ADDIS ABABA UNIVERSITY
FACULTY OF VETERINARY MEDICINE

PREVALENCE OF BOVINE TRYPANOSOMOSIS IN SOKORU WOREDA, JIMMA ZONE, OROMIA REGION, SOUTH WEST ETHIOPIA.

BY
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A thesis submitted to the Faculty of Veterinary Medicine, Addis Ababa University in partial fulfillment of Degree of Master of Science in Tropical Veterinary Medicine

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DEDICATION

This thesis is presented to be a remembrance to my darling parents, my late father AMEDE YEMER and my late mother MULUNESH EMIRU for their maximum affinity of parental care and love they have rendered me, and for unreserved help and concern they have provided me to promote my life in deed.

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ABBREVIATIONS

BCT	Buffy Coat Technique
bw.	Body weight
CFT	Complement Fixation Test
ELISA	Enzyme Linked Immunoabosorbent Assay
ESTC	Ethiopian Science and Technology Commission
FAO	Food and Agricultural Organization of the United Nations
GTZ	Germany Technical Assistance
IAEA	International Atomic Energy Agency
IBAR	International African Bureau for Animal Resources
ICIPE	International Center of Insect Physiology and Ecology
ILCA	International Livestock Center for Africa
ILRI	International Livestock Research Institute
Km	kilometers
Kg	Kilogram
m.a.s.l.	Meters above sea level
mg	Miligram
m l	Mililiter
MOA	Ministry of Agriculture
NTTICC	National Tsetse and Trypanosomiasis Investigation and Control Center
PAs	Peasant Associations
SIT	Sterile Insect Technique
STEP	Southern Tsetse Eradication Project
UNDP	United Nations Development Program

ABSTRACT

Tsetse transmitted animal trypanosomosis is a serious constraint in animal production and Agricultural development in Ethiopia. The vast area adjacent to the Ghibe valley in South West Ethiopia is tsetse infested where animal trypanosomosis is a serious threat to livestock economic development. The objectives of the study were to investigate the prevalence and magnitude of bovine trypanosomosis in representative and selected villages of Sokoru Woreda, to asses and analyze the efficacy of trypanocidals in use, to determine the extent of the disease based on the study findings to point out and search for the possible, sustainable and effective control options of tsetse transmitted trypanosomosis. The study was conducted from September 2005 to February 2006. The study methodology was based on questionnaire survey, seasonal cross sectional studies and longitudinal study for trypanocidals drug efficacy in villages of Abelty and Tiroshashama. The result of the questionnaire survey revealed that all the interviewees agreed that trypanosomosis was the most important and major problematic disease in their area. Cross sectional study was done on 515 selected cattle. Animals were examined using a buffy coat technique (BCT). A total of 64 monoconical traps were deployed along suspected tsetse habitat in the range of 1,392-1,629 meters above sea level. And entomological survey revealed that *Glossina m. submorsitans* was the highly prevalent tsetse fly species followed by *Glossina pallidipes* and with several S*tomoxys spp*. The apparent fly density tsetse was relatively higher in late rainy season (0.194 flies/ trap /day) at Abelty in late rainy season and none in dry season respectively where as in Tiroshashama village the fly catch was 0.028 fly / trap / day in late rainy and 0.017 fly /trap/ day of *G.m. submorsitans* and *0 .017 G. pallidipes* was caught in dry season . The fly catch was declined may be because of the high temperature of the dry season, low humidity and bush fire which occurred few weeks before the study period, and such condition may damage the suitable tsetse habitat and also inavailability of favorable hosts in the area, forced the flies to evacuate to the extreme low land areas towards the river basins. Nevertheless high catches of Stomoxys 10 flies /trap / day in late rainy season at Abelty and none flies of Stomoxys /trap /day in dry season at Abelty . Thirteen flies of Stomoxys /trap /day in late rainy season 20 flies of Stomoxys /trap /day in dry season at Tiroshashama village were caught. In the parasitological survey a total of 515 animals out of which 180 cattle in late rainy season 335 cattle in dry season were examined with buffy coat technique and the result showed the prevalence of trypanosomosis was highest in dry season 8.36% , the lowest 7.22 % in late rainy season was observed. A significant difference (P < 0.05) was noticed between the mean PCV values in parasitaemic (95% CI 21.24, 23.59) aparasitaemic (95% CI 23.93, 24.73) cattle.

Abelty and Tiroshashama villages were selected for Isometamidium chloride block treatment study .A total of 100 animals 50 from each of the villages identified and the selected animals in each village were grouped into 25 treatment and 25 control groups and they were identified with ear tags to allow easy access during field visits. Fourteen days prior the Isometamidium chloride treatment study all the 100 cattle were treated with Diminazene aceturate at a dose rate of 7mg /kg bw. Both groups of cattle were treated after 2 weeks (day 0). The treatment groups were given Isometamidium chloride at a dose rate of 1mg/kg bw. Both groups of cattle were examined for trypanosome parasite using buffy coat technique every 14 days interval until 84 days. The result of the total of 22.67% recurrent parrasitaemia of *T. congolense* infection and 35.29% *T. vivax* infection with 56 day after the treatment indicateed a better protection of Isometamidium chloride remain a choice of priority drug which could be used for prophylaxis of animal trypanosomes to protect cattle against trypanosomosis at Abelty and Tiroshashama villages and other risk areas of Sokoru Woreda. And the out put of the findings of the efficacy Diminazen aceturate revealed that the use of the drug was still curative and effective at both study villages.

Key words bovine trypanosomosis, prevalence, tsetse fly, apparent density, Abelty and Tiroshashama villages and Ghibe valley.

INTRODUCTION

One of the blackest clouds hanging over the civilization of tropical Africa is the scourge of trypanosome disease, which affects both human and his domestic animals (Chandler and Read, 1961). The trypanosomosis of domesticated livestock in Africa are diseases caused by infection with several different species of trypanosomes transmitted by tsetse flies of the genus *Glossina*. The diseases caused by these organisms vary considerably in severity and duration and depends on a number of factors associated with both the host species and the species of trypanosome involved (Brown *et al.*, 1990).

The disease associated with African trypanosomosis occurs in 38 African countries affecting 10 million km^2 area of land between latitudes 14^0N and $29^0$5 (Brown *et al.*, 1990). Close to 50 million cattle and countless numbers of other domestic animals live within tsetse infested area. African farmers spend 35 million US dollar per year on trypanocidal drugs to protect their cattle. If it were possible to eradicate trypanosomosis from Africa it is predicted that the benefit to over all agricultural production would gradually rise to 4.5 billion US dollar per year, the lives of over 40% of sub-Saharan Africa's 625 million population would benefit significantly and 55,000 deaths per year from sleeping sickness could be avoided (Budd, 1999).

Tsetse transmitted animal trypanosomosis is a serious constraint to livestock production and agricultural development in Southern and South Western and Western part of Ethiopia (Ford *et al*., 1976). Currently 220,000km^2 area of the country is infested with tsetse flies (NTTICC, 1996). Five species of *Glossina*, namely *Glossina pallidipes, G. morsitans submorsitans, G. fuscipes fuscipes, G. longipennis and G. tachinoides* invaded productive agricultural areas in the West, South and Southwest parts of Ethiopia (Langridge, 1976). More than 10 million heads of cattle are risking variable degrees of trypanosomosis infection at any time each year of which six million are from tsetse born (Lamecha, 1994). Non-tsetse transmitted trypanosomosis also affects considerable number of animal populations in tsetse free zones of the country (MOA, 1995). According to the report of the MOA (1995) one to two million doses of trypanocidal are administered at the cost of some US dollar 0.5 - 1 million annually by the government (NTTICC, 1996).

The antigenic diversity of trypanosomes has prevented the development of immunization techniques (no vaccines are available) as a result of which prevention and control of tsetse-transmitted trypanosomosis depends on minimizing contact between livestock, wild life and tsetse. Control measures against tsetse and trypanosomosis focus on parasite control with chemotherapy and chemoprophylaxis; vector control with insecticides and target / traps and use of trypanotolerant animals (Brown *et al.*, 1990). Community based tsetse trypanosomosis control operation show successful results if they are attached to local organization with objectives of livestock issues (Habtewold, 1997). Alternative approach is using trypanotolerant breeds of ruminants perhaps combined with judicious drug therapy may be in the future, offer a realistic solution in many areas where the disease is endemic and this aspect is currently under intensive study (Urquhart *et al*., 1996).

Oromia is one of the five regions of Ethiopia infested with tsetse flies. The tsetse distribution in Oromia is unique in nature that all the five tsetse flies species reported in Ethiopia are found along the main river basins of Oromia. Almost all the major rivers of Ethiopia either originate or pass through the Oromia region. The Ghibe valley, which is known for its high tsetse challenge and trypanosomosis, is adjacent to Sokoru woreda, where the current prevalence study was conducted. Sokoru is located in Jimma zone, partly extending to the tsetse infested Ghibe valley. As a result the livestock of the Woreda suffer from tsetse-transmitted trypanosomosis. The objectives of the study were as follows:

1. To study the prevalence and magnitude of trypanosomosis in selected sites of Sokoru Woreda,
2. To assess the strength and duration of the efficacy of trypanocidal drugs currently in use in naturally trypanosome infected cattle in the field condition.
3. To illustrate the extent of the disease constraint and
4. To search for the possible, sustainable and effective control options of tsetse trypanosomosis based on the present study.

1. LITERATURE REVIEW

2.1 AFRICAN ANIMAL TRYPANOSOMOSIS

2.1.1 Trypanosomes

Trypanosomes are flagellated protozoa, which belong to the family *Trypanosomatidae*. The family consists of several genera and many species**;** all are parasitic in habit. The species, which parasitize vertebrates, require a vector for transmission (Adam *et al*., 1979). Trypanosomes live and multiply in the bloodstream, lymphatic vessels, and tissues, including the cardiac muscle and the central nervous system. The most common form of *Trypanosomatidae* is the blood stream form of the mammalian parasites (Itard, 1989).

2.1.2. Classification

Trypanosomes are microscopic, elongated & flattened cells, which move with the help of a single flagellum directed anteriorly, at the base of which is found a characteristic structure, the kinetoplast (Itard, 1989). The length and position of the trypanosome's flagellum is variable. In trypanosomes the flagellum originates near the posterior end of the cell and passes forward over the cell surface to extend freely at the anterior end where the flagellum is adherent to the cell surface. The sheath is expanded and forms a wavy flange, called the undulating membrane (Adam *et al*., 1979).

