SOCIO-ECONOMIC EVALUATION OF ANIMAL TRYPANOSOMOSIS CONTROL IN THE NORTHERN REGION OF GHANA

BY

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DECLARATION

I, Alhassan, Mohammed Zakaria, author of this thesis, do hereby declare that, except for references which have been duly cited, this thesis titled **"SOCIO-ECONOMIC EVALUATION OF ANIMAL TRYPANOSOMOSIS CONTROL IN THE NORTHERN REGION OF GHANA"** is the result of an original research work undertaken by me as a student of the Department of Agricultural Economics and Agribusiness, University of Ghana, Legon from September 2002-February 2004. It is further declared that this thesis has never been presented either in whole or in part for any other degree of this university or elsewhere.

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DEDICATION

This thesis is dedicated to my late grand father, Kum Lana Yakubu Zakali and the entire Yakubu family.

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ABSTRACT

The Northern Region of Ghana is important agriculturally and contributes significantly to the livestock sub-sector. Livestock production in the region is, however, bedevilled with many constraints such as animal diseases and inadequate feed and water for livestock during the dry season. Among animal diseases, trypanosomosis is identified as the most important constraint and the sustainability of the control of tsetse, which is the main vector of this disease, is the focus of this study. Contingent Valuation (CV) techniques were used to generate estimates of farmers' willingness to pay in cash or labour for tsetse control. With respect to the low trypanosomosis risk villages, only 1.1% of the 90 farmers declined to contribute some resources for tsetse control. In addition 4.4% and 23.3% pledged monetary and labour contribution respectively. Furthermore, 71.1% were willing to contribute both money and labour. The average proposed monetary contribution is between 7,062 and 15,000 Ghanaian cedis (US$0.78-1.70). In the high trypanosomosis risk villages, the proposed average monetary contribution is between 8,040 and 11,500 Ghanaian cedis (US$0.89-1.30). Only 1.7% of the 181 farmers declined to contribute while 7.7%, 34.8%, and 55.8% pledged monetary, labour and both labour and monetary contribution respectively. Factors affecting monetary contribution as identified by the simultaneous equations model include: household income, household farm size, and household expenditure on associations. Farmers in the high trypanosomosis risk villages are found to use more veterinary drugs than those in the low risk villages. Factors that influence the use of these drugs are household income, household cattle size and household size. Key policy recommendations from the study are: (1) Government and non-governmental organizations should assist communities in the study area with reliable sources of water to solve the perennial water problem, (2) The Veterinary Services Department should be adequately resourced to embark on a massive

and comprehensive educational campaign to educate farmers on how to identify and handle simple livestock disease situations, the correct usage of animal drugs and the need to avoid bush fires, (3) A research should be conducted to find shrubs and trees that can stand the conditions of the study area to provide alternative feeding for animals in the dry season and (4) Government and other donor agencies should review their budgetary allocations to tsetse control to reflect the seriousness of trypanosomosis on both humans and livestock.

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LIST OF ACRONYMS

AAT	-	African Animal Trypanosomosis
CIRDES	-	Centre International de Recherche-Dėvelopement sur I'Elevage en Zone Subhumide
CV	-	Contingent Valuation
DDT	-	Dichloro-diphenyl-trichloroethane
FAO	-	Food and Agricultural Organization
g a.i/ha	-	Grams Active Ingredients per Hectare
GIS	-	Geographic Information Systems
GLSS	-	Ghana Living Standard Survey
HIV/AIDS	-	Human Immunodeficiency Virus/Acquire Immune Deficiency Syndrome
IBAR	-	Inter-African Bureau for Animal Resource
ILRI	-	International Livestock Research Institute
NLSP	-	National Livestock Services Project
OLS	-	Ordinary Least Squares
T&T	-	Tsetse and Trypanosomosis
TTCU	-	Tsetse and Trypanosomosis Control Unit
VSD	-	Veterinary Services Department
VSG	-	Variant Surface Glycoprotein
WASH	-	West African Shorthorn
WHO	-	World Health Organization
WLS	-	Weighted Least Squares
WTP	-	Willingness To Pay

CHAPTER ONE

INTRODUCTION

1.1 Background

1.1.1 African Animal Trypanosomosis

Trypanosomes infect a wide range of hosts, including wild and domestic animals. The success of the trypanosome as a parasite is due largely to its ability to change a single glycoprotein called Variant Surface Glycoprotein (VSG), thereby enabling evasion of host immune responses and the establishment of persistent infections (Cross, 1975).

African animal trypanosomosis is a disease of African people and their livestock that is primarily transmitted by the tsetse fly (Glossina genus). Tsetse flies infest an area of about ten million square kilometres stretching across 40 countries in sub-Saharan Africa (Swallow and Woudyalew, 1994). About 44 million cattle (IBAR, 1989) and 100 million sheep and goats (based on Jahnke, 1982 and Jahnke et al., 1988) are exposed to trypanosomosis in sub-Saharan Africa. In cattle, trypanosomosis causes poor growth, weight loss, low milk yield, reduced work capacity, infertility, abortion and death (Murray and Gray, 1984). By constraining the productivity and number of cattle, trypanosomosis also limits the opportunity for intensification of agricultural production through animal traction and nutrient cycling (Swallow and Woudyalew, 1994).

Certain breeds of cattle have the ability to survive and produce in areas of low to moderate tsetse challenge without the aid of drugs. This ability, known as trypanotolerance (Murray and Gray, 1984; Rege et al., 1994; d'Ieteren et al., 1998) is exhibited by the West African Shorthorn breeds (Bos Taurus brachycheros) that include the Baoulé and by the longhorn N'Dama breed (Bos Taurus longifrons). The exploitation of trypanotolerance is practised as a major option for sustainable livestock production in nineteen countries in the most humid part of West and Central Africa (d'Ieteren et al., 1998).

The African continent is faced with the challenge of satisfying a dramatic increase in demand for livestock products, in particular milk and meat (d'Ieteren and Kimani, 2002). Domesticated species play an important role in supporting human populations and in generating income and economic activity. The areas with the greatest potential for significant increases in livestock population and livestock productivity are the sub-humid and the non-forested parts of the humid zones.

Large areas of natural grassland could be better used to support the increasing demand for livestock products if constraints on their increased contribution to market economies were understood and overcome, and existing opportunities identified and exploited (d'Ieteren and Kimani, 2002). Animal diseases, especially those caused by parasites, are a major constraint on animal production in the sub-humid areas of Africa. Trypanosomosis is arguably the most important of these. Jahnke et al., (1988) considered that a total increase in cattle of 33 million heads might be possible and would lead to an additional production of 495,000 metric tonnes of meat per year (assuming productivity of 15kg/head/year) and an increase in milk production of 1.26 million metric tonnes per year (using estimates of 38.3kg/head/year) if eradication or sustainable control of trypanosomosis were achieved over the entire tsetse fly-affected area (10 million km2) in the sub-humid and humid zones in sub-Saharan Africa. Thus, the potential benefits of sustainable control of trypanosomosis would be considerable for the 40 countries in Africa affected by this disease.

In Africa, 80% of traction power is non-mechanised. A six-fold increase in agricultural output as a result of the availability of a draught ox to a family unit has been estimated (McDowell, 1977). Furthermore, the manure provided by livestock is essential for the production of food and cash crops and is a potential source of energy in the form of biogas. In spite of the perceived importance of trypanosomosis, relatively little information has been compiled about the direct and indirect impacts of the disease or its control (Swallow, 2000), particularly so for Ghana.

1.1.2 History of Human Trypanosomosis

African Animal Trypanosomosis, also known as sleeping sickness in human beings, has caused death and destruction to millions of people and animals since the 1850's. It was only at the beginning of the 20th century that the causative agent of the disease and the manner of its transmission by the tsetse fly were identified, and initial treatments were found. There have been three severe epidemics in Africa over the last century: one between 1896 and 1906, mostly in Uganda and the Congo Basin, one in 1920 in several African countries, and one that began in 1970 and is still in progress (WHO, 2000). As the disease ravaged all of Eastern, Western Africa south of the Sahara in the early 1930s, mobile teams organized prevention and control activities and systematic screening campaigns. Through the dedication and motivation of physicians and health workers, the disease was slowly brought under control in the 1960's (WHO, 2000). Unfortunately over the last 35 years sleeping sickness has again become the scourge of Africa. The disease strikes in remote rural areas south of the Sahara where health systems are either weak or non-existent. The spread of the disease is furthered by many socio-economic factors such as political instability, wars and poverty that prevent the establishment of public health initiatives (WHO, 2000).

Some 60 million people in Africa are estimated to live under the threat of sleeping sickness. Trypanosomosis is currently present as an epidemic situation across much of Central Africa from Angola to Sudan. The prevalence of the disease is influenced by the migration (movement) of people, which is aggravated by civil unrest, the nutritional state of populations, and the availability of suitable climatic and ecological conditions for the survival of tsetse. In high prevalence areas of the Democratic Republic of Congo, up to 10% of the population is estimated to be affected but due to limited resources only 25-30% of those affected are under surveillance (ibid).

1.1.3 Control of Trypanosomosis

Many factors contribute to the complexity of the problem of African animal trypanosomosis. One major factor is the complexity of the disease itself - for example, the multiplicity of species of trypanosomes that cause the disease, either individually or jointly (d'Ieteren and Kimani, 2002). These trypanosomes are transmitted cyclically by the tsetse fly, of which there are some 36 species and subspecies, each adapted to different climatic and ecological conditions. While the tsetse fly is not the only vector of African trypanosomosis, cyclical transmission of infection represents the most important problem because a tsetse fly, once infected, remains infective for a long period, in contrast to the ephemeral nature of non-cyclical transmission by other biting flies. At the same time, trypanosomes infect a wide range of hosts, including wild and domestic animals, which represent reservoirs for the parasite (d'Ieteren and Kimani, 2002). Apart from this, the enormous geographical area affected by trypanosomes, the variety of ecosystems, and the limitations of methods currently available for extensive control contribute to the difficulty of containing the disease. While eradication of trypanosomosis remains a distant objective for most African countries, considerable effort has been invested in the control of this disease by the use of trypanocidal drugs, management of the vector and exploitation of the genetic resistance exhibited by indigenous breeds such as N'Dama cattle and Djallonké sheep (d'Ieteren and Kimani, 2002).

The control of trypanosomosis in enzootic countries involves control of tsetse fly population, prophylactic and curative treatments of animals at risk and the use of trypanotolerant animals. There is no vaccine against the disease and, in spite of intensive research, none appears likely in the near future because of the ability of trypanosomes to readily change their glycol-protein surface coat through a process called antigenic variation (Radosttits et al, 1994).

Control of the tsetse fly has been successfully attempted in some African countries such as Nigeria and Burkina-Faso, but re-invasion of the area is frequent if land is not properly utilized. The earliest methods involved bush clearing and elimination of game animals that acts as a reservoir. These methods were effective in eradicating or controlling tsetse flies in some parts of the continent but they resulted in destroying valuable plant and animal resources and also led to soil erosion.

These methods have been replaced by the use of insecticides, especially DDT and endosulfan, applied strategically in the form of ground and aerial spraying over large expanses of land. As tsetse flies are very sensitive to insecticides and no resistance has developed, considerable successes have been achieved in some countries. However, the method is costly and harmful to the environment. The cost and the environmental effects can be reduced considerably if the insecticides, for example, synthetic pyrethroids, are applied directly on the animal in the form of spray or pour-on formulation. The latter method appears to offer great promise and will also reduce tick infestation in treated animal, thereby controlling enzootic tick-borne diseases at the same time.

Other methods that have been developed recently include targets impregnated with insecticides and traps that attract and kill the flies. Targets and traps are effective, simple, cheap and could be constructed and maintained by local communities. Furthermore, they do not pollute the environment, are suitable for both the small and large scale farmer. They have been used to reduce tsetse fly population by 97% within seven months in a community in the Congo, (Radosttits et al, 1994). However, steps must be taken to ensure that traps are not stolen by individuals or destroyed by wildlife.

Another recently developed method is the sterile male technique. Since the female tsetse only mates once in a lifetime this technique is theoretically able to eradicate a targeted tsetse species in areas where other methods have been used to reduce its density. But it is an expensive method requiring a lot of capital and high technology.

Finally, it should be stated that development of the land for agriculture, industries, highways, etc. would effectively destroy the habitat for tsetse. This has occurred significantly in Nigeria where there have been rapid economic activities and an expanding human population in the past two to three decades (Radosttits et al, 1994). Attempts at trypanosomosis control have also been directed to prophylactic dosing with chemicals such as suramin, prothridium and isometamidium (Samorin). Prophylaxis is used along side other methods in areas where there is heavy population of tsetse flies, especially areas that are invaded by the flies in a particular favourable season for the fly propagation. The duration of the prophylactic effect of each drug is supplemented by the development of antibodies and the total period of protection may be as long as five months. However, it is customary in practice to give four or five treatments per year and the productivity response to this pattern of treatment is good (ibid).

