 3= Twice 4= Three times

9=other (specify) ______________________

3.9 Which drugs do you most frequently use for treatment, prevention and both prevention and treatment? - give your answer in the following table in descending order of importance:

Table 7 Rank Drug use

Treatment	**Prevention**
1.	1.
2.	2.
3.	3.
4.	4.
5.	5.

1=veriben, 2=samorin, 3=homidium, 4=ethidium

3.10 Who are your major drug a suppliers? List in descending order

[_____________________________]

1=PATTEC 2=veterinary staff 3=local vendors 4=friends (neighbors) 5= NGOs 6=neighbouring country 7=drug companies 8=other (specify) [____________________]

3.11 Can you recall incidences in numbers of trypanosomiasis in your farm during the past 8 months? Give your answer in the following table;

Table 8 trypanosomiasis incidence/ trends

Parameter type	Incidences / trends of trypanosomiasis							
	S	O	N	D	J	F	M	A
Cattle								
Sheep								
Goats								
Donkeys								

3.12 Comment on the period between 2009 and 2013[______________________________]

3.13 In a descending order of importance identify the 6 major production constraints in your farm;

Table 9 Constraints

Rank	**Constrain code**	**Rank**	**Constraint code**	**Rank**	**Constrain code**
1		3		5	
2		4		6	

1= livestock diseases 2=lack of oxen for cultivation 3=drought 4=lack of pasture 5=insufficient extension and veterinary services 6=lack of credit 14=other (specify) [_______________________]

4. General

4.1 In descending order of importance, how would you rate the success of trypanosomiasis eradication effort in your area?

Table 11 Rank success rate

Rank	**Rate code**	**Rank**	**Rate code**	**Rank**	**Rate code**
1		3		5	
2		4		6	

5= Excellent 4= Very good 3= Good 2= satisfactory 1=Poor
[___________________________]

4.2 Who is responsible for welfare of livestock in your farm [______________]
1= Husband 2= Wife 3= other