The systematic position of *Trypanosoma* among the protozoa and revised classification of the mammalian trypanosomes was made by arranging related species into subgenera corresponding to the two sections i.e. Stercoraria & Salivaria (Mulligan, 1970). Pathogenic trypanosomes in the genus *Trypanosoma* are divided according to their development in the vector and transmission by either the saliva (inoculative) **(**Salivarian group**,**) or transmission by faecal contamination (Stercoraria) (Adam *et al*., 1979; Losos, 1986; Mulligan, 1970). The

Salivarian consists of species of veterinary and medical importance (Adam *et al*., 1979; Mulligan, 1970) and can be separated into four groups or sub-genera (Duttonella, Nannomonas, Trypanozoon and Pycnomonas) according to their morphology in the blood and their pattern of development in the tsetse fly (Adam *et al*., 1979; Mulligan, 1970). The major pathogenic trypanosomes of veterinary and public health importance are *T. vivax, T. congolense, T. brucei, T. evansi, T. equiperdum, T. rhodesiense and T. gambiense.*

2.1.3. Life Cycle of Trypanosomes

According to Seifert (1996), the transmission and interchange of hosts of African trypanosomosis, which is transmitted by tsetse fly, can be summarized as follows:

- The tsetse fly gets infected with the trypomastigote blood form, which loses its surface coat in the goitre of the fly and, while remaining there at least one hour, restructures its mitochondrion.
- The trypanosomes enter the mid gut where they transform through lengthwise division into the epimastigote form in the cardia.
- The trypanosomes penetrate the haemocoel via the peritrophe membrane and the mid gut epithelium and move from there to the salivary glands of the tsetse fly where they develop into the metacyclic infectious trypomastigote form which has now got its surface coat; the trypanosomes are haploid. Because of the complicated development of the trypanosomes within the tsetse fly, only about 0.1-0.4% of the flies is infected and thus is potential vectors of trypanosomosis.
- After the vertebrate host has been infected by the tsetse fly, syngamy takes place; the trypanosomes become diploid and multiply through lengthwise division.

According to Putt *et al*. (1980), *T. brucei* develops in the tsetse mid gut, proventriculus and salivary glands, while *T. congolense* develops in the mouth parts in addition to mid gut and proventriculus, and *T. vivax* develops entirely in the mouth parts (Ford, 1971; Putt *et al*., 1980).

2.2. The Vector, Tsetse Fly

2.2.1. Classification and morphology

The vector, tsetse fly, can be classified in the order *Diptera* (the two-winged flies), family *Glossinidae,* and within the genus: *Glossina*. There are about 23 species and 8 sub- species of *Glossina* identified so far (Moloo, 1993; Leak, 1999). From morphological point of view, tsetse flies are elongated and robust, of various shades of brown ranging from yellowish to grayish to dark or blackish brown in colour and about 6 to 16mm long excluding the proboscis. Males are usually smaller than the females (Itard, 1989). Useful features for identification include: wings being held closed over the abdomen fully overlapping one another; a piercing proboscis which sticks out horizontally from the front of head; widely separated compound eyes; the distal medial cell of the wing is shaped like a butcher's cleaver and is sometimes referred to as the 'hatchet cell' and the hairs on the arista of antenna have further hairs branching off them (Robertson, 2004).

The genus is further subdivided into well-markedxx species groups (subgenera) identified based on differences from ecological characteristics (Leak, 1999). These are the subgenus *Glossina* (the *Glossina morsitans* group), the subgenus *Nemorhina* (the *Glossina palpalis* group) and the subgenus *Austenina* (the *Glossina fusca* group). The *G. morsitans* group is typically found in savannahs and thicket habitats. The *G. palpalis* group is riverine flies requiring a higher humidity; this group, however, is also capable of adapting to peridomestic habitats in West Africa or lantana thickets in Uganda. The *Glossina fusca* group is found in high forest habitats or in more humid relict forests on the periphery of the rain forest belts (Cox, 1993). Within the subgenera, males of the palpalis group are identified mainly from the morphology of the inferior claspers, males of the morsitans group from the superior claspers and fusca group females most easily from the signum, which is a chitinized plate at the anterior of the oviduct (Leak, 1999).

2.2.2. Distribution and Diversity

Tsetse flies (genus *Glossina*) are the principal vectors of African trypanosomosis, which infect humans and their domestic animals over some 10 million km^2 (Green, 1994). They occur exclusively in the sub-Saharan Africa over an area extending on both sides of the equator from 15^0N to 29^0S latitude (Ford, 1971). According to Moloo (1993), most of the *fusca* and *palpalis* group of tsetse are concentrated in west and central Africa, while most of the morsitans group of tsetse species are found in eastern and southern Africa. *Glossina brevipalpis* and *G. longipennis* seem to be the only fusca group species found in eastern Africa.

The general distribution of tsetse flies, determined principally by climate and influenced by altitude, vegetation and the presence of suitable host animals, has been known for a long time (Leak, 1999). Each of these factors may directly affect the birth, death or migration rates of the vector and thus the population size (Hay *et al*., 1996). The limit of distribution is closely correlated with the tropical savannah (summer rain) climate, which follows the 508 mm annual isohyet. Climate, though dependent on latitude, is modified by altitude and of course has a great effect on the vegetation, which is vital for providing shade and maintaining a suitable microclimate for tsetse as well as a habitat for their vertebrate hosts. As a generalization, the tropical rain forest (equatorial) climate controls the habitats of the *fusca* and *palpalis* groups, and the surrounding woodlands are the habitats of the *morsitans* group. Altitude influences tsetse distribution through its effect on climate, particularly temperature (Leak, 1999). In Ethiopia, 1600m above sea level was considered the rough upper altitudinal limit to tsetse distribution according to Langridge (1976). Subsequently, however, *G. pallidipes* was found at 1700m altitude and *G. morsitans submorsitans* at altitudes up to 2200m (Tikubet and Gemetchu, 1984).

Generally, the habitat of livestock is directly related to the presence of human settlements. The most important factor to develop an optimum habitat for the disease is the direct interaction between host, vector and parasite each with their own optimum habitat (Glasgow, 1963).

2.3. Epidemiology

Tsetse-transmitted trypanosomes occur in Africa according to the distribution of vector. Mechanically transmitted trypanosomes can occur elsewhere in Africa (Hall, 1985), large areas of Asia, Middle East and South America (ILRAD, 1987). Among the Salivarian group, only *T. vivax* is considered to be spread beyond the confines of tsetse fly belt by mechanical transmission (Hall, 1985).

Tsetse-transmitted trypanosomosis infects various species of mammals but, from an economic point of view, it is particularly important in cattle. It is mainly caused by *T. congolense, T. vivax*, and to a lesser extent, *T. brucei brucei. T. uniforme, T. simiae* and *T. suis* are other, less common tsetse-transmitted species (OIE, 2002). The occurrence of trypanosomosis within the overall tsetse infested area is irregular because of differences in animal husbandry practices which affect the nature of the contact between tsetse flies and livestock and because of variation in the distribution and density of particular groups and species of tsetse flies which differ in their capacities to transmit the pathogenic trypanosomes. The pattern of the disease is also affected by differences in the distribution of the pathogenic trypanosomes; *T. congolense, T. vivax* and *T. brucei* are always found within tsetse infested areas. *T. simiae, T. uniforme*, and *T. suis* occur less frequently (Robertson, 1976). Beside the tsetse flies, the appearance of game is of great importance for the persistence of the disease within an infested area. Highly resistant wild ruminants harbour the trypanosomes and being alternative hosts for the tsetse fly become a reservoir of infection for the tsetse fly and contribute to its survival (Seifert, 1996).

The infection with *T. vivax* is widespread: if transmitted by *G. palpalis,* it shows a light and chronic course, but if as in east Africa, *G. pallidipes* becomes the vector or if it is *G. morsitans* or *G. tachinoides* as in West Africa, the disease occurs with high fever, oedemas in the sub-cutis and causes death after 3-4 weeks. The *T. congolense* infection shows the most severe course. High fever is a symptom for the heavy multiplication of these, the smallest pathogenic *Trypanosoma* species within the blood up to 3 weeks after natural infection (Seifert, 1996). Multiple infections are also of the most important features of trypanosomosis in cattle (Losos, 1986). *T. vivax* causes major losses in cattle in West Africa; whereas in East Africa, the disease is usually characterized by low mortality and morbidity (Hoare, 1972). However, there have been outbreaks of haemorrhagic disease caused by *T. vivax* in Kenya

(Olubayo *et al*., 1985). On the other hand *T. congolense* is most important in East Africa causing serious economic loss (Losos, 1986).

There is also a difference in host susceptibility to trypanosomes, which is best exemplified by the small West African breeds of cattle such as the N'Dama and West African short horn. These animals are less susceptible to the disease than zebu or the European breeds and are commonly found in endemic areas of trypanosomosis. They are referred to as 'trypanotolerant' breeds (Morrison *et al*., 1981). There are few data on trypanosomosis in small ruminants, which have received much less attention from scientists and veterinary researchers compared with cattle. This may be due to their smaller size and lesser apparent importance, but may also be because they are less susceptible to trypanosomosis (Leak, 1999).

2.4. Pathogenesis

The pathogenesis of the disease caused by the African trypanosomes differs according to the species causing the infection. *T. vivax* and *T. congolense* appear to be strictly parasites of the blood plasma and produce tissue injury primarily by the anaemia associated with infection. *T. brucei* is more widely distributed in the host affecting the intercellular fluids of the body cavities (Robertson, 1976). Here, although anaemia occurs, it is considered to be of secondary importance to the extensive degenerative, necrotic and inflammatory changes. The pathogenesis of trypanosomosis includes: chancre, lymphadenopathy, anaemia, and tissue damage (Mulligan, 1970).

2.5. Clinical Features

Acute infections may be seen occasionally in all domestic animals notably with *T. vivax* in cattle leading to death after 1-3 weeks (Robertson, 1976). Regardless of the species of trypanosomes and the species of the host, the principal clinical signs are intermittent fever, an increasing degree of anaemia and progressive loss of condition and the disease is seen more commonly as a chronic form (Hall, 1985; Robertson, 1976). Infected animals are dull, have a staring lusterless coat, lose weight and are easily exhausted, lagging behind the herd, superficial lymph nodes are enlarged and prominent. Cattle infected with *T. vivax* often show photophobia and excessive lachrymation (Hall, 1985; Losos, 1986; Murray *et al*., 1983; Robertson, 1976).

2.6. Pathology

Post-mortem examination of animals after acute trypanosomosis may show extensive small haemorrhages involving mucous and serous surfaces, areas of emphysema in the lungs and mild gastroenteritis. After more chronic infections, the carcass may be anaemic and emaciated with an enlarged spleen and lymph nodes (Robertson, 1976). Subcutaneous oedema and accumulations of pericardial and thoracic fluid containing trypanosomes are found particularly in horses and dogs infected with *T. brucei* (Seifert, 1996). Degenerative changes have been observed in testis and epididymis of sheep, goats, and cattle infected with *T. congolense, T. brucei* and *T. vivax* (Morgan, 1990). Pathological changes of pituitary and adrenal glands with associated endocrine dysfunction have been observed in Boran (*Bos indicus*) cattle infected with *T. congolense* (Abebe, 1991).