1.1.4 Trypanosomosis and its Control in Ghana

It is estimated that about 60-70% of the land surface of Ghana is suitable for livestock production yet sustainable livestock production has not yet been achieved. One of the characteristics of livestock production is that to a large extent production is still organised through small-scale rural farming system. Major constraints that impede livestock development in Ghana and that are being addressed by the on-going National Livestock

Services Project (NLSP) include poorly developed traditional livestock management systems, livestock diseases, devastating annual bush fires, and perennial lack of all-year-round pasture and water supply for livestock especially during the harsh dry season. Among the major livestock diseases, trypanosomosis is recognized as a major constraint to the realization of a sound and sustainable livestock development (VSD, 1997).

With the current drift of cattle southward from the ever-drier Northern Savannah and the large introductions of the larger and more productive Zebu breed into the humid tsetse infested zones, animal trypanosomosis is fast catching the attention of the nation as probably the most important livestock disease now that rinderpest has virtually been controlled (ibid). Over 60% of Ghana is infested with various tsetse species and the estimated average national trypanosomosis prevalence is about 35%. Although economic losses attributable to animal trypanosomosis have not been quantified in Ghana, there is abundant circumstantial evidence to suggest that the preclusion of livestock rearing in some parts of the country is due to the high tsetse challenge. Since 1994, four fatal cases of sleeping sickness have also been documented. This is believed to be a tip of the iceberg. It is believed that soonest, a sustainable trypanosomosis control will be accorded the recognition and given the push it rightly deserves (VSD, 1997).

The Tsetse and Trypanosomosis Control Unit (TTCU) of the Veterinary Services Department (VSD) continues to monitor the vector and disease situation in the Northern Savannah, which was thoroughly covered under the Ghanaian-German Agricultural Development Project (1979-1983) and also extend surveys southwards into the humid zone. Since 1995 the TTCU has vigorously tackled the Southern Savannah as part of the four-priority tsetse and disease control areas selected for immediate treatment under the National Livestock Services Project and supported by the World Bank. Staff training and provision of inputs have been taken care of under this project. The objectives of this project are to prepare staff through training and field trials for any future large-scale trypanosomosis control and to immediately reduce the incidence of the disease in these priority areas to an "acceptable" level (ibid).

Another on-going programme is the establishment and validation of the trypanosomosis Antigen-ELIZA Test with the hope of using the test to monitor the efficiency of control programme/option (VSD, 1997).

Tsetse and trypanosomosis control in Ghana faces a multiple of problems. First, tsetse and trypanosomosis control operations are expensive and national budget allocations have never been sufficient for tsetse control in Ghana. Secondly, there is hardly any concrete data showing the real impact of trypanosomosis on the livestock sub-sector hence the tendency to treat the disease as less important than say rinderpest or anthrax. This may also be due to the general chronic nature of the disease. Consequently governments have not put the control of animal trypanosomosis on the same footing as rinderpest or say rabies. A third problem is the absence of commercialisation of the livestock industry, that is, most livestock owners do not consider livestock raising as a commercial enterprise. Finally, successive governments have lacked the political will to put tsetse and trypanosomosis control high on their agenda probably because the people who suffer most from the activities of tsetse and trypanosomosis are rural people who do not have as strong a voice as their urban counterparts to lobby policymakers.

1.2 Problem Statement

For many years the Veterinary Services Department (VSD) has relied on chemotherapy (trypanocides) and the exploitation of trypanotolerance to improve livestock productivity in the trypanosomosis-endemic areas of Ghana. For the last 20 years in West Africa, concerns about costs, sustainability and environmental safety have helped to stimulate interest in impregnated traps and targets used in combination with pour-on insecticide treatments as a non-polluting, cost effective technique for combating trypanosomosis in cattle (Kamuanga et al, 2001a). At the national level, control programs using traps have been successful in Cote d'Ivoire (Project de Lutte Anti-Tsetse, 1982-1994). In recent years, tsetse control interventions are targeted at selected sites where the vector-host interactions have been previously identified through rapid appraisal and Geographic Information Systems (GIS) techniques.

The TTCU has successfully tried the bait technology on some pilot projects and is now looking for opportunities to use this technology for full-scale tsetse control in the future. However, several issues remain to be addressed regarding the sustainability of these techniques. First, in addition to technical assessment of disease risks, it is important to assess the farmers' perspective with regard to these risks and their awareness of available control measures, thus preparing the ground for successful participatory research-development activities. Second, there may be externalities associated with the continued use of pour-ons, because of their impact on a variety of insects (ticks, biting flies). Third, the role and need for tsetse control in areas with predominantly trypanotolerant livestock has to be established.

There is a private goods component in tsetse and trypanosomosis control where individual farmers engage in activities such as clearing the bushes around their kraals to keep the tsetse fly away and also buying trypanocidal drugs to treat their affected animals. The present study is, however, particularly concerned with the optimal use of tsetse control as a local public good, whereby local organizations and groups of potential beneficiaries are expected to play a greater role in the financing and delivery of tsetse control techniques. This study therefore seeks to find answers to the following questions;

1. What are the specific constraints to increased livestock productivity peculiar to Northern Ghana?
2. What is the level of knowledge of livestock farmers about trypanosomosis?
3. What is the perception of livestock farmers about trypanosomosis and its impact on livestock production?
4. What is the level of trypanocides and acaricides use among farmers in different locations in the study area?
5. What factors affect labour or monetary contribution by livestock farmers for tsetse/trypanosomosis control in the study area?

1.3 Objectives of the Study

The overall objective of this study is to conduct a socio-economic assessment of the sustainability of trypanosomosis control in the Northern region of Ghana. The specific objectives under this study are:

1. To document the major constraints to increased livestock productivity and the importance of trypanosomosis among farmers in the study area.
2. To assess the level of knowledge of livestock farmers about trypanosomosis.
3. To assess the perception of livestock farmers about trypanosomosis and its effects on livestock productivity.
4. To compare the level of use of trypanocides and acaricides among farmers in different trypanosomosis risk locations in the study area.
5. To estimate the factors affecting labour or monetary contributions by livestock farmers for tsetse/trypanosomosis control in the study area

1.4 Relevance of the Study

There are several reasons why this study is relevant. First of all, agriculture is the most important source of income in Ghana and for that matter Northern Ghana. Agriculture accounts for 55.6% of the income of farmers as shown by the results of the Ghana Living Standard Survey (GLSS) and also accounts for 65.1% and 60.4% of the income of the poor and hardcore poor, respectively (Okyere et al, 1991). Therefore, the importance of tsetse/trypanosomosis control which is ultimately aimed at improving the productivity of the farmers and their livestock and therefore agriculture cannot be over emphasized.

Secondly, when poverty is looked at from the point of view of geographical regions it is found that the Northern Savannah Region (comprising Northern, Upper East and West Regions) has the highest incidence of poverty of 56% (Okyere et al, 1991). Previous studies on Ghana also support the findings from the GLSS that poverty in Ghana is predominantly concentrated in rural areas. It can therefore be concluded from available data that poverty in Ghana is over-whelmingly a rural phenomenon and the incidence is more in the north than in the south (ibid). From the above argument, therefore, it can be concluded that the people from the study area are most likely to benefit from effective measures aimed at suppressing the tsetse flies and the control of trypanosomosis, which is a major constraint to livestock production in the study area.

Thirdly, Ghana spends large sums of hard-earned foreign currency annually on meat imports to make up for the short fall in its meat requirement. According to the commodity trade database of the United Nations Statistics Division, Ghana spent an average of US$ 2,421,750 annually between 1997 and 2000 on beef imports alone. Northern Ghana, however, has the potential to increase its livestock production to make up for most of this shortfall if constraints on livestock production such as animal diseases and trypanosomosis in particular are given the necessary attention. Therefore, findings from this study will have long-term financial implications for livestock farmers in the North and Ghana as a whole by way of increasing farmers' incomes and reducing the country's expenditure on meat imports.

Finally, there seems to be no study on socio-economic evaluation of tsetse/trypanosomosis control in Northern Ghana. Therefore, this base-line study will significantly bridge the knowledge gap and contribute to existing knowledge and literature on the socio-economics of tsetse/trypanosomosis control.

1.5 Organization of the Study

This study is organized into five chapters. Literature review is presented in chapter two while the analytical tools used to analyse the data as well as the methods of data collection, sources and description of data are presented in chapter three. The empirical results of the study are also presented and discussed in Chapter four. Finally, conclusions and policy recommendations are drawn and presented in chapter five.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The review is grouped into seven main sub-topics that include: the geographic distribution of tsetse/trypanosomosis in Ghana, economic issues in tsetse and trypanosomosis control, the environmental impact of tsetse/trypanosomosis control operations, and the impact of tsetse control on land use. Other topics covered include: the Socio-cultural factors and the control of tsetse/trypanosomosis, the Contingent Valuation Method (CVM) and willingness to pay (WTP) elicitation techniques used in valuing tsetse control as a local public good.

2.2 Geographic Distribution of Tsetse/Trypanosomosis in Ghana

The distribution of tsetse to a large extent is influenced by the vegetation, the climate, the drainage system of the area as well as the presence of large game. There are different species of tsetse in different locations across Ghana. *Glossina morsitans* also referred to as large game tsetse is found mostly in national parks where large game is found. It is confined to the Savannah woodland belt and does not normally approach the forest zone in the south (Dräger, 1981). Nash (1958) states that *G. morsitans* is more dependent on the presence of game than vegetation.

G. palpalis gambiensis, *G. palpalis palpalis* and *G. tachinoides* are all riverine species. *G. palpalis gambiensis* is found in all the major drainage systems north of latitude 8° N. *G. palpalis palpalis* on the other hand is found in all drainage systems south of latitude

8° N. A mixture of these two species are common between latitude 7° and 9° N. *G. tachinoides* is found in all the major drainage systems in the north above latitude 8° N. It is a savannah woodland fly and occurs along streams throughout the northern and upper regions and is only absent from the top of the Gambaga escarpment (Dräger, 1981). The distribution of *G. palpalis* extends northward along the highlands in the East and West, but tends to be absent in the low-lying central Volta plain. In the northern areas *G. palpalis* is dependent on the presence of substantial riverine vegetation cover especially during the dry season. The species share the habitat with *G. techinoides* but is generally much more rare.

The forest species also known as the fusca group is mainly found in dense forests in Ghana. They are believed to live on large game as well as human beings who work on cocoa, palm, rubber and other plantations in the forest areas

The trypanosomosis disease exists in every ecological zone of the country in as far as the tsetse fly is wide spread. The disease can also be found in areas where there may not be tsetse but due to the movement of people and animals that may have the disease. A case in point is the Bawku area where conditions do not favour tsetse existence but where isolated cases of animal trypanosomosis have been reported (VSD, 1997).

2.3 Economic Issues in Tsetse and Trypanosomosis Control

The most important criterion in terms of tsetse control programmes is effectiveness rather than cost per se. Within each individual project area there will be some techniques that will be more appropriate and effective, others less so or completely inappropriate. Cost should only be a factor in deciding between appropriate and effective techniques (Kamuanga, 2003).

The first major economic evaluation of tsetse and trypanosomosis (T&T) control, undertaken in Uganda (Jahnke, 1976), indicated that ground spraying of insecticide was cheaper and more effective in controlling tsetse flies than eliminating game. Different approaches were subsequently used to evaluate the benefit-cost ratios of meat production under scenarios with and without T&T control (prophylaxis treatment and/or the use of trypanotolerant cattle). Jahnke concluded that development of a tsetse control and trypanosomosis strategy has to be integrated with land-use development and planning in Uganda.

Brandl (1988) compared the cost-effectiveness of the Sterile Insect Technique (SIT), aerial applications of persistent insecticide and impregnated traps. His benefit-cost analysis examined tsetse control in pastoral areas of Burkina Faso and Côte d'Ivoire where projected livestock revenues are derived from milk, herd growth, slaughter off take and live sales. The profitability of the SIT was the lowest, and in general the viability of tsetse control depended on the scale of operation, the level of challenge and project life. However, there has been a major development in the SIT technique that has made it more effective. The initial cost of the SIT is steep at the outset but the accruing, long-term benefits from eradicating tsetse flies can justify the costs, as shown by the success in Zanzibar in 1997.

The economics of trypanosomosis control using trypanotolerant cattle were investigated under the auspices of the Trypanotolerant Livestock Network of the then International Livestock Centre for Africa (ILCA), in Kenya, Ethiopia, the Gambia, the Democratic Republic of the Congo, Togo and Côte d'Ivoire (Itty, 1992). Itty and Swallow (1993) have shown that tsetse control appeared appropriate in situations with higher disease risk, and that imports of trypanotolerant stock (the Democratic Republic of the Congo, Togo) were not necessarily profitable. Itty (1995) developed a dynamic herd model to simulate projections for herd growth, meat and village milk production, and economic performance, from the base values collected on herd structures and productivity.

Other studies have variably documented approaches and results of cost analysis in T&T control activities. For example, the International Laboratory for Research on Animal Disease (ILRAD) socioeconomic unit compared the structure of the costs of trypanosomosis at a national level in three countries (ILRAD, 1993). It showed that virtually all the costs of the disease in the Gambia (US$1.30/head of cattle at risk) were attributed to production losses; in Zimbabwe the costs (US$7.60/head of cattle at risk) were almost entirely the costs of control, while in Côte d'Ivoire the costs (US$4.66/head of cattle at risk) were attributed to production losses (90 percent) and control (10 percent). Barrett (1997) provided a comparative review of the costs of four major techniques for tsetse control based on case studies in Zimbabwe and Zambia where each technique has been used on a large scale. Treating cattle with insecticides was found to be the cheapest method of T&T control. The costs of using odour-bated, insecticide-treated targets compared well with traditional ground spraying, increasingly disfavoured on environmental grounds. In a more recent review, Shaw (2001) has addressed the issue of how to integrate economic criteria into the strategic planning process for T&T control and eradication in West Africa with focus on the guidelines for prioritizing projects on the basis of their economic performance.

At the continental and international levels, evaluation of T&T control programmes is turning more and more to ascertain the benefits and economies of scale from a much wider perspective. Under the auspices of the International Livestock Research Institute (ILRI), Kristjanson and colleagues (1999) measured the costs of animal trypanosomosis and the potential benefits of control at the continent level. The study used geographical information systems (GIS) to spatially link a biophysical herd simulation model with an economic surplus model. Results indicate that the potential benefits of improved trypanosomosis control in terms of meat and milk productivity alone amount to US$700 million a year in Africa. Trypanosomosis costs livestock producers and consumers an estimated US$1 340 million per year in Africa without including the indirect benefits such as manure and animal traction. The authors estimated the internal rate of return of a project for research on trypanosomosis vaccine development at 33 percent.

All in all, the study, commissioned by the Department for International Development (DFID), on Tsetse and Trypanosome Research and Development since 1980 (Budd, 1999) has provided an evaluation of the whole "International Research Programme" from the standpoint of cost-effectiveness of the product to the individual user, community, nation or region, the breadth of applicability, and research cost-effectiveness. The study concludes that over a 20-year period the ratio of total benefit to total cost would be as high as 2.6. If trypanosomosis were to be eradicated, 40 percent of the population in sub-Saharan Africa would benefit and 55 000 deaths per year from sleeping sickness would be avoided. The potential economic effectiveness of this international research programme compares very favourably with other Africa-wide, research-development initiatives such as those for the Larger Grain Borer and the African Cassava Mosaic (Budd, 1999).

2.4 The Environmental Impact of Tsetse/Trypanosomosis Control Operations

Experiments with insecticides for tsetse fly control began in 1945 and, two years later, resulted in a full-scale campaign to eradicate *G. pallidipes*, *G. brevipalpis* and *G. austeni* from their last foci in Zululand, South Africa (Du Toit, 1954). Persistent organochlorine insecticides were dispersed indiscriminately in dust or smoke over approximately 18 000 km^2 of bush both by air and from the ground. The successful eradication of the fly was achieved in 1954, by which time many areas had received eight treatments of DDT (approximately 400 g a.i./ha). The effects on non-target wildlife can only be guessed.

The direct effects of tsetse control on the environment have been relatively well studied and documented (Douthwaite, 1992) but the importance and complexity of the indirect effects of trypanosomosis control are far from being fully understood. Although tsetse control has been the main approach to the control of trypanosomosis for many years in Botswana and Zimbabwe, elsewhere in Africa today, the main approach to controlling this disease, except in zones where trypanotolerant breeds of livestock are kept, is by the use of trypanocidal drugs (Jordan, 1992). Although concern for the African environment and the possible role of the tsetse fly as a protector of this environment has come to the fore in recent years, it is by no means a new concept. The threat that this fly poses to humans and their domestic animals was recognized by the early explorers. For example, it was considered that anything which could exterminate the fly would be "the greatest benefactor that central Africa ever knew" (Burton, 1860). However, the converse was already appreciated by the 1920s and 1930s: "the tsetse is the most potent preservers of the natural flora and fauna. Drive out the tsetse and the whole landscape changes" (Swynnerton, 1936). Although workers in Africa since then have remained aware of this dilemma, until relatively recently the debate had rather receded from the public eye, at least partly because of the arguments associated with the use of insecticides for tsetse control and their perceived threat to the environment. To some extent these arguments were counterproductive, as they diverted attention from the most important environmental and ecological issues associated with trypanosomosis control.

2.5 Impact of Tsetse Control on Land Use

It is when successful control of trypanosomosis is achieved over extensive areas that are densely infested with tsetse flies that the most profound changes in land use - and risks to the environment - are to be expected. In such cases, particular care must be taken to try and prevent excessive pressure on what is often already a fragile ecosystem (Maclennan and Na'isa, 1971).

A highly successful tsetse eradication campaign was carried out in Northern Nigeria from 1955 to the late 1970s, mainly with ground spraying of insecticide (Maclennan and

Na'isa, 1971). In the short term, the campaign released extensive new areas for cattle grazing and reduced pressure on the arid, naturally fly-free traditional grazing areas in the far north of the country. The immediate outcome was thus entirely environment-friendly. In the longer term, the outlook for the environment has been less favourable. There are already indications that the occupation of new land, formerly infested by tsetse flies, is only postponing a crisis as humans continue to increase in numbers and still more land is required. As a result of this process the livestock owner is often coming out second best, as subsistence crop farmers increasingly encroach upon the most suitable land for pasturage. Land-use studies undertaken prior to tsetse control foresaw this potential conflict of interests and recommended the drawing up and enforcement of reservation ordinances to protect the graziers but, in practice, little was achieved. One lesson is clear from this experience: tsetse control should not be held responsible for the present rate of environmental change (Jordan, 1992).

The original objective of relocating the national herd away from overstocked areas in Nigeria was achieved but this success is being overtaken by pressures associated with rapidly expanding human populations - pressures beyond the scope of tsetse control. Because of its high and increasing human population density, Nigeria is perhaps a special case, but populations are expanding elsewhere in Africa, albeit usually from a lower baseline. Lessons are to be learnt from events in Nigeria and they should be taken into account when planning trypanosomosis control in wilderness areas elsewhere. Subsequent environmental change is inevitable (and necessary if expanding populations are to be fed), but every effort must be made to ensure that the changes are beneficial and sustainable and that they do not result in degradation (ibid).

2.6 Socio-Cultural Factors and the Control of Tsetse/Trypanosomosis

Most of the failures of development projects occur when the communities concerned have been left out of the processes related to the design, formulation and implementation of the projects. Up until the mid-1980s, tsetse control had been achieved primarily by bush clearing and insecticide spraying, implemented by public agencies with little or no involvement of the local beneficiaries. The high costs and complexity of these operations have recently proved to be beyond the capacity of national organizations without extensive technical and external financial support (Kamuanga, 2003).

The debate about public, private and communal roles in controlling trypanosomosis gained interest and momentum with recent developments in the bait technologies that are proving to be increasingly popular because of their cost effectiveness, technical efficiency and low environmental impact. Since bait technologies are logically suitable for local populations, donors and governments are looking at programmes with community participation and especially cost-sharing programmes as the ideal solution to the problem of sustaining tsetse and trypanosomosis (T&T) control activities (Barrett and Okali, 1998b). This development triggered the farmer/community-based approach promoting participation and the integration of T&T control activities into general rural development activities (Dransfield and Brightwell, 2001). Emerging community approaches to the management of T&T control are now based on the recognition that needs and perspectives of local people have to be understood, and their aspirations accounted for (Mwangi, 1996; Ssennyonga, 1998). Community participation has not only been an important element of African governments' policies and programmes, it also reflects current donors' policies towards more participatory approaches to rural development, with the hope that some of the costs of T&T programmes can be "passed over" to the community (Barrett and Okali, 1998a; Echessah *et al,* 1997).

The results of a community-based tsetse and trypanosomosis control in Samorogouan and Sissili in 1989 and 1993 indicates that farmers willing to contribute only money (23 percent) pledged to pay CFA 184.32 (US$0.26) per month; those willing to contribute only labour (37 percent) pledged to contribute 5.2 work-days per month; and the remaining group willing to contribute in both forms of payment (40 percent) pledged to pay CFA563.2 (US$0.86) per month and contribute 7.8 work-days per month. Thus, farmers contributing only money or only labour were contributing less of each than farmers who were contributing both. The actual contribution of labour by the last two groups at the start of the tsetse control programme was less than a third of the amount pledged (Kamuanga *et al.*, 2001a).

Control operations began with careful consideration of partnership obligations involving several institutions (parastatals, research and development institutions, livestock owners' associations and private veterinarians). Despite the success of tsetse campaigns, several mechanisms put in place to ensure the sustainability of control operations failed. Although the strategy had elements of a bottom-up approach to facilitate the implementation and commitments of community leaders, too much responsibility rested with the community participants with regard to the management of collected funds, deployment of traps and targets including impregnation, repairs and replacement, applications of pour-ons to cattle and sensitisation to involve even more people. The participation of private veterinarians was an innovative action in the tsetse control programme. However, their involvement brought new problems to the surface as profit motives overran concerns for efficiency and sustainability of control operations. Finally, little account was taken of the latent conflicts between agriculturalists and pastoralists. The nature of the relationships between technical personnel and community action leaders changed over time without further incentives given to the former to continue providing quality service and advice.

In a related development, the Tsetse and Trypanosomosis Control Services under the Ivorian Ministry of Agriculture and Animal Resource from 1996 to 1999 intiated a series of participatory experiments in tsetse control in the northern savannah areas with varying degree of success (Kamuanga, 2003).

A recent assessment of the impacts of the sensitization campaign for increased community participation in more than 350 villages indicated that 26,818 people attended village meetings of whom 34 percent were owners of oxen and only 3 percent were transhuman herders. Full participation by the villagers (purchase, installation, maintenance, repairs and surveillance of traps) was noted in 86 percent of the villages for 5,913 traps and targets out of a total of 6,982 (Krüger et al., 2001).

The Côte d'Ivoire experience is impressive in the longevity (nearly 20 years) of external assistance to the community for developing a sustained T&T control programme. The biggest concern today turns around the question of cost recovery in the use of traps and targets as control techniques. There are legitimate questions as to what will happen when external funding comes to an end (Kamuanga, 2003).

2.7 The Contingent Valuation Method (CVM)

Contingent Valuation Method (CVM), which was introduced into the environmental economics in the early 1970's, has received considerable attention in recent years as a method of overcoming the limitation of other valuation methods. It entails the establishment of a carefully defined hypothetical market for non-market commodities, such as environmental quality or research output (Bergstorm, 1990). Because it creates a hypothetical market place in which no actual transactions are made, CV has been successfully used for commodities that are not exchanged in regular markets, or when it is difficult to observe market transactions under the desired conditions (Alberini and Cooper, 2000), hence its application in this study to elicit respondents willingness to pay for tsetse control as a local public good.

The goal of contingent valuation is to measure the compensating or equivalent variation for the good in question. Compensating variation is the appropriate measure when the person must purchase the good, such as an improvement in environmental quality. Equivalent variation is appropriate if the person faces a potential loss of the good, as he would if a proposed policy results in the deterioration of environmental quality. Both compensating and equivalent variation can be elicited by asking a person to report his willingness to pay (WTP) amount. Formally, WTP is defined as the amount of money that must be taken away from the person's income whiles keeping his utility constant (Alberini and Cooper 2000):

Although critics consider CV a "deeply flawed method" for valuing non-use goods and point at the possible biases affecting CV data, the method has been the basis for a significant amount of policymaking in the United States (Cropper and Alberini, 1998). The World Bank, the United States Agency for International Development and other donor agencies have taken an interest in CV as a means of assessing the demand for sanitation services, improvement in water supply, the benefits of establishing national parks and the cost/benefit of restricting land use to reduce tropical deforestation in developing countries (Alberini and Cooper, 2000).

Based on the results of CV studies, researchers have been able to predict the number of connections to water system at improved conditions, and the resulting revenue for the local water authority, making it possible to study the feasibility of such improvements and of various financing schemes (ibid).

However, CV practioners conducting studies in developing countries have had to struggle with a variety of problems, including sampling without lists, and influence of community leaders on survey responses (Alberini and Cooper, 2000). Respondents have struggled with the notion of maximum willingness to pay, or have been found to report very low

WTP for a commodity (for example, the public water supply system) when their actual expenditures for purchasing water from alternative sources, such as private vendors, are much higher. This has been attributed to seasonal markets and cash constraints related to regular payment to the water authority.

At many locations in Asia and Africa, respondents distrust the government, which they blame for current state of disrepair of facilities and this is reflected in their WTP for commodities or service such as regional-level sanitation, water quality programmes and local water supply. It has also been difficult in some cases to describe the technology that would bring the specified improvement, and researchers have been forced to craft the CV questions in imaginative ways to get around this problem (ibid).

Despite these difficulties, it is hoped that proper application of CV can and will provide valuable information to policymakers and donor agencies seeking to evaluate the benefits of intervention, or revenues associated with investment in infrastructure.

2.8 Willingness To Pay (WTP) Elicitation Techniques

A number of methods have been used to elicit the willingness to pay (WTP) by individuals, including open-ended willingness-to-pay technique, close-ended iterative bidding, contingent ranking (or ranked choice), the dichotomous choice, referendum, and the payment card with comparative tax prices, or with a range of prices for the good (Boardam, 1996). Evidence has shown, however, that such "guidance" is subject to starting point bias, which can bias respondents' answers. Open-ended questions are now widely used in conjunction with other CV methods, as they are not prone to starting point bias. Thus open-ended questions provide a check on the extent of starting point bias introduce by other methods

A number of studies on livestock disease control have used the contingent valuation method to elicit information about the respondents' willingness to pay towards the control of specific animal disease. For example (Swallow et al., 1994) used the CVM to generate estimates of the maximum amount of money and/or labour that farmers were willing to contribute towards tsetse control in Ethiopia. The results of that study indicated that 59% of the respondents volunteered both money and labour and only 3% volunteered neither money nor labour. Willingness to contribute money was related to the sex of the household head, the number of cattle held by the household and the participation of the household in a monitoring exercise being conducted by the research organization. Willingness to contribute labour was related to the employment status and the information on the tsetse control program available to the respondent.