2.7. Diagnosis

The history of the affected animals, the geographical incidence of the disease and the clinical signs of infection may arouse suspicions of trypanosomosis, but definitive diagnosis depends on the demonstration of trypanosomes of pathogenic species. In the field, reliance is placed on the examination of blood smears and occasionally, on lymph node biopsy (Mulligan, 1970; Losos, 1986; Robertson, 1976; Wilson, 1969). It can be accomplished through direct and /or indirect demonstration of the parasite. In spite of certain differences between the different species, direct demonstration of the parasite can generally be accomplished with a blood smear in the form of a wet film with or without concentration, e.g. by centrifugation in a haematocrit capillary (HCT), dark ground buffy coat technique (DG) or by separating trypanosomes from blood by anion-exchange chromatography (e.g. diethylaminoethyl cellulose), stained (Romanowski or Giemsa stain) blood smears as either thick or thin films; a lymph node biopsy may be useful (*T. vivax*) and transmission of blood to splenectomized calves or small laboratory animals. Since, depending on the species of trypanosomes, the pathogens are either found in the peripheral blood (*T. congolense*) or in the blood of the large vessels, collecting the blood has to be done accordingly (Seifert, 1996).

A large number of serological tests have been used to indicate infections with trypanosomes indirectly. However, few of them have found practical application. The most commonly used techniques are: immunoflourescence agglutination test (IFAT), enzyme-linked immunosorbent assay (ELISA), card agglutination test (CAT) (*T. evansi*). With use of the mentioned serological techniques, the responsible *Trypanosoma* species may be identified within certain limitations (Seifert, 1996). Interpretation of the results is made difficult because antigens from different trypanosome species show considerable cross-reactivity, and antibodies persist for several months after trypanocidal drug treatment. The most promising test apparently is the ELISA. Species-specific monoclonal antibodies are currently being developed which should allow preparation of defined antigens for use in assays for antibody detection. In addition, monoclonal antibodies can be used in a sandwich-ELISA to detect trypanosomal antigens and thus the presence of active infections (Brown *et al*., 1990). An antigen-detection enzyme-linked immunosorbent assay (antigen-ELISA) for trypanosomosis has been described (Nantulya and Lindquist, 1989) and is now available for the diagnosis of *T. vivax*, *T. congolense and T. brucei* infections in cattle. However, field evaluations of the test have given inconsistent results. Works done in various countries have shown unexpected results such as high prevalence of *T. brucei* infections which were not usual. Therefore, additional work is needed to discover and overcome the cause of those inconsistencies before the test can be used in the routine diagnosis of trypanosomosis (OIE, 2002). Specific circulating antigens can be detected in cattle from 8-14 days after infection, but within 14 days of treatment they are not longer detectable. Therefore, this test seems to be an important tool for controlling the efficiency of trypanocidal treatment, or whether or not a treatment has eliminated premunity (Nantulya, 1990; Nantulya *et al*., 1989).

New tools developed by molecular biologists now make it possible to characterize trypanosomes both in the vectors and the hosts. The use of molecular biological tools, and in particular the Polymerase Chain Reaction (PCR), introduced an exceptional sensitivity and especially the possibility of characterization at the specific or intra-specific level, which had been impossible previously (Solano *et al*., 2000).

2.8. Control

Programs to control trypanosomosis have been in operation for nearly 100 years (ILRAD, 1984). The different options currently in use for trypanosomosis control, with particular reference as to their suitability for control and/or eradication, amenability to community participation, suitability for large scale use and a general appraisal of their advantages and disadvantages were briefly indicated as follows.

2.8.1. Parasite Control

In many parts of Africa where bovine trypanosomosis is a serious constraint to development, trypanocidal drug treatments constitute the principal method of controlling the disease. Despite the availability of effective vector control methods, it is very likely that in the foreseeable future, chemotherapy and chemoprophylaxis will continue to contribute significantly to the control of bovine trypanosomosis (Van den Bossche *et. al*., 1999). Certain compounds have specific effects on some enzyme system or block essential metabolic pathways and thus kill trypanosomes or inhibit their development (Uilenberg, 1998). Drugs currently recommended for chemotherapy of animal trypanosomosis come from only three closely related groups. These are the phenanthridines, Isometamidium, and Homidium, and the aromatic diamidine, Diminazene. Only Isometamidium and homidium are recommended for prophylaxis (Peregrine, 1994). Chemoprophylaxis against bovine trypanosomosis has been in widespread use in tropical Africa for many years and Isometamidium chloride (Samorin®) has been marketed since 1961 as a prophylactic and therapeutic drug. Because of the cost of developing new trypanocides, and the relatively small commercial market, there have been no new drugs for about 30 years and there is little prospect of new ones being developed in the near future. The use of the same drugs over such a long period has resulted in the widespread development of drug-resistant stains of trypanosomes (Leak, 1999; Peregrine, 1994). In Ethiopia, presences of moderate to high prevalence of trypanosomes resistant to drugs were reported in different sites (Afework *et al*., 2000; Codjia *et al*., 1993; Tewolde *et al*., 2004).

Resistance in trypanosomes to the available trypanocides is a constant and, in some areas, increasing threat. Drugs are not always available and their purchase consumes valuable foreign exchange (Erkelens *et al*., 2000). Resistance to mainly chemoprophylactic trypanocides used in cattle has been reported at sites in west, central, east and southern Africa

(Peregrine, 1994). The only alternative for circumventing the problem of drug resistance is the alternating application of products, which should not have a chemical relationship and thus are not subject to a cross-resistance. However, known prophylactic products do not fulfill this prerequisite, and therefore Diminazene aceturate offers itself as a secondary “sanative” trypanocide (Seifert, 1996). ‘Sanative pairs’ of drugs, by means of which induction of resistance to one drug can be eliminated by use of the other that can effectively be used (Seifert, 1996; Leak, 1999). In addition to this, it is widely accepted that the best way to delay the development of drug resistance is to reduce selection pressure on parasite populations. This is best achieved by using the correct dose, decreasing the treatment frequency and reducing the number of animals treated (Geerts and Holmes, 1998).

In view of the increasing prevalence of drug resistance, it is important to know how effective tsetse control would be in alleviating trypanosomosis in livestock in situations where trypanocidal drugs alone have become ineffective. Studies carried out at Ghibe, in Southwest Ethiopia, where a high prevalence of multiple drug resistance was detected (Codjia *et al*., 1993), showed that tsetse control, in combination with trypanocidal drug use, can effectively reduce the apparent trypanosome prevalence in cattle (Leak *et al*., 1993).

2.8.2. Vector Control

Vector control is the most reliable means of disease control since it removes the threat of trypanosomosis on a permanent basis. Many vector control methods including woody vegetation clearance to remove tsetse shelter, and large-scale application of insecticides by air (non-persistent and persistent formulations) and ground spraying (only persistent insecticides) and large wild life elimination (to deny tsetse its source of food i.e. blood), could be applied (SIT, 1996).

With regards to removal of vegetation in savannah areas, larviposition occurs in shaded places, so one control method is to remove trees and bushes so one is just left with grass. This method was used quite extensively with success in the past but is labour intensive and requires that there be reslashing of vegetation on an annual basis. The method fell into disuse with the advent of insecticides. However, removal of vegetation for firewood and urbanization has sometimes achieved the same effect. Also, killing of wild animals with the objective to remove reservoirs of infection in the wild animal populations was used extensively in the past (Robertson, 2004). However, these methods are now unpopular on environmental and on biodiversity grounds (SIT, 1996).

Persistent insecticides like organochlorine compounds were used until the mid 1970s during which environmental considerations led to a search for alternative insecticides. Ground spraying technique was used in the first attempts at control of tsetse with such insecticides. It was widely used in Nigeria, Uganda, Zambia, Zimbabwe, Kenya, and Botswana in different ways. Over 200,000km^2 of tsetse infested land was cleared by ground spraying in West Africa, mainly in Nigeria, and proved particularly successful and cost-effective. However, the technique was highly labour intensive, demands high level of supervision and allowed limited areas to be covered during the spraying season, difficult to cover inaccessible areas of possible tsetse resting sites, mechanical difficulties and high cost restricts their use (Leak, 1999).

In the 1970s and 1980s there were many advocates of spraying of tsetse habitats from the air, which apparently offered a high technology solution requiring little organization on the ground. Aerial spraying has, however, proved highly expensive, especially in foreign currency, and is also polluting (although less so than ground spraying) (Green, 1994). Nevertheless, aerial spraying is appropriate for the need to control tsetse over large areas and inaccessible sites infested. Apart from the use of aircraft to control tsetse successfully in South Africa in the 1940s, the technique was developed largely at the then Colonial Pesticides Research Institute in Tanzania in the early 1970s and large-scale control was carried out in Zambia, Zimbabwe, and Botswana in southern Africa, in Nigeria, and more recently in Somalia (Leak, 1999).

A family of techniques of tsetse control has recently been coming to the fore, which offers some important advantages over those previously practiced, the so-called ‘bait systems’. Instead of the destruction or contamination of the environment of the tsetse, they depend on the attraction of the fly from its surroundings to some introduced object, which may be insecticidal, but which can if necessary be removed later; this may be an artifact (e.g. trap), or a live host, treated with insecticide. Although not new, several developments have come together over the last 10-15 years to render bait techniques more practicable, over a wider range of tsetse habitats, than ever before. Bait systems are inherently of low environmental impact, and are relatively low technology. It is also claimed that they are logistically less demanding than other approaches, and are capable of being adopted by local communities on self-help basis and seems increasingly likely that these techniques will form the basis for tsetse fly control in the short to medium term (Green, 1994).

Although attempts were made to control tsetse-using targets impregnated with insecticide many years ago, successful application of this technique followed the production of the second-generation synthetic Pyrethroid insecticides (Deltamethrin, Cypermethrin, Cyfluthrin etc.) and the development of potent odour attractants in the last 10-20 years (Leak, 1999).

One of the latest methods of control is the Sterile Insect Technique (SIT) involving continuous release of sterile insects among the indigenous insect population at rates sufficient to result in a reduction in biotic potential of the target population. The mating of released sterile male insects with indigenous fertile female insects causes infertility in the target population (SIT, 1996).

2. 8.3. Trypanotolerance

Innate resistance, or trypanotolerance, has been recognized since 1906 when the ability of indigenous taurine cattle in West Africa to survive and be productive under trypanosomosis risk was observed. Both acquired and innate resistance to African trypanosomosis can occur in cattle. The two most important trypanotolerant breeds are the *Bos taurus* subtypes, N'Dama and Baoule, whilst a degree of trypanotolerance has also been shown to occur in some *Bos indicus* zebu breeds, for example, the Orma Boran (Leak, 1999). The use of trypanotolerant cattle, had it not been limited in availability (account only for 17% of the total cattle population of the continent), was a potential alternative strategy for coping with the problem (Erkelens *et al*., 2000).