In a related case study of the Yale agro-pastoral zone in Southern Burkina Faso, (Kamuanga et al., 2001a) also used the CV technique to generate estimates of farmers' willingness to pay for tsetse control in money, labour, or both forms of payment. Results of the study indicated that major factors affecting contingent contribution of labour and money include the age of the household head, off take of cattle, household head involvement in secondary economic activities, membership in rural organizations, current expenditure on drug therapy, and cash-on-hand.

The opened-ended WTP elicitation technique was used for this study to elicit the maximum amount of labour or money that the respondents were willing to contribute. The most important concern that researchers have about using the open-ended technique is the large number of non-responses or protests zero responses that it generates and which results in many missing values for WTP (Mitchell and Carson, 1989; and Alberini and Cooper, 2000). This concern did not, however, prove to be a problem in the pre-tests or the actual survey. The opened-ended technique resulted in data that were easy to analyse and avoided the anchoring biases that can be associated with the closed-ended techniques (Cumming et al.,1986; Kealy and Turner, 1993).

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter presents the methods used to analyse the data to achieve the specific objectives of this study. The first four specific objectives are addressed using descriptive statistics including percentages, means, frequencies and weighted averages. The theoretical framework and the structure of the empirical model on factors affecting the willingness to contribute money or labour are also developed and presented to address specific objective five. Data collection methods, including sampling and sample size and methods of data collection are also presented and discussed in this chapter.

3.2 Major Constraints to Increased Livestock Productivity in Northern Ghana

Frequencies and weighted averages were used to identify the major constraints to increased livestock productivity in the study area, that is, the first objective of this study. First, frequencies were run to determine the total number of respondents identifying a particular constraint. A similar approach was used to further determine the number of respondents identifying the particular constraint as the most important, second, third and fourth most important (maximum of four constraints were allowed). The weighted average was then estimated by the following equation;

$$WA = \frac{((1 \times FC1) + (2 \times FC2) + (3 \times FC3) + (4 \times FC4))}{TF} \quad (1)$$

Where WA represents weighted average, 1, 2, 3 and 4 respectively represents the weights assigned to the most important, second, third and fourth most important constraints as ranked by the farmers. *FC1, FC2, FC3* and *FC4* also denote the number of farmers identifying the particular constraint as the most important, second, third and fourth most important constraint respectively. Finally, *TF* denotes the total number of farmers identifying the particular constraint. The importance of trypanosomosis among farmers, which is part of the first objective was also analysed using the frequency and weighted average approach. In both cases, since the most important constraint is weighted with the least number, the constraints with the least weighted average value is ranked most important.

3.3 Livestock Farmers Knowledge Level about Trypanosomosis

The second objective of this study, which looks at farmers' level of knowledge about trypanosomosis, was achieved with the use of frequencies and percentages. Frequencies were run on the number of symptoms of trypanosomosis identified correctly by farmers and the corresponding percentages used to describe farmers' knowledge of those symptoms. A similar approach was adopted for knowledge about trypanosomosis transmission and knowledge about the physical features of the tsetse fly itself.

3.4 Farmers Perception about the Impact of Animal Diseases on Livestock

Specific objective three of this study examines the perception of livestock farmers' about animal diseases in relation to the changes in livestock population. This objective was accomplished by the use of percentages.

3.5 Use of Acaricides and Trypanocides among Farmers in the Study Area.

The import of specific objective four is to compare the use of acaricides and trypanocides among livestock farmers in low and high trypanosomosis risk locations in the study area. Due to lack of consistent data on quantities of these inputs, the mean expenditure values were used as proxy for quantities for the purpose of the comparison. The t-test was then used to determine the statistical significance of the differences between the mean values of expenditures on these inputs by farmers in the two locations. Similar tests were conducted on the means of selected household level variables to identify variables which are likely to explain the differences in expenditure on the use of the drugs by farmers in the two locations.

3.6 Theoretical Framework on Willingness to Pay for Tsetse Control

Contingent valuation is a survey technique that is used primarily to place monetary value on products and services for which market prices do not exist or are not reflective of the goods' actual social value. Respondents' were presented with realistic but hypothetical scenarios about tsetse control that will reduce the risk level of trypanosomosis and asked questions about the maximum amount of money and labour time (in days) that they would contribute if those scenarios were to be realised. The values that are derived are "contingent" upon the realization of the scenarios (Swallow et al., 1994).

The questionnaire for this study was designed such that three mutually exclusive alternatives were presented to the respondents: (1) contributing only money (indexed M), (2) contributing only labour (indexed L), (3) contributing both money and labour (indexed MNL). The pledged labour contribution (WTPL) and pledged monetary contribution (WTPM) of the sub-sample of households willing to contribute in both forms of payment, that is, labour and money (MNL) are determined simultaneously. The relevant functions of the simultaneous equations model are specified as follows.

$$WTPM_i = f(EXPONASS_i, FARMSIZE_i, HHINCOME_i, HHSIZE_i, TRYPRISK_i, WTPL_i) \quad (2)$$

$$WTPL_i = f(CATTLESIZEi, EMPLOY_i, FARMSIZEi, WTPM_i) \quad (3)$$

The definition and description of the variables in (2) and (3) are presented in Table 3.1

An appropriate methodology for modelling a simultaneous equations model in which the random terms of the various relations of the system are dependent is the three-stage least squares. The three-stage least squares procedure involves the application of the method of least squares in three successive stages. The procedure utilises more information than the single-equation techniques, that is, it takes into account the entire structure of the model including the structure of the error term with all the restrictions that this structure imposes on the values of the parameters (Koutsoyiannis, 1977).

In using the 3SLS, the following assumptions are made:

1. The complete specification of the entire system is correctly known.

2. The random term of each equation is serially independent (non-autocorrelation).

3. The random terms of the various relations of the system are contemporaneously dependent. If the random terms of the various relations are independent, the 3SLS

Table 3.1: Definition of Variables in the Willingness to Pay Empirical Model

Variable	Variable name	Description
	Dependent Variables	
Willingness to pay money	WTPM	Total amount of money in Ghanaian cedis that farmers (who are willing to contribute money and labour) are willing to pay per month for tsetse control.
Willingness to contribute labour	WTPL	Total number of days that farmers (who are willing to contribute money and labour) are willing to contribute per month for tsetse control.
	Independent Variables	
Household size	HHSIZE	Number of adults and children resident in the household at the time of the survey.
Household expenditure on associations	EXPONASS	Household total expenditure(in cedis) on associations in the past year prior to the survey.
Farm size	FARMSIZE	Number of hectares cultivated by the household in the previous season before the survey.
Household income.	HHINCOME	Household total income (in cedis) over the last one year from various sources.
Employment of household head	EMPLOY	Equals 1 if household head is employed off-farm; 0 otherwise.
Household Cattle size	CATTLESIZE	Number of cattle owned by household including calves.
Trypanosomosis risk level	TRYPRISK	Equals 1 if the respondent comes from a high trypanosomosis risk village; 0 otherwise

reduces to 2SLS. However, taking into account the complex nature of economic phenomena and the simplification which are adopted in specifying econometric models, it may well be expected that the error terms (U's) will be contemporaneously correlated, that is $E(U_i U_j) \neq 0$, where i refers to the ith equation and j to the jth equation.

4. The system is over identified.

3.7 Rationale for Proposing Monetary and/or Labour Contribution for Tsetse Control

Respondents were allowed to volunteer money and/or labour rather than just cash as is normal in contingent valuation studies. This was desirable for the following reasons.

The first reason was to assess the acceptability of money or labour contribution to the local population. It was thought that local people would be reluctant to contribute money because they expect the government and non-governmental organizations to finance the provision of public goods such as tsetse control. The second reason was to provide an opportunity for the people to express their support for the proposed tsetse control programme even if they felt they would be unable to contribute money. Since most farmers in the study area have very little opportunities for earning cash income, it could be misleading to equate a low willingness to contribute money with a general reluctance to support the programme. Respondents were asked if they were willing to contribute money to a fund for replacing materials and/or labour time for constructing, monitoring, and maintaining the targets. Whether they volunteered nothing, money only, labour only, or both money and labour determined the set of contingent valuation questions that were then asked.

3.8 Empirical Models

Based on the theoretical framework and available data, the following system of equations was specified and estimated simultaneously using the three-stage least squares procedure.

$$WTPM_i = \beta_0 + \beta_1 EXPONASS + \beta_2 FARMSIZE_i + \beta_3 HHINCOME_i + \beta_4 HHSIZE_i + \beta_5 TRYPRISK_i + \beta_6 WTPL_i + e_i \quad (4)$$

$$WTPL_i = \beta_0 + \beta_1 CATTLESIZE_i + \beta_2 EMPLOY_i + \beta_3 FARMSIZE_i + \beta_4 WTPM_i + u_i \quad (5)$$

The definitions and descriptions of the variables in (4) and (5) are presented in table 3.1.

3.9a: Statement of Hypothesis on Factors Affecting Money Contribution

The following sets of hypotheses are tested.

1. H_O: Farm size of the household has no effect on the amount of money that the household is willing to contribute for tsetse control.

   H_A: Farm size of the household exerts a negative effect on the amount of money that the household is willing to contribute for tsetse control.

2. H_O: Household size has no effect on the amount of money that the household is willing to contribute for tsetse control.

   H_A: Household size exerts a negative effect on the amount of money that the household is willing to contribute for tsetse control.

3. H_O: High trypanosomosis risk has no effect on the amount of money that the household is willing to contribute for tsetse control.

   H_A: High trypanosomosis risk exerts a positive effect on the amount of money that the household is willing to contribute for tsetse control.

4. H_O: Level of expenditure on membership in associations exerts no effect on the amount of money that the household is willing to contribute for tsetse control.

   H_A: Level of expenditure on membership in associations exerts a positive effect on the amount of money that the household is willing to contribute for tsetse control.

5. H_O: Household income exerts no effect on the amount of money that the household is willing to contribute for tsetse control.

   H_A: Household income exerts a positive effect on the amount of money that the household is willing to contribute for tsetse control.

6. H_O: The amount of labour a household is willing to contribute for tsetse control has no effect on the amount of money that the household is willing to contribute for tsetse control.

   H_A: The amount of labour a household is willing to contribute for tsetse control could have a negative or positive effect on the amount of money that the household is willing to contribute for tsetse control

3.9b: Statement of Hypothesis on Factors Affecting Labour Contribution

The following sets of hypotheses are tested.

1. H_O: Farm size of the household has no effect on the amount of labour that the household is willing to contribute for tsetse control.

   H_A: Farm size of the household has a negative effect on the amount of labour that the household is willing to contribute for tsetse control.

2. H_O: The number of cattle owned by the household has no effect on the amount of labour that the household is willing to contribute for tsetse control.

   H_A: The number of cattle owned by the household exerts a negative effect on the amount of labour that the household is willing to contribute for tsetse control.

3. H_O: Employment status of the household head has no effect on the amount of labour that the household is willing to contribute for tsetse control.

   H_A: Employment status of the household head negatively affects the amount of labour that the household is willing to contribute for tsetse control.

4. H_O: The amount of money a household is willing to contribute for tsetse control has no effect on the amount of labour that the household is willing to contribute for tsetse control.

   H_A: The amount of money a household is willing to contribute for tsetse control could have a negative or positive effect on the amount of labour that the household is willing to contribute for tsetse control.

3.10 Sample Size and Sampling Procedure

A total of 271 households were randomly selected in the Savelugu/Nanton and West Mamprusi Districts of the Northern Region of Ghana for this study. Before the actual survey, an exploratory survey was conducted in the study area from 9 to 13 April 2002. The idea behind the exploratory survey was to establish contact with farmers and the Veterinary Services Department (VSD) at Pong-Tamale. During this survey, information was also gathered on the number of villages in each of the two districts. This information later became the basis upon which villages and subsequently households were selected for the actual survey. Data and information collected during the group discussions was also used in revising the preliminary questionnaires intended for the actual survey.

Subsequently, the preliminary questionnaires were pre-tested in Dipale and Kudiziegu (Savelugu-Nanton District) and Mishuo and Kpasenkpe (West Mamprusi District). These villages were purposively selected because they are known to be high tsetse challenged villages. The pre-testing had to be carried out in the two districts also because they differ in their ethnic composition. Twenty respondents were selected from each of the four villages for the pre-testing between September and August 2002. The main aim of the pre testing was to further reshape and fine-tune the preliminary questionnaires for the actual survey and provide an opportunity for field assistants to learn appropriate ways of approaching the farmers in conducting the survey.

There are 58 and 48 villages in the Savelugu-Nanton and the West Mamprusi Districts respectively. Out of these numbers, a total of 14 villages were purposively selected on the basis of available information on their level of trypanosomosis risk. Eight of these villages were drawn from the Savelugu-Nanton District whiles the other six villages were drawn from the West Mamprusi District. The selected villages were further classified into low and high trypanosomosis risk zones based on management of herd in relation to exposure to tsetse.

Three of the selected villages in the Savelugu-Nanton District namely, Nyamandu, Nanton-Kurugu and Zieng were categorised as low trypanosomosis risk zones and a maximum of 45 households was selected from these villages. The number of households selected from each of the three villages was based on proportional weighting. That is, the share of each village in the 45 households was found by dividing the total number of households in that village by the total number of households in the entire three villages and then multiplied by 45. The other villages that were categorised as high risk in the Savelugu-Nanton District included Pong-Tamale, Kpendua, Kpallon, Gushie and Pigu and the sample size for these villages were defined in exactly the same manner as those in the low risk category. A total of 101 households were selected from the high-risk villages in the Savelugu-Nanton District. This brought to 146 the number of respondents selected in the Savelugu/Nanton district.

In the West Mamprusi District, two of the selected villages namely, Wulugu and Dimea were also categorised as low risk trypanosomosis villages and a total of 45 households selected. The other four villages namely, Duu, Bugyapala, Moatani and Bugyakura were categorised as high-risk villages and a total of 80 households selected. The share of each village in the total allocation was also based on proportional weighting. This also brought to 125 the number of respondents selected in the West Mamprusi district.

The proportional weighing procedure which was used to determine the sample size for the selected villages as well as the random sampling approach that was used to select the respondents, could not have been applied without information on the number and listing of households respectively for all the selected villages in the two districts. The household number and listing were therefore, a requirement for the use of these methods (proportional weighting and simple random sampling).

Due to absence of existing household listings, a household census was conducted in December 2002 in both districts to develop lists for the sampling of respondents. Household for the purpose of this study is defined as a family unit that makes independent decisions about agriculture production, food consumption and allocation of labour and other resources. The census results for the Savelugu/Nanton and West Mamprusi districts respectively are presented in Tables 3.2 and 3.3.

3.11 Selection of Respondents and Conduct of the Interviews

To remove bias and to make the selection of respondents more representative, the simple random sampling approach was used for the selection of respondents. Using the household listings generated from the household census, a random number table was generated from the computer and used to do the random selection of respondent for all the villages involved.

Table 3.2 Census Results and Sample Size for the Selected Villages in Savelugu/Nanton District.

Name of location	Number of households	Number of households selected by proportional weighting
Nyamandu (LR)	36	5
Zieng (LR)	172	25
Nanton-kurugu (LR)	100	15
Sub-total	**308**	**45**
Pigu (HR)	47	8
Gushie (HR)	83	14
Kpallon (HR)	34	6
Kpendua (HR)	32	4
Pong-Tamale (HR)	416	69
Sub-total	**612**	**101**
Grand total	**920**	**146**

LR = Low Risk Trypanosomosis

HR = High Risk Trypanosomosis

Table 3.3 Census Results and Sample Size for the Selected Villages in West Mamprusi District.

Name of location	Number of households	Number of households selected by proportional weighting
Dimea (LR)	14	1
Wulugu (LR)	503	44
Sub-total	**517**	**45**
Duu (HR)	286	56
Moatani (HR)	14	3
Bugyakura (HR)	36	7
Bugyapala (HR)	75	14
Sub-total	**411**	**80**
Grand total	**928**	**125**

LR = Low Risk Trypanosomosis

HR = High Risk Trypanosomosis

The reliability of results of any research work depends to a large extent on the quality of data used for the study. As a result, all the necessary steps were taken to ensure that quality data was generated for this study. Very experienced officials of the Veterinary Services Department (VSD) were selected for the field activities. They were adequately trained during the pre-testing and prior to the actual survey to ensure adequate knowledge and common understanding of all the questions on the questionnaire. The data was collected over a period of two months (January to February 2003).

CHAPTER FOUR

EMPIRICAL RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents and discusses the empirical results. The discussion begins with a brief description of the characteristics of the sampled farm households and continues with an analysis of the constraints faced by livestock farmers in the study area. This is followed by a discussion on farmers' knowledge and perception about trypanosomosis. Also presented and discussed are results on the use of acaricides and trypanocides by farmers in different trypanosomosis risk locations in the study area. Finally, the chapter closes on the discussion of the factors that affect the form of contribution farmers are willing to make towards tsetse control in the study area.

4.2 Characteristics of the Sampled Farm Households

The 271 household heads sampled for this study turned out to be predominantly male with only 7% being female. In addition, only 33.5% of the sampled household heads had some formal education. Among those with formal education, 51% had between 1 and 6 years of formal education completed, 11% had between 7 and 9 years, 19% had between 10 and 12 years while the remaining 19% had over 12 years of formal education. The age distribution of the sampled population is as follows: below 31 years (6%), 31-40 years (20%), 41-50 years (23%), 51-60 years (19%) while 31% were above 60 years. The mean age is 53years whiles the minimum and maximum ages respectively are 20 and 85 years. Of the total sample, 81% of the people interviewed were the household heads themselves.

The remaining 19% represented other household members such as wife, son or daughter, sister or brother and other relations of the household head. The survey results also indicated that 70%, 49% and 43% of the sample population owned some goats, sheep, and cattle respectively. In addition, 12% and 8% of the sample population owned donkeys and pigs respectively. This indicates that many more farmers keep goats than any other livestock in the study area.

4.3 Major Constraints to Increased Livestock Productivity in Northern Ghana

In addition to animal diseases as noted by the VSD, there are several other constraints that militate against the livestock sub sector in Ghana. Some of these constraints came to light during the household survey that was conducted in the Savelegu/Nanton and West Mamprusi districts of the northern region of Ghana. Farmers were asked to mention at most four constraints (in order of importance) in their communities that they found as obstacles to increased livestock productivity. Several constraints were identified and after a careful combination of those constraints that were similar, the constraints were reduced to those presented in Table 4.1.

The constraints as they are presented in Table 4.1 are based only on the absolute frequencies. The importance of these constraints was, however, ranked by the farmers and therefore the absolute frequencies alone will be insufficient to indicate which constraints are ranked most important by the farmers. The weighted average, which is based on the absolute frequencies, is therefore used to identify the most important constraints that serve as obstacles to increased livestock development in the study area.

Table 4.1: Constraints to Increased Livestock Productivity in Northern Ghana

CONSTRAINTS	FREQUENCY	PERCENTAGE
Lack of feed for animals in the dry season	106	39.1
Animal diseases	100	36.9
High mortality rate in animals	91	33.9
Lack of water for animals in the dry season	85	31.2
Poverty (lack of funds to buy and raise livestock)	70	25.8
Theft of animals (mostly livestock)	66	24.4
Lack of proper housing facilities for animals	42	15.5
High cost of Veterinary drugs	19	7.0
Killing of animals by vehicles	17	6.3
Lack of good knowledge in livestock management	16	5.9
Lack of veterinary assistants to treat sick animals	13	4.8
Frequent sales of animals to solve household problems	12	4.4
Tethering of animals throughout the raining season	10	3.7
Incidence of biting insects	8	3.0
Lack of improved breeding stock	2	0.7
Lack of reliable animal caretakers (Fulani herdsmen)	1	0.4
Eating of young animals by dogs	1	0.4

Source: From field data
Note: Frequencies do not add to 271 and also percentages do not add to 100 because respondents were allowed multiple responses.

In using the weighted average approach, farmers' responses on constraints were weighted. Constraints that were identified by farmers as the most important were given a weight of one while those identified as least important were also given a weight of four (maximum of four constraints were allowed). One important limitation of the weighted average approach to ranking responses is that responses with very low frequencies affect the validity of the process if included in the analysis. For example if just one farmer mentions a particular constraint as the most important constraint in his/her situation, such a constraint will have a weighted average of one and will be ranked equal to another constraint that may have say hundred farmers identifying it as their number one constraint (most important), since the latter case will also have a weighted average of one.

As a result of this limitation therefore, only constraints that were mentioned by at least 20% of the 271 farmers interviewed were arbitrary considered important and included in the analysis. The use of the weighted average equation as specified in chapter three is demonstrated below using high mortality in animals as an example;

$$WA_{HM} = \frac{((1\times58) + (2\times20) + (3\times12) + (4\times1))}{91} = \frac{138}{91} = 1.52 \qquad (6)$$

Where WA_{HM} is the weighted average for high mortality in animals. The results of the weighted average approach of ranking the constraints are presented in Table 4.2.

Based on the weighted average ranking as shown in Table 4.2, high mortality rate in animals is ranked as the most important constraint to increased livestock development in the study area. This constraint in the view of farmers is attributable to factors including animal diseases and general lack of proper care for animals in the study area.

Table 4.2: Ranking of Constraints by the Weighted Average Approach

CONSTRAINTS	WEIGHTS 1	2	3	4	FREQ	W. A.	RANK
High mortality in animals	58	20	12	1	91	1.52	1
Animal diseases	47	26	23	4	100	1.84	2
Lack of water for animals in the dry season	42	31	15	7	95	1.86	3
Lack of funds to buy and rear animals (Poverty)	41	23	14	11	89	1.94	4
Lack of feed for animals in the dry season	34	48	13	11	106	2.00	5
Theft of animals (livestock)	15	25	16	10	66	2.32	6

Note: frequencies do not add to 271 because multiple responses were allowed
FREQ.- Frequency
W. A. – Weighted Average
RANK- Ranking

When asked what ought to be done to overcome this constraint, the farmers suggested roles for livestock owners, the government and the personnel of the Veterinary Services Department (VSD). The majority view was that personnel of the VSD should intervene by intensifying their effort at animal diseases control to reduce the high mortality rate in herds. Some of the respondents also thought that the high mortality rate among animals could be reduced if government acts by subsidizing animal drugs to make it affordable for livestock farmers to buy and treat their sick animals. The role of the livestock farmers should be to take proper care of their animals through the provision of suitable housing and adequate feeding especially in the dry season.

For controlling the high incidence of animal diseases, the second most important constraint, similar suggestions were made by the farmers to overcome this constraint.

Majority of those farmers who identified animal diseases as a constraint thought that the Veterinary Services Department has a greater role to play in controlling animal diseases while the government can also help the situation by making animal drugs cheaper and affordable for farmers. According to the respondents, livestock owners' role should be to report sick animals to the veterinary personnel for attention and to provide the right conditions that promote good health for the animals. The consequence of disease is an increase in morbidity, which in itself reduces livestock productivity, leading to death if cases are severe.

All over the Northern region, lack of water for animals especially during the dry season has been identified as one of the major constraints to increased livestock development. Solutions exist in some villages in the form of dams built by the people themselves, but the long dry seasons and rainfall shortages in recent years have made it difficult for dams to be filled with water and used efficiently. In some villages, cattle in particular travel several kilometers on daily basis in search of water. The majority of farmers, that is, 72% of those who identified lack of water as a constraint to livestock development favoured strong government assistance to provide water for their villages. The remaining 28% of the farmers, however, thought that it was the responsibility of the communities and for that matter livestock farmers to provide water for their animals and should therefore initiate the process themselves before seeking government assistance.

Lack of adequate capital on the part of farmers to purchase the initial breeding stock of cattle in particular and other small ruminants was also identified as a constraint that militates against the livestock industry in the study area. Most started with raising poultry, earning enough income to buy small ruminants; with the flock size increasing, cattle were later purchased. Other households acquired cattle through inheritance and normal herd growth. Over 70% of those who identified inadequate capital as a constraint, suggested that governmental and non-governmental interventions through various poverty alleviation packages to alleviate poverty is the way out of this problem.

Lack of pasture and feed during the dry season for livestock is yet another problem that confronts livestock farmers in the region. Bush fires are very common and almost every available grazing field is lost to the perennial bush fires leaving virtually nothing for livestock to graze on. The feeding problem is further exacerbated by the increasing number of migrant herds from further north of the country including Fulani herds on transhumance from Burkina Faso. Most farmers favoured strong local chiefs and government measures to regulate or stop bush fires during the dry season. Stockpiling of feed by farmers for dry season feeding, planting of forage trees, restricting the activities of immigrant herdsmen among others were suggested by the farmers as solutions to the problem of inadequate pasture and feeding of animals in the dry season.

Theft of animals in some villages remains a very serious problem for livestock owners. Most farmers or livestock owners do not have any secured housing facilities to attach their animals, especially cattle. The animals are left outside in open kraals with virtually no security measures against stealing. Reliable caretakers (herdsmen) are lacking in some cases and animals are left wandering about without any body to protect them from the activities of thieves. Because of theft, herd management is private in a number of villages. Community watchdog committees, provision of more secured housing for livestock, vigilance on the part of livestock owners and severe punishment for thieves were suggested by farmers as the way forward.

Some of the suggestions made by the farmers as solutions to the constraints discussed above are feasible and can be implemented at the village level to overcome some of these constraints. For example it should be possible for livestock farmers to stockpile feed for their animals for the dry season. It is also feasible for village chiefs in the study area to get their people together to initiate self-help projects such as sinking wells and building small dams, forming watchdog committees and fire fighting squads to prevent and control bush fires. Some of these are already happening in a number of villages in the study area and needs to be encouraged. The government and most non-governmental organizations have in place micro credit facilities for organized groups in towns and villages across Ghana. These facilities are also in some villages in the study area and can possibly be expanded if the people are able to form credible groups to engage in viable economic ventures.