2.8.4 Tsetse and Trypanosomosis in Ethiopia

Ethiopia, located in the horn of Africa between latitude from 3^0 N to 15^0 N of the equator and longitude from 33^0 E to 48^0E, is an agrarian country (Tikubet, 1993) with an estimated human population of about 61 million and a land area of about 1.1 million km^2 (Bourn *et al*., 2001). The rural agricultural sector makes up 85% of the total population and accounts for 95% of all crop and livestock production (Slingenbergh, 1992a). Climate and temperature are largely dependent on elevation, but rainfall patterns are highly variable. Three distinct seasons are recognized. From February to May, South-easterly winds usually bring moisture from the Indian Ocean to produce the short rains ('Belg' in Amharic). From the June to September, South-westerly and South-easterly winds carry winds from both the Atlantic and Indian oceans to produce the generally more reliable main rains ('Kiremt' in Amharic). The dry season ('Bega' in Amharic) lasts from October to January (Bourn *et al*., 2001).

The livestock population of Ethiopia is estimated at 35.1 million heads of cattle, 22 million sheep, 16.95 million goats, 8 million equines and 1million camels (FAO, 2000). Livestock contributes to the national export earnings, sources of food, cash income, energy and fertilizer (Ford *et al*., 1976; Leak, 1999).

The devastating disease, trypanosomosis, had relatively little impact on the economy of the country or it had little consideration before 1960's. However, the magnitude of the problem has increased enormously and still it is increasing (NLDP, 1997). This is due to a number of factors which include mainly, overpopulation and overstocking of the highlands which forces people to use the tsetse infested lowlands, the advance of tsetse flies into previously un-infested areas and the development of a widespread drug resistance by trypanosome parasites over the different types of trypanocidal drugs which are in use in Ethiopia (NLDP, 1997).

The potential area of tsetse infestation has been variously estimated at 66,000 km^2, based on a 1500m above sea level breeding limit (Ford *et al*., 1976); 98,025 km^2, based on a 1600 m above sea level breeding limit (Langridge, 1976); and between 135,000 – 220,000 km^2, based on maximum dispersals up to 1700 m above sea level and 2000 m (Slingenbergh, 1992 a & b).

Five species of tsetse are found in Ethiopia: *Glossina longipennis*, *G. m. submorsitans*, *G. pallidipes*, *G. fuscipes fuscipes*, and *G. tachinoides*, and are confined to southern and southwestern regions of the country (Langridge, 1976). *G. m. submorsitans* is usually found in deciduous woodland and wooded grassland, often interspersed with evergreen vegetation. *G. pallidipes* is almost invariably associated with extensive and fragmented thickets, including evergreen species. *G. longipennis* is found in dry acacia, thorn-bush and is very active after sunset and before nightfall. *G. fuscipes fuscipes* and *G. tachinoides* inhabit gallery forest, thickets and fringing vegetation on streams, rivers and lake shores (Ford *et al*., 1976; Langridge, 1976).

Four tsetse-borne trypanosome species, *T. congolense*, *T. vivax* and *T. brucei brucei* of livestock and *T. brucei rhodesiense* of humans have been identified and their distribution and frequency in hosts recorded. *T. vivax* was detected in almost all regions of the country below the 2500m above sea level altitudinal limits (Lamecha, 1994).

In tsetse-infested regions of Ethiopia, the problem of trypanosomosis is the main cause of decline in the number of cattle and particularly draught oxen (Abebe and Jobre, 1996; NLDP, 1997). Therefore, draught animals cannot be used for ploughing and other purposes, the situation forces the farmers to cultivate manually, as the majority of peasant farmers can not afford costly machinery. The end result is that only a small fraction of potential agricultural land is cultivated for crop production (Tikubet, 1993). Annual losses to the national economy are estimated to exceed US$ 200 million due to mortality and morbidity of livestock, denied access to land resources and the costs of controlling the disease (Vreysen *et al*., 1999).

3. MATERIALS AND METHODS

3.1. The study area.

The study area, Sokoru Woreda (District) situated in Jimma Zone, Oromia Region, southwest of Ethiopia (Fig.1), was selected based on intensity and magnitude of trypanosomosis problem, which is currently educing livestock losses particularly in the peasant associations where tsetse fly challenge is enormously high. The Woreda (District) is bounded to the North and Northeast by main Ghibe River and Gilgel Ghibe (Small Ghibe) river to the east, to the east with Yem Woreda (District), to the South and Southwest by Ommonada Woreda (District), and to the Western with Gilgel Ghibe River. The Gilgel Ghibe valley in the western and the big Ghibe River in the Northeast circles the Woreda (District) and the livestock which are in the adjacent peasant associations around the valley are extremely exposed to the tsetse flies infestation and most livestock found in the 13 peasant associations are attacked by tsetse transmitted trypanosomosis.

The peasant associations of Abelty, Adama, Adami-Bedeyi, Bede, Doyokobota, Ghibe, Guragebiftu, Kulata, Saqalga, Tirokunbbi, Tiroshashama and Yabu and Basso suffer from the disease. Among these the two peasant associations Abelty and Tiroshashama were selected as the study sites because of logistic accessibility. These two study sites are found adjacent to the Gilgel Ghibe valleys.

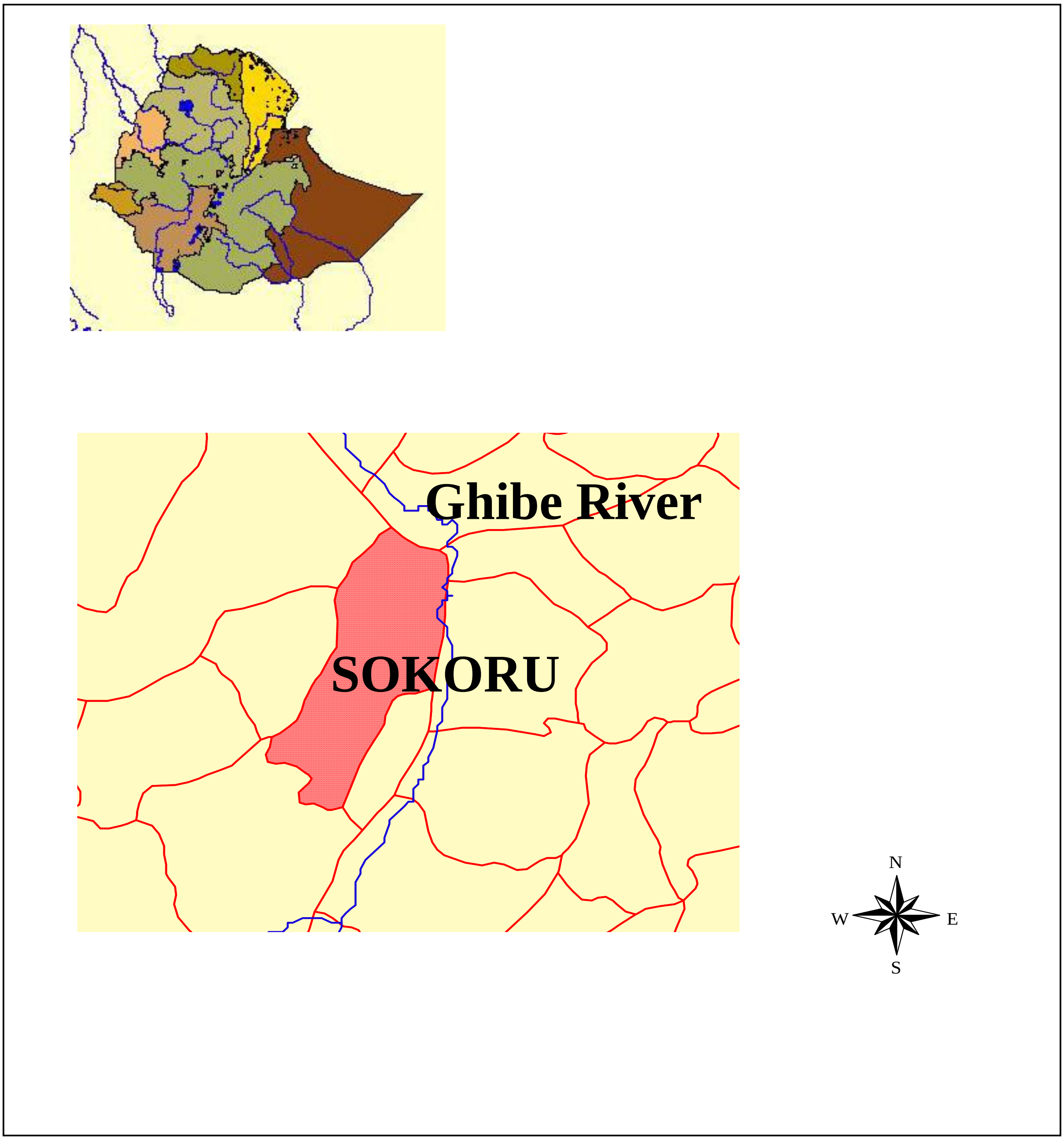

Figure 1: Map of Ethiopia and Sokoru Woreda

3.1.1. Climate

Sokoru has mostly moist, low, mid and high altitude type of climate. Out of the total land cover 20% is lowland (Kolla), 50% midland (Weyinadega) and 30 % highland (Dega). The climate is characterized by wet and dry seasons with ample rainfall in the rainy seasons ranging from 800 to 1450 mm; average annual temperature 20^0C - 20 ^{0}C and altitude ranging from 900-2300 m.a.s. The climate during the whole year is conducive for agricultural practices.

3.1.2. Vegetation

The coverage of vegetation in the Woreda varies from the highland to the low land. In the high land there are naturally grow and artificially planted dense forests distributed in scattered condition including shrubs and bushes. Open woodland forest and riverine forest along the river banks mostly covers the area in the mid altitude and open wood grass land savanna is widely available in the ecosystem. But deforestation and overgrazing are the major constraints, which degrade soil fertility status of the Woreda.

3.1.3. Agriculture

Agriculture is the most important economic sector in the Woreda (District). About 95% of the farmers practice mixed farming condition on labour-intensive base. Major crops produced in the district are teff, maize, sorghum, millet, wheat, barely, horse bean, pea and nug, root crops like taro, potato, sweat potato, false banana and fruit plants such as banana, sugar cane, and mango are cultivated from the high land to the low land.

3.1.4. Animal husbandry

Sokoru has about 55,366 heads of livestock contributing significant economic importance being one of the major categories of production system. Animal rearing plays a vital role in providing traction power, generating cash income and consumption for the household.

3.1.5. Disease situation in the Woreda (District)

Disease such as anthrax, bovine pasteurellosis, lumpy skin disease, gastrointestinal parasites, trypanosomosis, fasciolosis, tick infestation and other affect the livestock population of the Woreda. Above all vector-borne trypanosomosis particularly tsetse-transmitted trypanosomosis is the most prevalent disease among cattle population.

3.2. Study Population

The livestock population of the Sokoru Woreda (District) is 55,366 with high population of cattle (41,637), followed by sheep and goats (11,732), equines (1997) and poultry (54,000). Smallholder farmers in the study site manage cattle. The study of bovine trypanosomosis was focused on the cattle.