Some of the suggestions made by the farmers are, however, not feasible at least in the short term. For example, subsidies on agricultural inputs were removed in Ghana in the early 1990's as conditionality by Ghana's external donors. The feasibility of its re-introduction therefore looks bleak as most donors still insist on this conditionality. Also, more animal health assistants will need to be trained to increase their number in the study area to ensure effective coverage and intensification of animal disease control. The training process takes time and money and may not be feasible in the short term.

4.4 The Importance of African Animal Trypanosomosis (AAT) among Farmers

The assertion by the Veterinary Services Department that African Animal Trypanosomosis occupies a central position among diseases affecting livestock development in Ghana and for that matter the Northern region cannot be over emphasized. This assertion was confirmed by data generated from the survey conducted in the study area.

Cattle owners were asked to first identify the presence of animal diseases in their cattle herds and oxen and rank the importance of those identified diseases. The most important disease was given a weight of one and the second most important given the weight of two and so on. The weighted average procedure of ranking responses was then applied to rank the importance of the diseases. As usual, responses with very low frequencies were dropped from the analysis for the same reason advanced earlier. In the case of cattle herd responses with frequencies less than 20 and frequencies less than 10 in the case of oxen were dropped from the ranking analysis. The results of the ranking of diseases in cattle herds and oxen are presented in Tables 4.3 and 4.4 respectively.

Table 4.3: Disease Ranking in Cattle Herds in the Study Area

DISEASES	WEIGHTS 1	2	3	4	5	FREQ	W. A.	RANK
Trypanosomosis	33	23	13	0	3	72	1.84	1
Respiratory disease	9	12	11	1	0	33	2.12	2
Diarrhoea	12	11	12	3	1	39	2.20	3
Poor nutrition related diseases	7	7	3	2	2	21	2.29	4
Diseases caused by worms	7	5	6	4	0	22	2.30	5
Foot rot	8	5	9	4	0	26	2.35	6
Anthrax	9	6	7	2	3	27	2.41	7
Black quarter	4	7	1	6	2	20	2.75	8

Source: Author's own computations from field data
FREQ.- Frequency
W. A. – Weighted Average
RANK- Ranking

Table 4.4: Disease Ranking in Oxen in the Study Area

DISEASES	WEIGHTS 1	2	3	4	5	FREQ	W. A.	Rank
Diarrhoea	8	1	1	2	0	12	1.75	1
Trypanosomosis	9	12	5	0	1	27	1.96	2
Respiratory diseases	3	4	3	0	0	10	2.00	3
Poor nutrition related diseases	5	1	2	2	0	10	2.10	4

Source: Author's own computations from field data
FREQ.- Frequency
W. A. – Weighted Average
RANK- Ranking

As shown in Tables 4.3 and 4.4, trypanosomosis is the number one disease in the region among cattle herd. In oxen, even though it is ranked second to Diarrhoea it still has the highest absolute frequency of farmers mentioning it as a problem.

Trypanosomosis, known locally as "Garli" and "Nag-gbara" in the Savelegu/Nanton and West Mamprusi districts respectively, is variably recognized as the most severe disease constraining livestock productivity in northern Ghana. However, only a few farmers were able to link tsetse flies with the outbreak of trypanosomosis.

According to the sampled farmers, the sources of assistance include government, non-governmental organizations and the VSD. The types of assistance according to the farmers included cash loans to some identifiable groups, provisions of boreholes and dugouts, provision of breeding rams and other livestock production inputs such as salt licks, parasitological screening and treatment of sick animals among others. Further investigations, however, revealed that some of the assistance that 8.1% of the farmers claimed they received were one time activity and cannot be said to be on any regular basis. Solutions to these identified constraints can, therefore, be said to be left almost entirely to farmers.

4.5 Livestock Farmers' Knowledge Level about Trypanosomosis

In assessing the knowledge level of farmers on trypanosomosis, three indicators were selected. These include knowledge of symptoms of trypanosomosis in animals, knowledge of the physical features of the tsetse fly and knowledge of how trypanosomosis is transmitted.

An exhaustive list of the symptoms of the disease in animals was drawn and farmers asked to mention the symptoms they know. Scores were assigned and farmers ranked, depending on the number of symptoms identified correctly. In a similar manner, farmers were asked to mention the features that one could use to identify the tsetse fly adequately. Finally, farmers were asked how trypanosomosis is transmitted. The outcome of these assessments is presented in Tables 4.5, 4.6, and 4.7.

The numbers in Table 4.5 clearly show that farmers' knowledge on how trypanosomosis is transmitted is indeed scanty. Out of the 271 people interviewed, only 5.5% could associate the transmission of trypanosomosis to the tsetse fly. As much as 94.5% of the farmers did not have an idea how the disease is transmitted.

Knowledge on the symptoms of the disease in livestock as presented in Table 4.6 above looks much better in comparison with knowledge of transmission of the disease in table 4.5. As much as 60.5% of the sample population knows at least one symptom of the disease while the remaining 39.5% knows no symptom of the disease.

Knowledge of the tsetse fly is even much better. Only 5.5% of the sample population did not know any feature of the tsetse fly and as much as 94.5% knows at least one feature that one could use to identify the tsetse fly. This probably is an indication that the tsetse fly is one of the common biting insects in the study area.

Table 4.5: Knowledge on Transmission of Trypanosomosis

What transmits trypanosomosis	Frequency	Percentage
Tsetse fly	15	5.5
Too much milk	1	0.4
Dirty places	4	1.5
Insufficient grass for animals	3	1.1
Maggots	1	0.4
Ticks	1	0.4
Overcrowding of animals in pens	1	0.4
Staying near large water bodies	8	3.0
Drastic change in weather	3	1.1
Wind	1	0.4
Heavy rains followed by intense heat	1	0.4
Mosquitoes	1	0.4
Dirty water and the onset of dry season	3	1.1
Lack of drinking water for animals	1	0.4
Heat	1	0.4
Worms	1	0.4
Migrant cattle	2	0.7
Housefly	1	0.4
Cold	6	2.2
Drinking dirty water	9	3.3
Eating certain grasses	7	2.6
Drinking water from certain sources	4	1.5
Lack of adequate feed	1	0.4
Do not know	195	72.0
Total	**271**	**100**

Source: from field data

Table 4.6: Knowledge of Symptoms of Trypanosomosis in Animals

Number of symptoms identified correctly	Frequency	Percentage
0	107	39.5
1	51	18.8
2	60	22.1
3	40	14.8
4	12	4.4
5	1	0.4
TOTAL	**271**	**100**

Source: from field data

Table 4.7: Identification of the Tsetse Fly

Number Of Features Of The Tsetse Fly Identified Correctly	Frequency	Percentages
0	15	5.5
1	48	17.7
2	159	58.7
3	45	16.6
4	4	1.5
TOTAL	**271**	**100**

Source: from field data

From results of the three indicators discussed above, it appears there is an appreciable level of knowledge about the symptoms of the disease and the tsetse fly, which is the main vector in the transmission of the trypanosomosis. The important factor that seems to be missing is the link between tsetse fly and the transmission of trypanosomes. A lot of education is, therefore, needed to get farmers to appreciate the importance of the tsetse fly in trypanosomes transmission. This will go a long way to improve farmers' willingness to contribute resources towards tsetse control programs.

4.6 Farmers' Perception about Animal Diseases in Relation to Changes in Livestock Numbers

A structured questionnaire was used to assess farmers' perception about the impact of animal diseases on livestock numbers. The result of this assessment is presented in Table 4.8.

Farmers were asked to assess the trends in livestock numbers over the last ten years. About 67% of the total sampled population assessed the numbers of all livestock in general to have reduced over the last ten years. The other 29% of the farmers, however, assessed the numbers of all livestock in general to have increased while the remaining 4% saw no significant difference between the numbers at the time of the survey and ten years ago.

The perception of farmers on the impact of animal diseases on the numbers of specific categories of livestock, that is, herd cattle, draft cattle, local trypanotolerant cattle, crosses of cattle, sheep and goats, follows a similar trend as in the case of all general livestock as discussed above. Majority of the farmers thought that numbers of these categories of livestock had all reduced over the last ten years.

The trend was, however, different for horses and donkeys. Most respondents claimed horses and donkeys are not common in their villages and so did not have sufficient basis to assess the direction of change in their numbers.

Table 4.8: Farmers Perception about Changes in Livestock Numbers Due to Diseases in the Last Ten Years

Type of livestock	Percentage of Farmers Indicating Changes in Livestock Numbers					
	A lot fewer	Fewer	The same	More	Many more	Do not know
All livestock in general	22.1	42.44	3.69	25.83	4.43	1.48
Herd cattle	15.87	42.22	6.27	34.32	1.85	1.48
Draft cattle	16.24	47.23	3.69	29.89	1.48	1.48
Local Trypanotolerant	14.76	42.44	7.38	29.52	4.60	1.48
Local Zebu	17.71	49.82	5.17	24.72	0.37	1.48
Crosses	16.61	41.33	5.17	33.58	1.85	1.48
Sheep	17.71	41.07	4.80	32.84	1.11	1.48
Goats	17.71	41.70	4.43	32.47	2.21	1.48
Horses	2.21	4.78	1.85	2.58	0.00	88.56
Donkeys	8.11	11.81	4.78	30.63	13.65	29.15

Source: computed from field data

4.7 Comparison of the Use of Acaricides and Trypanocides between Farmers in the High and Low Trypanosomosis Risk Villages in the Study Area.

Table 4.9 presents the results of the statistical tests of the differences between the mean annual expenditure values on acaricides and trypanocides in the low and high trypanosomosis risk villages in the study area. The mean expenditures on both drugs in the high-risk areas are higher than expenditures in the low risk areas at the 1% level of significance. It is, therefore, argued that the use of these drugs is more in the high trypanosomosis areas than the low risk areas.

Table 4.9: Comparison of Expenditures on Trypanosomosis and Acaricides in the High and Low Trypanosomosis Risk Areas

Variables	Low Trypanosomosis risk			High Trypanosomosis risk			df	t-value
	Mean (Cedis)	Std dev. (Cedis)	N_L	Mean (Cedis)	Std dev. (Cedis)	N_H		
Trypanocides	36,833.3	46,572.1	6	110,727.3	179,123.3	18	22	-585.9***
Acaricides	21,472.2	18,503.1	49	55,530.6	149,710.9	22	69	-532.9***

*** Significant at the 1% level

df is the degrees of freedom = ($N_L + N_H$ -2)

N_L is sample size of farmers using acaricides and trypanocides in the low risk villages

N_H is sample size of farmers using acaricides and trypanocides in the high-risk villages

4.8 Factors Influencing Household Level Expenditure on Acaricides and Trypanocides

Following from the results of the preceding section that farmers in the high trypanosomosis risk areas spend more on both acaricides and trypanocides than farmers in the low trypanosomosis risk areas, an attempt was made to compare the means of some selected farm household level characteristics to determine what factors could explain the observed differences in expenditure on these veterinary drugs. The variables included in this analysis are, age of the household head (AGE), household size (HHSIZE), farm size (FARMSIZE), education of the household head (EDU), number of cattle owned by the household (CATTLESIZE) and household income (HHINCOME). The result of this analysis is presented in Table 4.10.

The results indicate that the differences between the mean number of cattle owned by farmers (CATTLESIZE), household size (HHSIZE), and household income (HHINCOME) in the low and high trypanosomosis areas are statistically significant at the 1%, 5% and 1% respectively. Hence these variables can be said to influence the use of acaricides and trypanocides in the study area.

The means of (AGE), (FARMSIZE), and (EDU) in the two-risk zones did not show any significant difference from each other. In other words, farmers in the low trypanosomosis risks areas and high trypanosomosis risk areas do not differ significantly in their education, farm size and the age of the household head. Hence these variables can be said not to have any influence on farmers' expenditure on acaricides and trypanocides.

Table 4.10a: Comparison of Household Level Characteristics of Farmers in Low and High Trypanosomosis Risk Areas

Variables	Low Trypanosomosis risk			High Trypanosomosis risk			df	t-value
	Mean	Std dev.	N_L	Mean	Std dev.	N_H		
AGE	53.27	14.84	90	52.76	15.81	181	269	1.02
CATTLESIZE	5.03	11.71	89	6.64	17.94	181	268	-3.35***
FARMSIZE	4.06	4.28	90	4.33	6.47	181	269	-0.92
EDU	1.48	3.83	90	1.75	3.83	181	269	-1.069
HHSIZE	15.61	10.63	90	14.74	14.11	181	269	1.965**
HHINCOME	2,177,012	2,897,058	85	3,066,973	4,188,452	177	260	-3703.5***

*** Significant at the 1% level of significance
** Significant at the 5% level of significance
df is the degrees of freedom = (N_L + N_H -2)
N_L is sample size of farmers using acaricides and trypanocides in the low risk villages
N_H is sample size of farmers using acaricides and trypanocides in the high-risk villages

Table 4.10b: Units of Measure of the Variables in Table 4.10a:

VARIABLES	UNITS OF MEASURE
AGE	Age of household head in years since birth.
CATTLESIZE	Number of cattle owned by household including calves.
FARMSIZE	Number of hectares cultivated by the household in the previous season before the survey.
EDU	Number of years of formal education completed by the household head
HHSIZE	Number of adults and children resident in the household at the time of the survey.
HHINCOME	Household total income (in cedis) over the last one year from various sources.