3.3. Study Design

The study was based on questionnaire survey, vector (entomological) survey, parasitological studies and field assessment of trypanocidal drug resistance (Chart.1). It was an epidemiological cross-sectional study covering selected sites of the Woreda with midland agro-ecological zones in two seasons of the year. The area was stratified in to altitude and vegetation type.

3.3.1. Questionnaire Survey

To assess the perception of farmers on the occurrence of tsetse and trypanosomosis, livestock constraints, socio-economic status, herd composition, use and source of trypanocidal drugs as well as delivery of the drug for treating their animals and other control methods of trypanosomosis and tsetse fly, a questionnaire survey was undertaken. A total of 20 farmers was selected randomly in the study area for this purpose. The questions used during the interview have been shown in Annex 1.

3.3.2. Entomological Survey

To assess the apparent density, species of tsetse fly and other biting flies in relation to season, altitude levels, trap and vegetation types, sampling was done in selected sites of the study area. The altitude levels and vegetation types were recorded during the sampling period.

3.3.2.1. Colletion of tsetse and other biting flies

Entomological data was collected twice during the study period, in the late rainy season and during the dry period. The flies were caught with traps baited with acetone and cow urine (Brightwell *et al*., 1991). In the selected sites of the study area 64 traps, 24 (12 in each village) in late rainy season and 40 (20 in each village) in dry season were deployed before sunrise in the morning and kept in the position for 72 hours.

The different flies that were caught in each trap were counted, identified and analyzed. The species of tsetse fly was identified based on the characteristic morphology (Langridge, 1976; Ford *et al.,* 1976, Leak *et al*., 1993) and for other biting flies according to their morphological characteristics such as size, colour, wing venation structure and proboscis at the genus level (Walle and Shearer, 1997). Average aging of tsetse was done by categorizing the degree of wear of wings on scales of 1-6 using wing fray method described by Jackson (1946) and Challier (1965). Mean wing fray was calculated as the sum of each category total divided by the sum of fly number for each category and find the corresponding number from tables. Observing the posterior end of the ventral aspect of the abdomen by hand lenses did sexing. As a result male flies could be easily identified by enlarged hypophygium in the posterior ventral part of the abdomen. The apparent density of tsetse fly was expressed as the number of tsetse catch/trap according to Leak *et al*., 1993.

3.3.2. 2. Parasitological Survey

To determine the seasonal prevalence of trypanosomosis and to assess the risk factors associated with trypanosomosis snapshot cross-sectional studies were conducted twice during the study period, in the late rainy season and during dry season in two PAs of the study area.

3.3.2.3. Sampling Method and Sample Size Determination

Cluster sampling method was sampling strategy (Martin *et al*., 1987) and herds were considered as clusters. The sample size was determined using Winepiscope 2.0: improved epidemiological soft ware for veterinary medicine based on the expected prevalence rate of 20% and absolute desired precision of 5% at confidence level of 95%. As a result, a total of 420 animals were to be sampled (Thrusfield, 1995). But in case of cluster sampling the subjects were not independent and hence larger sample was required. Therefore, as a rule of thumb double the number of animals required for simple random sample was needed for cluster sampling (Martin *et al*., 1987). For the over all optimum sample of the study 515 samples were taken during the late rainy season and in the dry season.

3.3.2.4. Sample Collection and Parasitological Eexamination

Paired blood samples were collected from auricular vein of each animal using two haematocrite capillary tubes filling 3/4 of the height and sealed with Cristaseal. The capillaries were also used to measure the PCV values for the determination of anaemia and comparison of infected animals with non-infected animals. The capillary tube was cut 1mm below the buffy coat to include the top layer of red cells. The content of the capillary tube was then expressed onto a clean slide, mixed and covered with a 22 x 22 mm cover slip. Then the slide was examined for trypanosomes based on the type of movement in the microscopic field. Confirmation of trypanosome species by morphological characteristics was done after staining with Giemsa by examination with oil immersion microscopy with 100x power of magnifications (Murray *et al*., 1977). During sampling age, sex, herd number, PA, Woreda, altitude and previous history of treatment with trypanocidal drugs were recorded.

3.3.2.5. Assessment of Tryapanocidal Drug Efficacy (Isometamidium block treatment study)

A total of 100 animals, 50 from each village, was selected with a simple random method. All these animals were treated with Diminazene aceturate at a dose rate of 7mg/kg body weight to eliminate the existing trypanosome infection (blanket treatment) while parasitological examination was done to determine the initial prevalence of trypanosomosis. Cattle of each village were then randomized into ISMM treatment group with 25 animals and control (sentinel) group with 25 animals following the methods proposed by Eisler *et al*. (2001) and Rowlands (2001). Animals in each group were ear tagged using yellow plastic tags, which allowed easy identification of animals during each visit for parasitological examination.

After two weeks of the blanket treatment (day 0), one group was treated with ISMM at a dose rate of 1mg/kg body weight and the other group was left as untreated control group. Body infection recurrence rate was defined as the proportion of cattle, which were found infected with same species of trypanosome among the total number of animals that were treated with Diminazene aceturate before two weeks.

Body weight of each animal was estimated using heart girth measuring tape (Arora *et al*., 1981). Blood examination of animals for trypanosome infection was conducted every two weeks starting from day of blanket treatment up to 12 weeks following ISMM block treatment i.e. day 0, 14, 28, 42, 56, 70 and 84. Date of treatment, dosage of trypanocidal drugs, PCV values and trypanosome infections were recorded during each examination. In each group, cattle infected with trypanosomes were treated with Diminazene aceturate at a dose rate of 7mg/kg body weight (Chart 2)

Interpretation of Survival Data (Eisler *et al*., 2001)

The efficacy of Diminazene aceturate treatment was assessed on the basis of parasitaemia followed within two weeks after treatment of cattle with drug at a dose rate of 7mg/kg body weight. To analyze data on the efficacy of Diminazene aceturate, trypanosome incidence rate and trypanosome infection recurrence (Rowlands *et al*., 2001) at each village was compared using Fisher's exact test (Stata Corporation, 2000).

3.4. Data analysis

For the management, analysis and interpretation of data collected based on the study methodology statistical software was employed. Stata version 7.0 Software and Excel were used. The following parameters were analyzed: The apparent fly catches in relation to variables measured (season, altitude level, and vegetation and trap types) were analyzed using Kruskal Wallis test. The prevalence of trypanosomosis in different variables (altitude levels, season, sex and age) was compared by χ^2-test. A multivariate computation was conducted using logistic regression analysis in order to establish the effects of different risk factors (age, sex, altitude and season) compared with odds ratio for each risk factor. Student's t-test was also employed to compare the mean PCV of the parasitaemic and aparasitaemic animals and the effect of altitude on PCV values in the two seasons.

Mean trypanosome prevalence was calculated to compare study sites during 8 weeks period as the mean of the two weekly trypanosome prevalence during 0-56 days. Mean PCV and 95% confidence interval was used to assess for any change in PCV values of the ISMM treated and control groups of cattle over 8 weeks in each village. Data of questionnaire was summarized using frequency distribution (parentages). To evaluate any relation between different parameters correlation slope and r-value have been determined. Significant level was determined at P< 0.05 for all statistical results.

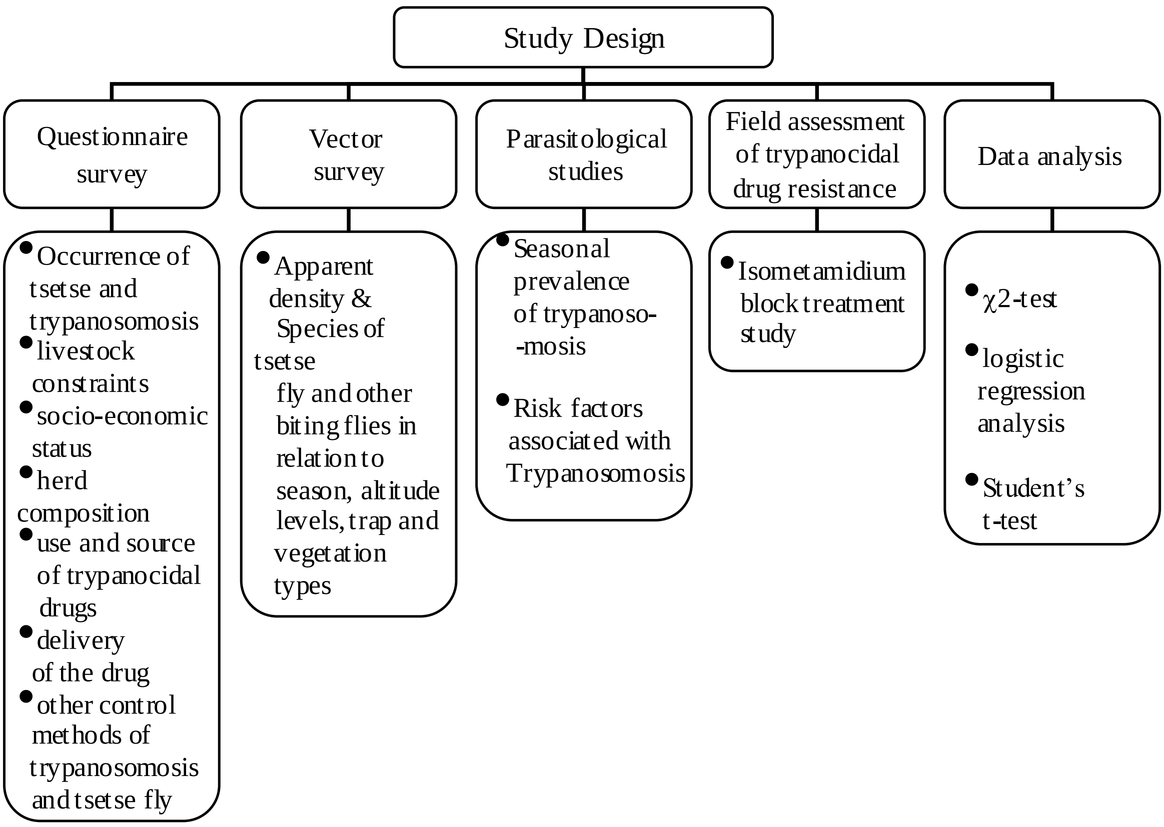

Chart 1: The study design

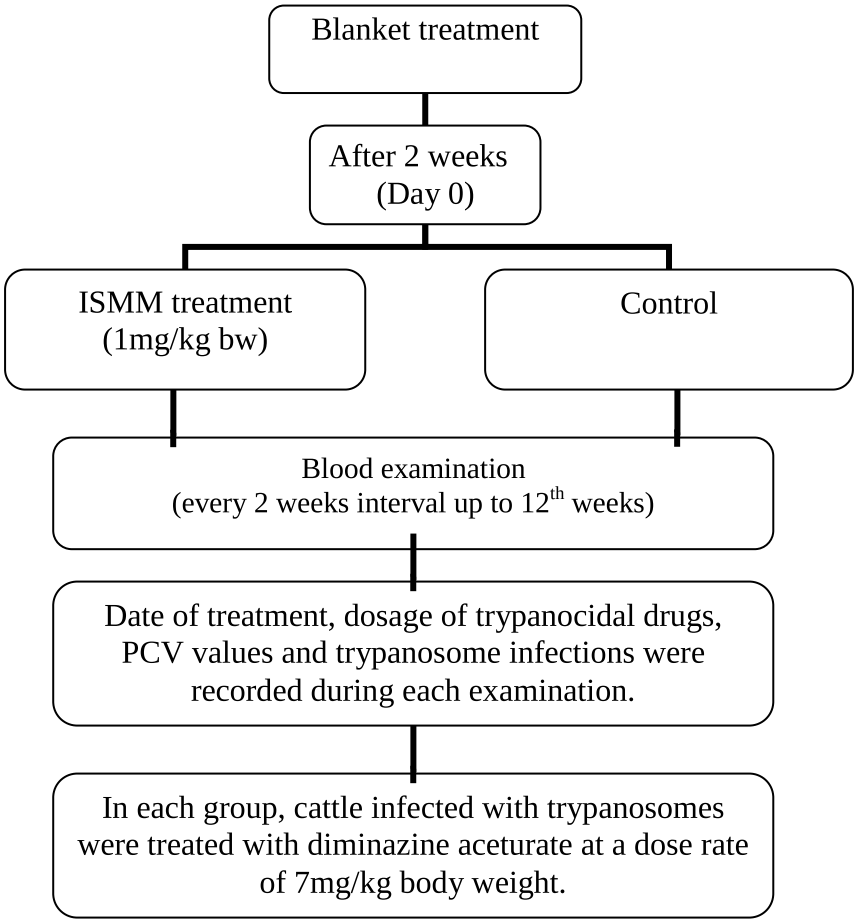

Chart 2: Plan of work for the study of trypanocidal drug efficacy on naturally infected cattle on the field .

4. RESULTS

4.1. Questionnaire Survey

In the first week of September, 2005 the questionnaire survey was carried out to assess the magnitude and situation of trypanosomosis particularly in Abelty and Tiroshashama villages of Sokoru Woreda district, Southwest Ethiopia. During questionnaire survey the response was 100% in both sites.

A total of twenty elder dwellers, ten representatives (members) of peasant associations from each of Abelty and Tiroshashama were interviewed. They have been asked about managerial activities of their livestock, herd composition, the over all disease situation, opportunity of disease prevention, treatment and socio-economics of livestock production.

4.1.2. Livestock Production

According to the responders free grazing of livestock constituted about 99%, which was used as the major source of feed. Cattle used to move about 1.5 – 5 kms from Abelty, 5-7 kms from Tiroshashama living centers to the pasture and watering yards. The water needed for livestock of Abelty village was usually collected from ponds built by GTZ and from small stream found along the savannah grassland where as at Tiroshashama, livestock used to drink water from Kerker River and small streams found near by the permanent pasture. The pasture was composed of open woodland and vast grass fields. The interviewed farmers of both the villages agreed that the livestock feed was scarce in dry season from January to May and plenty available in wet season from June to December.

4.1.3. Disease Situation

All of the interviewed livestock owners (100%) of both peasant associations claimed trypanosomosis (Gendi) is a serious livestock disease, which causes mortality and lowers productivity. Trypanosomosis was ranked as the first priority disease among other diseases followed by blackleg, pasteurollosis, internal parasites, external parasites, anthrax and pneumonia (Fig. 2). The most affected livestock species as mentioned by farmers were cattle. The villagers are unable to keep equines, due to adverse risk of trypanosomosis but few people at Abelty purchase donkeys from other places and tether them at home and exploit them for transporting water from ponds to dwelling center.

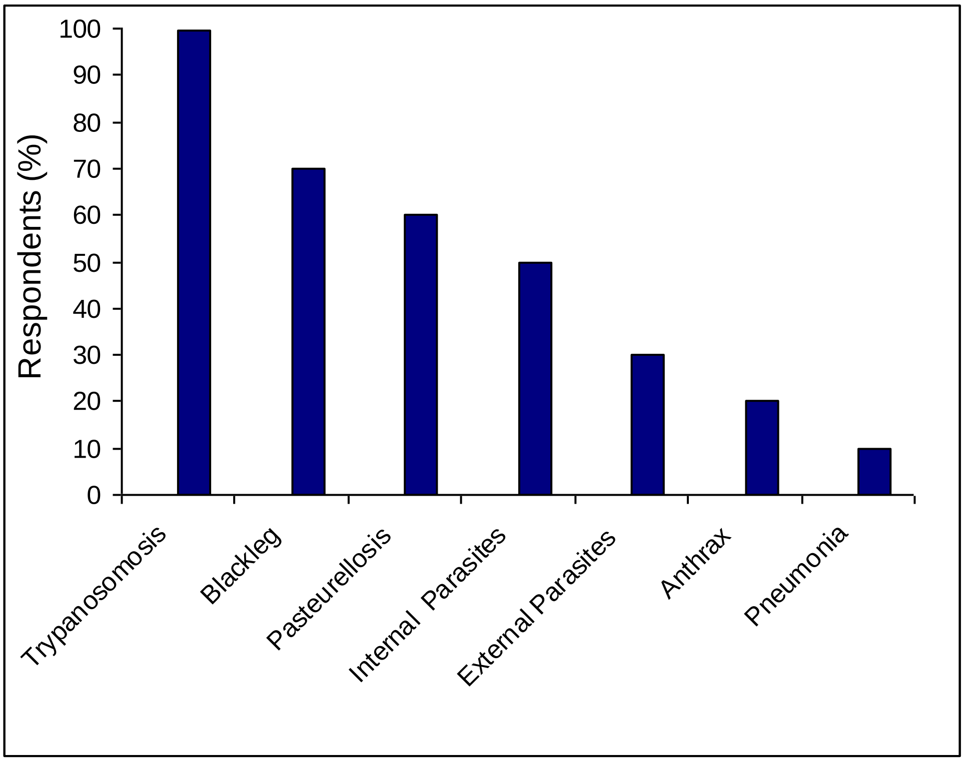

Figure 2: Priority of livestock diseases of economic importance according to the respondents in Abelty and Tiroshashama PAs, Sokoru district, Southwest, Ethiopia.

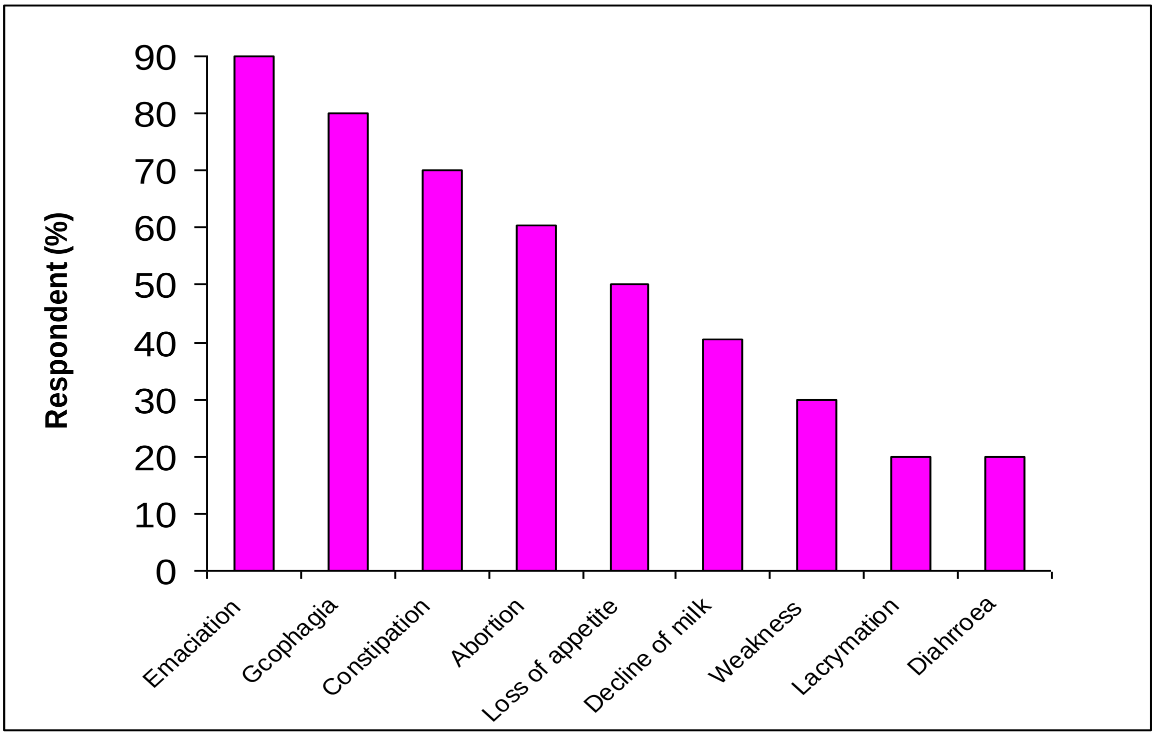

Figure 3: The signs of trypanosomosis in cattle reported by interviewed persons at Abelty and Tiroshashama villages in Sokoru district, Southwest Ethiopia.

The interviewed farmers clearly pointed out the main syndrome of trypanosomosis as emaciation, geophagia (soil eating), constipation, abortion, loss of appetite, decreased milk, weakness, salivation and diarrhea and loss of capacity of their ploughing oxen (Figure 3).

The disease affects their livestock all year round even though they look better during the rainy seasons. About 80% of the responders agreed that the trypanosomosis disease casuality was known to occur long ago at Abelity in 1966 and at Tiroshashama area in 1978. Concerning the disease situation at present time the interviewed people of Abelty and Tiroshashama villages have expressed their different views. According to the Tiroshashama group trypanosomosis was getting worse & occurred 5% in rainy season, 15% in dry season and 10% all year round, where as the Abelty group agreed that the disease risk elevated 80% in wet season and 20% in dry season. On other hand 90% of the interviewed farmers of both PAs knew that biting flies transmit trypanosomosis. The respondents agreed that the fly abundance was higher in rainy season than dry season in Abelty and Tiroshashama villages.

Even though this was the case the interviewed persons were unable to differentiate tsetse fly from other fly species.

4.1.4. Treatment Opportunities Against Trypanosomosis

Fifty per cent of interviewed respondents treated their animals against trypanosomosis themselves. Twenty per cent of them obtained service from Government veterinary clinics and 30% by drug smugglers (non professionals who trade trypanocidals illegally and sale to the surrounding farmers) (Figure 4).