4.9: Factors Affecting the Form of Contribution for Tsetse Control

The sub-sample of households willing to contribute in both forms of payment, that is, labour and cash (MNL) provided an opportunity to test complementarity or substitutability of pledged amounts of labour and money. First, ordinary least squares (OLS) analysis was run with WTPL (Total number of days that farmers who are willing to contribute money and labour are willing to contribute per month for tsetse control.) and WTPM (Total amount of money in Ghanaian cedis that farmers who are willing to contribute money and labour are willing to pay per month for tsetse control.) as dependent variables and a number of potential explanatory variables included. The results of the OLS (not shown) indicated many insignificant relations, thus allowing selection of a limited number of variables for inclusion into the simultaneous equations model in which WTPL and WTPM as dependent variables were determined simultaneously. WTPL was entered as an explanatory variable for WTPM, and WTPL as an explanatory variable for WTPM.

The results of the simultaneous equations model as presented in Table 4.11 indicates that there is no significant statistical relationship between money and labour contribution despite the fact that the format of the questionnaire demanded the respondents to make tradeoffs between labour time and money contribution. In addition, farm size, household expenditure on associations and household incomes have a statistically significant effect on willingness to contribute money for tsetse control. Household size though significant did not show the expected sign.

Table 4.11: Empirical Results of the Simultaneous Equations Model of the Factors Affecting Willingness to Contribute Money and Labour for Tsetse Control. (n = 164)

Explanatory Variables	Dependent Variables					
	WTPM			WTPL		
	Estimated coefficient	t-Statistic	Elasticities	Estimated coefficient	t-Statistic	Elasticities
FARMSIZE	-239.042	-1.81073*	-0.12056	0.025697	0.569619	0.0172004
HHSIZE	194.2304	3.586835***	0.370645	-	-	-
TRYPRISK	871.2878	0.509176	0.068130	-	-	-
HHINCOME	0.000693	3.059125***	0.221596	-	-	-
CATTLESIZE	-	-	-	0.013336	0.799905	0.012869
EMPLOY	-	-	-	1.744271	1.673508*	0.034576
EXPONASS	0.151207	4.132089***	0.267026	-	-	-
WTPM	-	-	-	-4.25E-05	-0.61808	0.05640
WTPL	185.1997	0.136670	0.139547	-	-	-
CONSTANT	1372.206	0.169727	0.16336	6.298015	10.2849***	0.995062

*** Significant at the 1% level

*Significant at the 10% level

Farm size of the household is hypothesized to affect willingness to pay money negatively because households with larger farms will have greater demands on available cash to purchase crop production inputs such as fertilizers and insecticides. At the same time more cash may be required to hire more labour for weeding, fertilizer application and other farm operations. Therefore, households with large farms are likely to contribute less money for tsetse control. The farm size variable was significant and negative and therefore confirms the hypothesis that farm size is negatively related to money contribution. With a calculated elasticity value of -0.121, an increase of 10% in farm size will result in a 1.2% decrease in the amount of money farmers will be willing to contribute for tsetse control, all things being equal. The inelastic response indicates that monetary contribution is fairly constant across farm size.

Households with higher disposable income from a variety of sources including sale of cattle and milk, and other secondary activities, have large cash balances and would be willing to contribute money rather than labour for tsetse control. Therefore, household income is expected to influence money contribution positively. This expectation was realized since the household income variable was positive and significant. The elasticity of household income with respect to money contribution is 0.222. This means that any change that will increase household income by 10% will stimulate a 2.2% increase in the amount of money farmers will be willing to contribute for tsetse control in the study area, ceteris paribus. The elasticity value of 0.222 implies inelastic response of monetary contribution to household income. That is, monetary contribution is fairly constant across income levels

All things being equal, farm households that make cash contributions at the village level to associations to which they are members, will be more pre-disposed to monetary contributions. They would be more willing to contribute money rather than labour to tsetse control. The coefficient of household expenditure on associations (EXPONASS) is positive and highly significant at the one percent significance level. Hence membership of associations promotes monetary contributions towards tsetse control in the study area.

Furthermore, except for the employment status of the household head (EMPLOY) which was significant without the expected sign, the rest of the variables did not show any statistically significant association with the level of labour contribution. Household heads with off-farm employment would have greater access to cash, and thus be more willing to contribute cash. At the same time they will have less discretion over time allocation and thus be less willing to contribute labour time. Lack of the expected negative sign could, therefore, be due to low incomes from such off-farm jobs they are engaged in, so that the farmers will prefer to offer some labour time instead of money. An alternative explanation is that traditionally hard field tasks are left to younger household members and therefore the household head would still prefer to pledge labour for tsetse control even if he is employed off-farm since he is not going to provide the labour directly.

4.10 Level of Resource Contribution for Tsetse Control

In order to compare the levels of money or labour contribution by farmers in the high and low trypanosomosis risk villages, the data was stratified into high and low trypanosomosis risk villages and analysed. The means and standard deviations for willingness to pay for tsetse control by farmers in these two categories of villages are presented in Tables 4.12 and 4.13.

The results indicate that farmers in the high trypanosomosis risk villages are willing to contribute more labour than farmers in the low trypanosomosis risk villages. With the exception of those willing to contribute money and labour, the level of monetary contribution by farmers in the low trypanosomosis risk villages is relatively higher compared with those in the high trypanosomosis risk villages. This result is probably due to the fact that farmers in the low trypanosomosis risk villages have healthier animals. As a result their incomes from the sale of milk, use of bulls for traction, and sale of livestock are higher. At the same time farmers in the low trypanosomosis risk villages are spending less money on veterinary drugs (Table 4.9). These probably make livestock production more profitable in the low trypanosomosis risk villages. Hence the ability and willingness of farmers in the low risk zone to pledge higher monetary contribution than those in the high trypanosomosis risk areas. Household income has already been shown to have a statistically significant positive relationship with monetary contribution by the results of the simultaneous model discussed earlier (Table 4.11).

In addition, farmers who are willing to contribute in money and labour in both the high and low trypanosomosis risk locations pledged more labour than those farmers who opted for only labour or only money contributions. Furthermore, when the figures (in Tables 4.12 and 4.13) are put into perspective it is realised that more farmers are willing to contribute labour than money. In the low trypanosomosis risk locations, 94.4% are willing to contribute labour compared to 75.5% who are willing to contribute money. Also, about 91% and 64% are willing to contribute labour and money respectively in the high trypanosomosis risk locations. It thus appears that more farmers favour labour contribution for tsetse and trypanosomosis control in the study area.

Table 4.12: Labour and Money Contributions for Tsetse Control by Farmers in the Low-Risk Trypanosomosis Villages (n = 90)

Proposed Contribution	Number of Households	Mean contributions	
		Money (Cedis)	Labour (Days)
No contribution	1 (1.1%)	-	-
Only money	4 (4.4%)	15,000 (5,773.5)	3.5 (0.58)
Only labour	21 (23.3%)	9,619 (11,056.6)	4.76 (2.84)
Both money and labour	64 (71.1%)	7,062.5 (8,486.9)	5.91 (3.51)

Source: computed from field data

Standard deviations in parenthesis

Table 4.13: Labour and Money Contributions for Tsetse Control by Farmers in the High-Risk Trypanosomosis Villages. (n = 181)

Proposed Contribution	Number of Households	Mean contributions	
		Money (Cedis)	Labour (Days)
No contribution	3 (1.7%)	-	-
Only money	14 (7.7%)	11,500 (10,456)	3.7 (1.68)
Only labour	63 (34.8%)	8,040.32 (10,718.5)	5.1 (3.39)
Both money and labour	101 (55.8%)	9184 (1,125.5)	6.6 (3.84)

Source: computed from field data
Standard deviations in parenthesis

CHAPTER FIVE

CONCLUSIONS AND POLICY RECOMMENDATIONS

5.1 Conclusions

The people of the Savelugu-Nanton and West Mamprusi districts are predominantly subsistence farmers. Except for the few commercial rice farmers, the majority of them cultivate by the hoe with an average of 4.2 hectares per household of fifteen people on the average. In addition to crop farming, the two districts have quite a significant livestock population with an average cattle size of six per household. The livestock sub-sector in the study area is, however, bedevilled with several problems. The most important of these problems according to the farmers' own ranking are, high mortality rate in livestock, animal diseases, lack of water and feed for animals in the drier part of the year, lack of funds to purchase breeding stock for a start and theft of animals. For these livestock production constraints, the majority of farmers strongly favoured government intervention to help them solve the problems.

Farmers consider trypanosomosis as the most important disease among herd cattle constraining the production of cattle in the area. This confirms what the Veterinary Services Department had already established in an earlier survey. In oxen, farmers ranked the importance of trypanosomosis second to diarrhoea but even there trypanosomosis had the highest absolute frequency of farmers identifying it as a known devastating disease. By this finding, therefore, it can be concluded that trypanosomosis is indeed a disease that occupies a central position, among others, that affect livestock production in Northern Ghana and need to be given the attention it deserves.

An assessment of farmers' knowledge about trypanosomosis reveals that out of the 271 sampled farmers, only 15 farmers (5.5%) knew that trypanosomes which cause trypanosomosis are transmitted by the tsetse fly. It is, therefore, concluded that most farmers in the study area are ignorant about how trypanosomosis is transmitted. This finding is very significant for any successful tsetse control program. If farmers do not understand or know the link between the tsetse fly and the transmission of the trypanosomosis disease it might be difficult to ask farmers to contribute resources towards any tsetse control program since they may not see the tsetse fly as any threat to the very survival of their animals. Knowledge about the tsetse fly itself was quite high and is an indication that the fly is common in the area. Knowledge on the symptoms of trypanosomosis is also quite high and probably indicates a very high prevalence rate of the disease in the area.

Livestock farmers in the study area perceived livestock numbers at the time of the survey to be few and a lot fewer in some cases than it was ten years ago. This perception was across all livestock in general and specific categories including cattle, sheep, goats, horses and donkeys. In the case of horses and donkeys, the perceived changes were different because most farmers did not have the basis to assess the direction of change. The perceived reduction in livestock numbers was attributed mainly to animal diseases including trypanosomosis. This finding is an indication that the effect of animal diseases is enormous and an age-long problem in northern Ghana that needs drastic corrective measures.

An assessment of farmers' willingness to contribute resources for tsetse control indicates general enthusiasm for tsetse control. Only 1.4% of the 271 sampled farmers were not willing to contribute anything towards tsetse control with the rest pledging either labour or money or both. Generally, the majority of the farmers preferred labour contribution to cash contribution. This is because most farmers in the study area have very limited opportunities for earning cash income but have labour in abundance especially during the dry season after harvest. A further investigation about factors that influence the form of contribution revealed that household income, household farm size and household expenditure on associations are statistically significant factors that influence cash contribution for tsetse control. On the other hand none of the factors included in the simultaneous equations model proved to be significant in influencing labour contribution.

Comparison of the expenditure on veterinary drugs between farmers in the low and high trypanosomosis risk villages indicates that farmers in the high risk villages spend significantly more on veterinary drugs than those in the low risk villages. By this finding it can be concluded that the use of veterinary drugs is more in the high-risk villages than in the low risk villages. In addition to the risk level, other factors that influence household use of veterinary drugs in the study area are household income, household size and the number of cattle owned by the farm household. The source of these veterinary drugs for most farmers is the animal health assistants of the Veterinary Services Department and occasionally local retail shops.

Finally, the efforts of the Veterinary Services Department (VSD) at fighting the menace of trypanosomosis is being frustrated by a number of problems. Paramount among these problems are: (1) the lack of political will on the part of successive governments to put the control of tsetse high on their agenda and give it the right budgetary allocation and (2) a growing problem of drug resistance which is believed to be due to the behaviour of some farmers in their attempt to cut production cost on drugs by under dosing.

5.2 Policy Recommendations

The policy recommendations of the findings of this study are outlined in this section. The survey results reveal that livestock production in northern Ghana is bedevilled by a lot of constraints. The solution to some of these constraints, particularly the provision of water requires huge initial capital injections and therefore need serious governmental and non-governmental interventions to help solve the perennial water problem. It is also recommended that the Veterinary Services Department be adequately resourced to embark on a massive and comprehensive educational campaign on animal disease management in the study area to equip farmers with the basic knowledge on how to identify and manage simple animal disease situations. This will help reduce the high mortality rate in animals in the study area. The educational campaign should also include education on the need to avoid bush fires in order to preserve grasses for dry season feeding. A further research into forage shrubs and trees that can stand the conditions of the north should be seriously considered. Such shrubs and trees, if found, can then be strategically planted to provide alternative feeding for animals in the drier periods of the year. In all this, the concerns and aspirations of the farmers should be considered and incorporated appropriately into the research design.

One of the main objectives of this study is to enhance community participation in tsetse control. For tsetse control to be sustainable there is the need for some level of participation by the intended beneficiaries. However, 94.5% of the sampled farmers do not appreciate the fact that the trypanosomosis disease that they identified as a major constraint is transmitted mainly by the tsetse fly. This ignorance is therefore bound to affect participation in tsetse control negatively. It is therefore recommended that the VSD should educate farmers on trypanosomosis and in particular the important link between the tsetse fly and the transmission of the trypanosomosis disease. This is expected to boost the level of farmers' interest in contributing resources towards tsetse control.