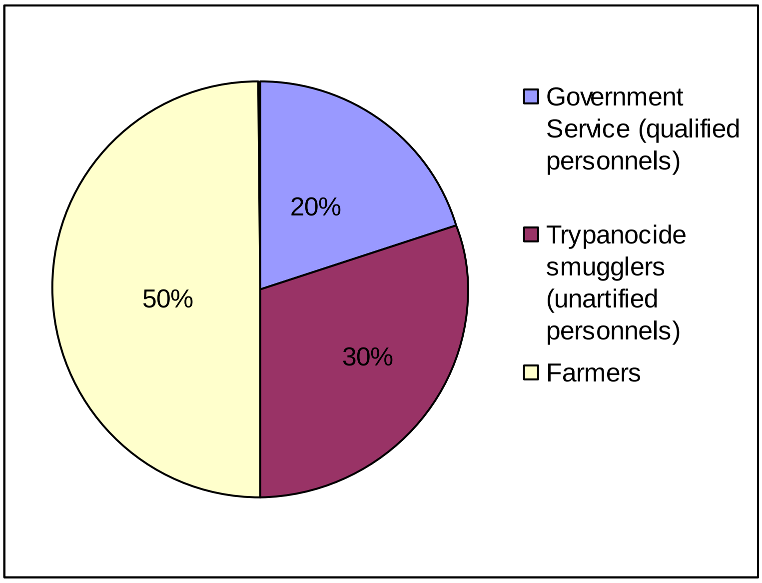

Figure 4: Personnel concerned in the treatment of trypanosomosis at Abelty and Tiroshashama PAs indicated by questionnaire results.

Among farmers of both PAs 90% used trypanocides to treat sick animals and some 10% of responders claimed that they practiced traditional medicine against trypanosomosis but fail to obtain satisfactory results to cure their livestock. The farmers using the trypanocides disclosed that trypanocidal drugs were applied only to sick animals. Further more all of interviewed livestock keepers appealed that the risk of trypanosomosis was advancing its horizon to the adjacent and near by peasant associations.

According to the interview, among different trypanocides Diminazene aceturate and Isomtamediuim were widely used. Diminazene constitutes 90% and Isometamedium hydrochloride 10% and none of the other trypanocides were used at both villages. Concerning the dose of drugs 60% of respodents treated their livestock with correct dose (one sachet for 10 adult cattle) of Isometamidium chloride (Trypamidium) whereas 25% used underdose (one sachet for 20 adults) and 15% had no idea about the dose of drugs.

Regarding the drug Diminazene aceturate, 70% of the farmers used the appropriate dose (one sachet of 1.05g to one adult animal), 20% treated with underdose (one sachet for more than 2 adults) and 10% had no idea about the dose (Fig.5).

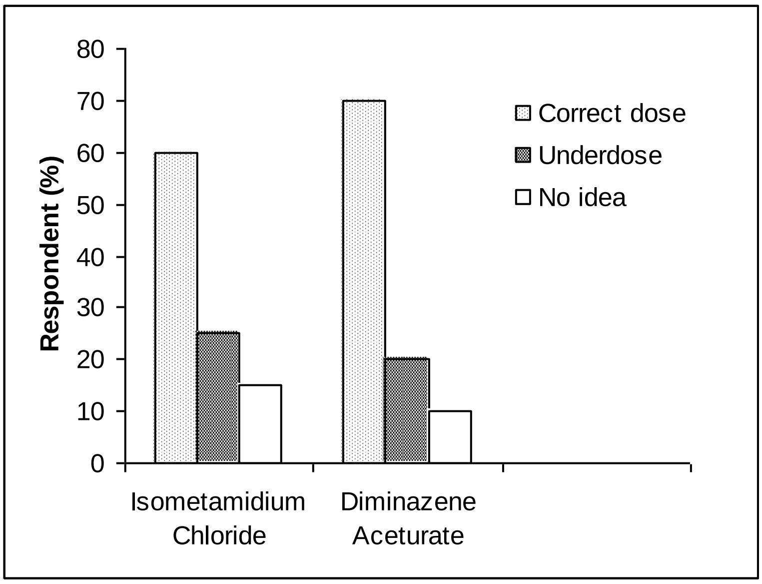

Figure 5: Dosage of trypanocidal drugs used by farmers as indicated during questionnaire inspection at Abelty and Tiroshashama villages in Southwest Ethiopia.

At both villages 65% of responders stated that they have been using trypanocidals for the past 25 years at intervals of 2-4 months. Regarding the frequency of treatment of trypanosomosis, 38.4%, 30.7%, 23.1% and 7.7% of farmers responded from both the villages rendered 4, 6, 5 and 3 times treatment in the year time respectively (Figure 6). The farmers of both groups claimed 80% cure and 20% relapses of the disease after treatment.

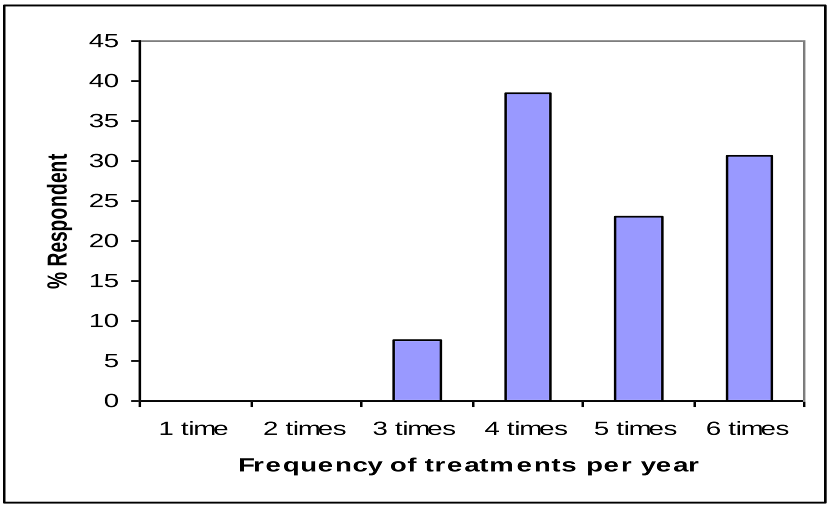

Figure 6: Frequency of treatments rendered in the year time to treat trypanosomosis as verified in questionnaire survey at Abelty & Tiroshashama sites, Sokoru Woreda, Southwest Ethiopia.

4.1.5. Socio-economic Practice

The interviews revealed that both of the farmer associations practiced crop-livestock related farming systems, which generated income for livelihood. Furthermore livestock sector provided power, milk and meat for the house hold consumption.

4.2. Cross sectional Study

4.2.1. Entomological Survey

During entomological survey two species of tsetse flies were identified. These were *Glossina morsitans submorsitans and Glossina pallidipes.* A total of 10 tsetse flies were caught and identified at Abelty and Tiroshashama at suspected fly habitat. In late rainy season six females and one male of *Glossina morsitans submositans* at Abelty and one female of *Glossina m. submoristans* at Tiroshashama were found respectively. In dry season, one female of *G.m. submorsitans* and one female of *G. pellidipes* were found from Tiroshashama village and no fly found in Abelty village (Table 1 and Figure 7).

The mean catch of *G. m. submorsitans* in late rainy season at Abelty was 0.194 flies/ trap /day (95% CI= 0.085- 0.303) whereas 0.028 fly/trap/day (CI=- 0.03, 089) at Tiroshashama village. During dry season the mean catch of *G.m.submositans* and *G.pallidipes* at Tiroshashama were 0.017 flies/trap/day (95% CI -.017, .052) whereas no tsetse fly was found at Abelty village.The mean catches of *G.m.submorsitans* showed significant difference ($\chi 2=1.9$, $P< 0.01$) between seasons.

During late rainy season at both sites and in dry season at Tiroshashama very high catches of *Stomoxys* spp. were recorded (Table 1).

Table 1: Tsetse and other fly catches in late and dry seasons at Abelty and Tiroshashama villages in Sokoru district, Southwest Ethiopia.

Village	Altitude Range (MAS)	Season	Types of flies				Flies / trap/day	Remark
			Species	Sex		Total		
				F	M			
Abelty	1,353-1,475	Late rainy	*G. m. submorsitans*	6	1	7	0.194	Traps positioned at grazing and watering points
			G. pallidipes	-	-	-	-	
			Stomoxy spp.	-	-	357	9.92	
			Tabanus spp.	-	-	2	0.057	
			Heamatopota spp.			2	0.057	
		Dry season	*G. m. submoristans*	-	-	-	-	
			G. pallidipes	-	-	-	-	
			Stomoxys spp.	-	-	-	-	
			Tabanus spp.	-	-	-	-	
			Heamatopota spp.	-	-	-	-	
Tiroshashama	1,555-1,629	Late rainy	*G. m. submorsitans*	1	-	1	0.028	
			G. pallidipes	-	-	-	-	
			Stomoxys spp.	-	-	39	1.08	
			Tabanus spp.	-	-	1	0.028	
			Heamatopota spp.	-	-	1	0.028	
		Dry	*G. m. submorsitans*	1	-	1	0.017	
			G.palldipes	1	-	1	0.017	
			Stomoxys spp.	-	-	200	3.33	
			Tabanus spp.	-	-	-	-	
			Heamatopota spp.	-	-	-	-	

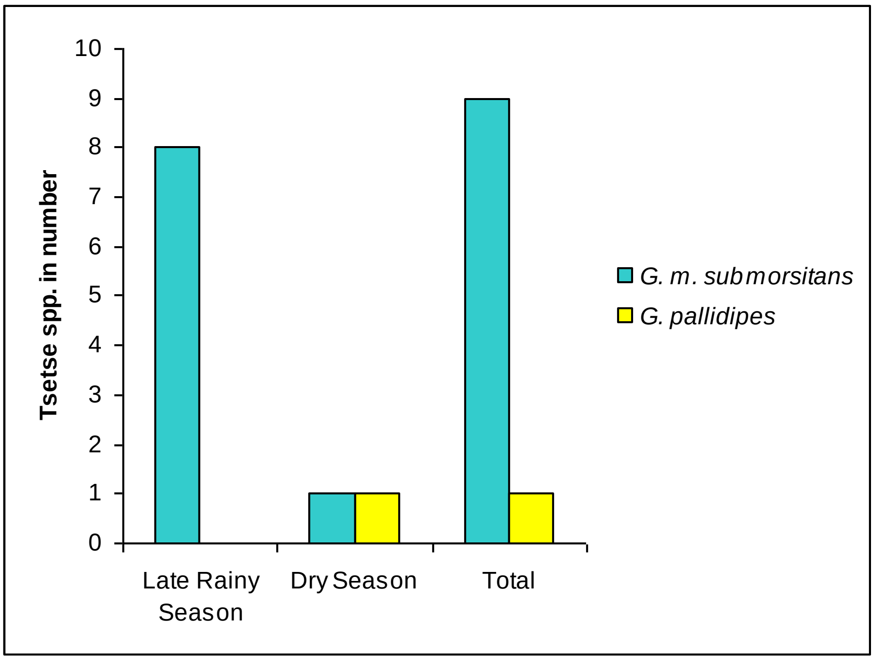

Figure 7: Species of tsetse flies found in different seasons at Abelty & Tiroshashama village in Sokoru district of Southwest Ethiopia.