In addition, the estimated three stage least squares (3SLS) model has identified household income as a significant and positive factor that influences how much money farmers are able and willing to contribute for tsetse control. It is, therefore, recommended that policies and programs such as micro credit and other poverty alleviation programs that will improve the income levels of the farmers in the study area should be vigorously pursued. Improving farmers' incomes will improve livestock production and improve their ability and willingness to contribute toward tsetse control. Furthermore, membership of an association positively influences monetary contribution for tsetse control. Hence it is recommended that Farmer Based Organization (FBOs) formation should be pursued and encouraged in the area.

Trypanosomosis control is most effective when tsetse control is carried out along side prophylactic treatment of animals with trypanocidal drugs. However, very few farmers were found to use these drugs in the study area. It is, therefore, recommended that policies are put in place to make these drugs more affordable for farmers.

Finally, the government and other donor agencies should review their budgetary allocations to tsetse control to reflect the seriousness of the disease on both humans and livestock and the current challenges regarding tsetse control. This will go a long way to improve productivity and enhance incomes of livestock owners. This will contribute to poverty reduction in the study area and ease the pressure on foreign exchange demand for imports of meat and meat products. Farmers should also be educated on the appropriate use of animal drugs to avert the emerging drug resistance problem.

5.3 Suggestions for Future Research

The database for conducting any reliable impact assessment on the effect of trypanosomosis and other related agricultural projects is very weak or non-existing in most cases. Hence there is the need for research institutions like the universities and other agriculture related government departments and agencies to pursue a systematic policy to build up and maintain a comprehensive database through research.

In addition, future research effort should be directed at estimating the returns to investment in controlling tsetse in northern Ghana. This will be valuable input for policy direction

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LIST OF APPENDICES

Appendix 1.

Empirical Results of the Three Stage Least Squares Simultaneous Equations Model on Willingness to Pay

System: SYS03
Estimation Method: Iterative Three-Stage Least Squares
Date: 12/12/03 Time: 11:15
Sample: 1 271
Included observations: 164
Total system (balanced) observations 328
Instruments: FARMSIZE HHINCOME HHSIZE CATTLESIZE
TRYPRISK EMPLOY EXPONASS C
Convergence achieved after: 5 weight matricies, 6 total coef iterations

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	1372.206	8084.776	0.169727	0.8653
C(2)	-239.0419	132.0141	-1.810730	0.0711
C(3)	194.2304	54.15091	3.586835	0.0004
C(4)	871.2878	1711.172	0.509176	0.6110
C(5)	185.1997	1355.084	0.136670	0.8914
C(6)	0.000693	0.000227	3.059125	0.0024
C(7)	0.151207	0.036593	4.132089	0.0000
C(8)	6.298015	0.612350	10.28499	0.0000
C(9)	0.025697	0.045113	0.569619	0.5693
C(10)	0.013336	0.016672	0.799905	0.4244
C(11)	-4.25E-05	6.87E-05	-0.618081	0.5370
C(12)	1.744271	1.042284	1.673508	0.0952

Determinant residual covariance 1.12E+09

Equation: WTPM = C (1) + C (2)* FARMSIZE + C (3)*HHSIZE + C (4) *TRYPRISK + C (5)*WTPL + C (6)*HHINCOME + C (7) *EXPONASS
Observations: 164

R-squared	0.234939	Mean dependent var	8399.909
Adjusted R-squared	0.205701	S.D. dependent var	10313.99
S.E. of regression	9192.183	Sum squared resid	1.33E+10
Durbin-Watson stat	1.212029		

Equation: WTPL = C (8) + C (9)*FARMSIZE + C (10)*CATTLESIZE + C (11)* WTPM + C (12)*EMPLOY
Observations: 164

R-squared	-0.025923	Mean dependent var	6.329268
Adjusted R-squared	-0.051733	S.D. dependent var	3.764721
S.E. of regression	3.860873	Sum squared resid	2370.108
Durbin-Watson stat	1.784070		

Appendix 2.

SAMPLE QUESTIONNAIRE FOR FARMERS

1. VILLAGE - DISTRICT IDENTITY

1.1 Village name ____________________ |___| District ____________________ |___|

List and codes of all villages and districts

Savulegu District = 1	**West Mamprusi = 2**
Nyamandu = 1	Wulugu = 9
Nanton-Kurugu = 2	Dimea = 10
Pong-Tamale = 3	Bugyapala = 11
Kpendua = 4	Moatani = 12
Kpallon = 5	Duu = 13
Gushie = 6	Bugyakura = 14
Pigu = 8	

1.2 Major ethnic group in the village ______________________________

2. CHARACTERISTICS OF HOUSEHOLD HEAD

2.1 Name of household head (hhh) ____

2.2 Relationship of person interviewed to the hhh |___|

1 = head
2 = senior wife
3 = other wife
4 = brother or sister
5 = son or daughter
6 = other family member
7 = other person

2.2 Ethnic group of household head ______________________

2.3 Sex of hhh (0 = female; 1 = male) |___|

2.4 Age (in years) |___|

2.5 Number of years of formal education completed by household head |____|
(Total the following categories of schooling)
__________ number of years of primary school completed
__________ number of years of secondary school completed
__________ number of years of higher (University level) education
__________ any other schooling
|__________| total *(Enumerator : move up to box 2.5)*

2.6 During the past 12 months, did the hhh hold any salary employment? |____|
0= none; 1 = Employed

3. CHARACTERISTICS OF HOUSEHOLD

3.1 Total number of adults and children resident in the household |____|

3.2 On how many hectares did your household grow crops this growing season ? |____|

3.3 Total number of cattle, including calves, kept by the household |____|

3.4 Number of sheep kept by the household |____|

3.5 Number of goats kept by the household |____|

3.6 Number of donkeys kept by the household |____|

3.7 Number of pigs kept by the household |____|

4. MAJOR CONSTRAINTS TO LIVESTOCK PRODUCTION

4.1 We will like you to prioritise what you believe are the constraints to increased livestock production in this village.
1______________________________
2______________________________
3______________________________
4______________________________

4.2 Propose solutions to the above mentioned constraints.
1______________________________
2______________________________
3______________________________
4______________________________

4.3 Have you received any for of assistance from any body (organization) to help you solve these problems? Yes = 1 No = 0

4.4 If yes to 4.3 who (organization, government, etc) assisted you? ________________

4.5 What kind assistance was given? ____

5. KNOWLEDGE AND INFORMATION ABOUT TRYPANOSOMOSIS

We would like to ask you a few questions to evaluate your knowledge of and trypanosomosis. We will use the information to design future educational programmes like plays and posters.

5.1 What transmits trypanosomosis? |___|

(Enumerator: *these are codes, do not read aloud and add new codes as new responses vary*)

1 = tsetse	8 = hard work
2 = mosquito	9 = waking up a sleeping person
3 = snail	10 = stepping on a cursed object
4 = housefly	11 = punishment of sinners
5 = ticks	12 = staying near large bodies of water
6 = witchcraft	13 = eating a certain species of fish
7 = inheritance	14 = eating meat from animals with tryps.
15 = ________________	
16 = ________________	

5.2 Please name as many as you know of the symptoms of Trypanosomosis in animals |___|

(Enumerators: *check each of the following that is correctly identified and add up checks to get score ranging from 0 to 14 (maximum). Do not force respondents to answer.*)

-hair stands on end____	- lose hair at the tail____
-no appetite (don't want to eat)___	- cannot stand well____
-lose weight____	- animals eats sands/soil____
-cows produce less milk____	- animal ejects saliva____
-cows miscarry___	- animal has frequent diarrhoea__
-oxen aren't as strong___	- nervous trouble____
-animal smells bad___	- coughing____

5.3 What are the things to look for when identifying the tsetse fly? |___|
(Enumerators : *check each of the following that is correctly identified and add up checks to get score ranging from 0 to 5. The maximum score is 5. Do not force respondents to answer*).

-long pointy proboscis
-grey in colour
-wings overlap completely when resting
-larger than a housefly
-flies and bites very quickly

6. USE OF VETERINARY INPUTS

(Enumerator: *this section seeks information on the use of trypanocides and acaricides to combat trypanosomosis.*).

6.1 Has the hhh or herd manager ever used trypanocides for cattle? |___|
1 = yes; 0 = no

6.2 If yes, has he used trypanocides over the year to date (i.e. over the last 12 months)? 1 = yes; 0= no |___|

6.3 If the answer to 10.2 is yes, what quantity has been used:
- in preventive trypanocides? |___|
- in curative trypanocides? |___|

6.4 What has been the total expenditure (Cedis) on trypanocides for all livestock treated over the year? |___|

6.5 Sources of trypanocides ______________________ |___|
1 = VSD, livestock assistants
2 = other ministry department
3 = private veterinary
4 = local trader or local market
5 = other (specify) ______________________________

6.6 Has the hhh or herd manager used acaricides to treat ticks last year? (1 = yes 0 = no) |___|

6.7 Were acaricides used also against tsetse flies? (1 = yes; 0 = no) |___|

6.8 Estimate the amount of acaricides used last year |___|

6.9 Estimate the total expenditure on acaricides last year |__|

7. PERCEPTIONS OF DISEASES AT VILLAGE LEVEL

7.1 Over the last ten years, how do you think that livestock numbers in your village have changed?

(Enumerator: *insert the appropriate code in the cell*)

All livestock in general	
Daft cattle	
Herd cattle	
Local trypanotolerant	
Local zebu	
Crosses	
Sheep	
Goats	
Horses	
Donkeys	

1= a lot few, 2= fewer, 3= the same, 4= more, 5= many more, 6= do not know

7.2 List the common diseases and problems in your cattle (*tick the cell for presence and ask the respondent to list disease/problem and rank their importance*)

Diseases parasites/pest	**Cattle in herd**	**Oxen**
Trypanosomosis		
Black quarter		
Haemorrhagic septicaemia		
Respiratory disease		
Poor nutrition related diseases		
Diseases caused by worms		
Skin problem		
Anthrax		
Foot rot		
Diarrhea		
Other		

1= a lot few, 2= fewer, 3= the same, 4= more, 5= many more, 6= do not know

9. WILLINGNESS TO CONTRIBUTE TO CONTROL PROGRAMME

We are visiting your village because we were told by people at the veterinary and tsetse control departments that some animals died of trypanosomosis.

In this situation the people of the village can play a greater part in efforts to achieve an effective long-term solution to the tsetse problem. We are interested in finding out whether the people in this village, and other villages in the West Mamprusi and Savulegu/Nanton districts would be willing and able to contribute labour and money to assist the government and the community in tsetse control activities.

Therefore, we would like to pose a few questions about your interest in making such contributions.

9.1 Would your household be willing to contribute |___|

some labour time to tsetse control in your community? (1 = yes; 0 = no)

9.2 Would your household be willing to contribute some |___|
money to tsetse control in your community ? (1 = yes; 0 = no)

(Enumerator : *only one of the 3 sub-sections remaining in section 9 should be completed if the respondent provided a « yes » answer to either of the above.*

-If yes to 9.1 and no to 9.2, go to sub-section A « ONLY LABOUR CONTRIBUTIONS » below.

-If no to 9.1 and yes to 9.2, go to sub-section B « ONLY MONEY CONTRIBUTIONS » below.

-If yes to 9.1 and yes to 9.2, go to sub-section section C « BOTH MONEY AND LABOUR CONTRIBUTIONS » below.

-If no to 9.1 and no to 9.2, then the interview is finished

A. ONLY LABOUR CONTRIBUTIONS

9.3 What would be the maximum number of days per |___|

month that your household would be willing to contribute during
each month of the first year of such a programme in your community?

9.4 Which member of the household do you think would regularly Provide the labour?

1 = household head; 2 = spouse of head
3 = children; 4 = hired labour

9.5 The tsetse control programme may be organized in such a way that local residents would only be asked to make cash contributions. If no labour contributions were necessary, what is the maximum number of Cedis per month that your household would be willing to contribute during the first of such a programme in your community?.

(Enumerator: *section 9 is now complete.*)

B. ONLY MONEY CONTRIBUTIONS

9.6 What would be the maximum number of Cedis per month that your household would be willing to contribute during the first year of such a programme in your community?

9.7 The tsetse control program may be organized in such a way that only labour contributions would be necessary. If no cash contribution were necessary, what is the maximum number of days per month that your household would be willing to contribute during the first year?

9.8 Which member of the household do you think would regularly provide the labour?

1 = household head; 2 = spouse of head
3 = children; 4 = hired labour

(Enumerator : *Section 9 is now complete.*)

C. MONEY AND LABOUR CONTRIBUTIONS

9.9 What is the maximum number of days per month that your household will be willing to contribute to such a programme in your community ?

9.10 Which member of the household do you think would regularly provide the labour? |____|
1 = household head; 2 = spouse of head
3 = children; 4 = hired labour

9.11 What is the maximum number of Cedis per month that your household would be willing to contribute to such a programme? |____|

(Enumerator: *please thank the respondent for being patient in answering all the questions. Assure him or her the confidentiality of the information. Ask him or her if you can return to ask some follow-up questions if necessary*