4.2.2. Parasitological Findings

To assess the prevalence of trypanosome infection in cattle in two villages, cattle were registered and examined (Table 2) which indicated the presence of trypanosome species in both villages. A total of 41 trypanosome infections were recorded at both sites of the study. Out of 180 cattle examined in early November 2005(the late rainy season), 13 (7.22%) were infected with trypanosomes and 335 animals examined in dry season (February 2006) showed 28 (8.36%) animals to have trypanosome infection (Photographs in Annex 2).
However the variation showed significant difference between seasons and infection ($P < 0.05$, CI =6.21- 7.8) and CI= 7.42- 9.31 respectively.

Table 2: Prevalence of infection in cattle in different seasons and 95% confidence interval at Abelty and Tiroshashama villages Sokoru district of Southwest Ethiopia.

Study site	Season	No of cattle examined	Total positive	Trypanosome prevalence rate (%)	95 % CI
Abelty	Late rainy	116	10	8.62	7.65 - 9.6
Tiroshashama	Late rainy	64	3	4.69	4.1 - 5.14
Total		180	13	7.22	
Abelty	Dry	150	8	5.33	4.73 - 5.93
Tiroshashama	Dry	185	20	10.81	9.6- 12.03
Total		335	28	8.36	

There are significant differences ($P<0.05$) in abundance of trypanosome between species and the variation of seasonal distribution occurred at both villages. Out of 41 total infected cattle 60.98% was due to *T. congolense,* 36.58% due to *T.vivax* and mixed infection of *T. congolense* & *T. vivax* accounted for 2.44 % (Table 3).

Table 3: The abundance and seasonal distribution of trypanosome species at Abelty and Tiroshashama villages in Sokoru district of Southwest Ethiopia.

Season	Study site	No. Cattle examined	Rate of infections of trypanosome species (%)		
			T. congolense	*T. vivax*	Mixed infection *T.c & T.v*
Late rainy	Abelty	116	8 (80%)	1 (10%)	1 (10%)
	Tiroshashama	64	3 (100%)	0	0
Dry	Abelty	150	6 (75%)	2 (25%)	0
	Tiroshashama	185	8 (40%)	12 (60%)	0
Late rainy and dry	Total mean	515	25 (60.98%)	15 (36.58%)	1 (2.44%)

Concerning the comparison of trypanosome infections between sexes of host, there was significant difference ($P= < 0.05$) in infection, 68.29% detected in male and 31.71% observed in female (Table 4).

Table 4: Trypanosome infections of cattle, illustrated in terms of sex difference in Abelty a nd Tiroshashama village, Southwest Ethiopia.

Season	No. of cattle of either sex wih trypanosome infection				Total at both villages		Seasonal over all infection %
	Abelty		Tiroshashama				
	Female	Male	Female	Male	Female	Male	
Late rainy	2	8	1	2	3	10	31.71
Dry	1	7	9	11	10	18	68.29
Total	3	15	10	13	13	28	
Infection%					31.71	68.29	100

4.2.3. Prevalence of Trypanosomes according to Age and Sex of Aanimals

Out of 515 samples examined 31 (6.02%) were young male cattle, 43 (8.35%) young female cattle and 441 (85.63%) were adult animals.

Regarding the infection rate out of 41 confirmed parasitaemic cattle 23 (56.1%) were infected with *T. congolense.* Out of these 14 (34.15%) were adult males, 4 (9.76%) were young males and 5 (12.2%) were adult females.

On other hand out of 41 infected animals 18 (44%) were infected with *T. vivax* . Of these10 (24.4%) were adult males, 6 (14.63%) adult females and 2 (4.88%) young females (Table 5 and Figure 8).

The proportion of *T. congolense* infection was higher in adult male (34.15%) and lower in adult female (12.2%). In the same way the *T. vivax* infection was also higher in adult male cattle which constituted 24.4% and lower in adult female animals with 14.63% infection.

The proportion of *T. congolense* infection in young male animals was 9.6%. The infection of *T. vivax* was 4.9% in young females. None of the young females were infected with *T. congolense* and none of the young male cattle were infected with *T. vivax*. The prevalence rate has been found to increase with the age of animal. There was a significant difference (χ^2 = 9.8, df= 1 P< 0.002) in trypanosome infection between different age groups.

Comparison of trypanosome infection groups between males and females were made to analyze if the infection in males was aggravated or not. The prevalence of trypanosome infection was found to be higher in males with 68.29% (95%CI =57 -79) infection than females with 31.71% (95% CI =26.2-37.14).

Table 5: Different types of trypanosome infection in different age and sex group at Abelty and Tiroshashama villages of Sokoru district, Southwest Ethiopia.

Age group	*T. congolense* infection				*T. vivax* infection				Total
	Adult male	Adult female	Young male	Young female	Adult male	Adult female	Young male	Young female	
No. of animals infected	14	5	4	-	10	6	-	2	41
% of animals infected	34.15	12.2	9.76	-	24.39	14.63	-	4.88	
Total	23 (56.1%)				18 (43.9%)				

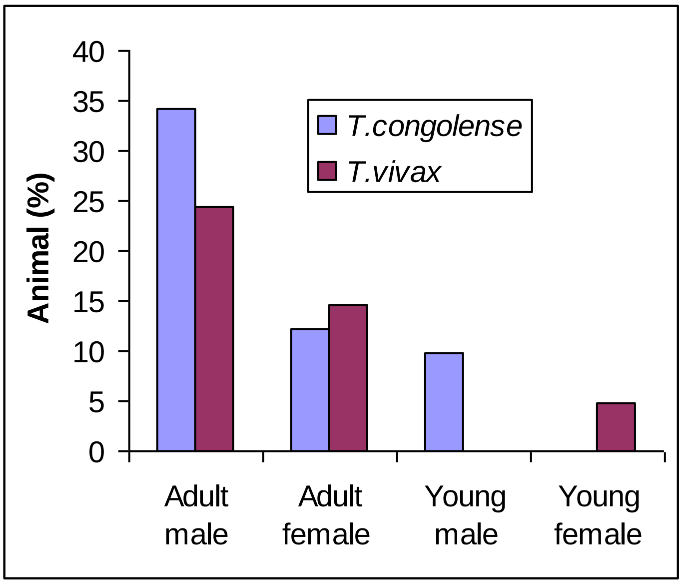

Figure 8: Trypanosome infections in cattle by age & sex groups at Abelty and Tiroshashama villages, Sokoru district Southwest Ethiopia.

4.2.4. Infection Risk Factor

Logistic regression analysis was used to obtain the degree of infections among risk factors. In relation to multivariate analysis the odds ratio of the risk of trypanosomosis of cattle with different age groups in late rainy season (early November) was 1.16 times lower than that of dry season (February). There was a significant difference ($P<0.05$) between odds ratio of late rainy and dry seasons.

4.3. Hematological Findings

The over all mean PCV (%) value of the total number of cattle at Abelty and Tiroshashama villages was 24.33% (95% CI= 24.11- 24.57.). The frequency distribution of the PCV values of the total examined animals is illustrated in figure 9.

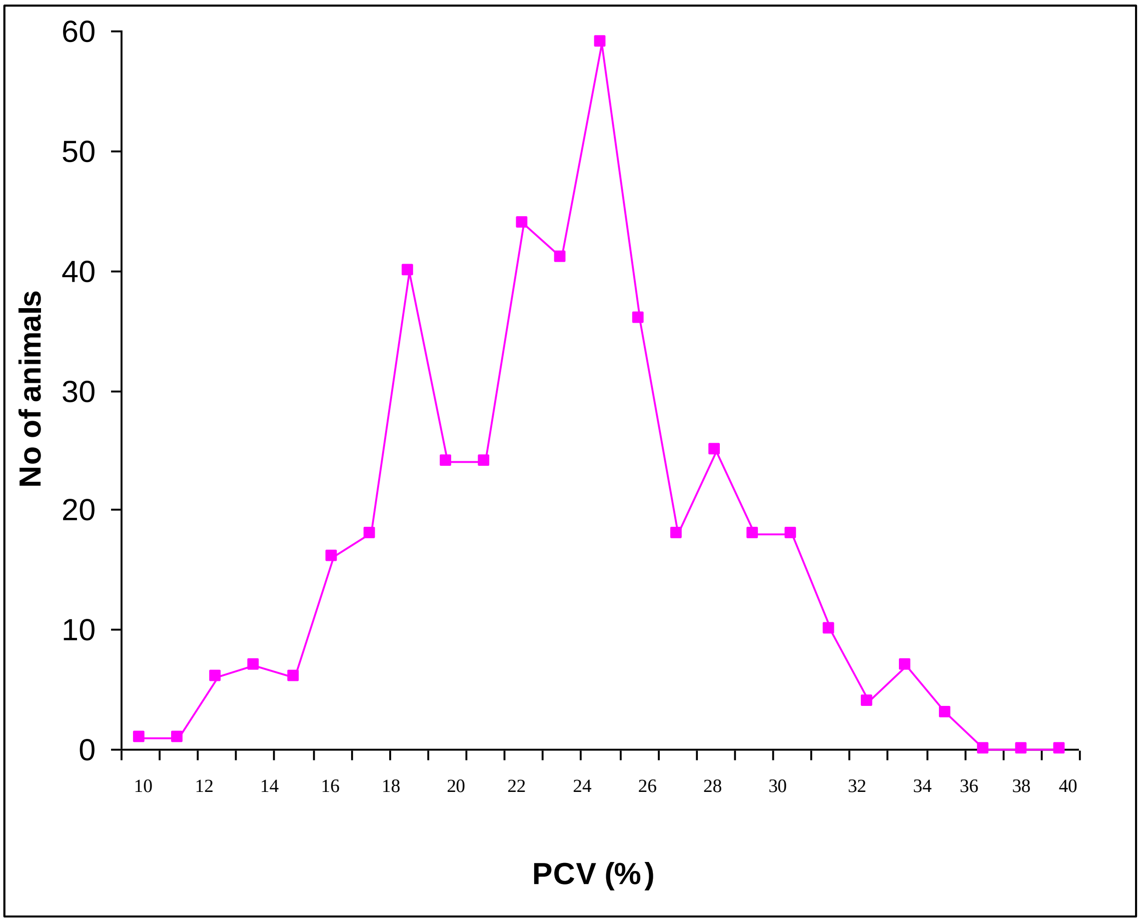

Figure 9: Frequency distribution of PCV (%) values of the total herds in two villages of Sokoru district (Abelty & Tiroshashama), Southwest Ethiopia

Out of tested cattle 68.91% had PCV value less than 26% and 31.09% had PCV greater or equal to 26% (Table 6). Kruskal – Wallis chi-square test showed that there was no significant difference (χ^2 =0.317, P>0.05) between PCV values of cattle tested during different seasons.

Table 6: Mean PCV (%) results of sampled cattle during cross sectional study and mean PCV (%) value of cattle which had PCV (%) value of $\geq$ 26% and < 26% in Sokoru district, Abelty & Tiroshashama villages of Southwest Ethiopia.

Village	No of cattle examined	Season	Mean PCV (%)	% Cattle With PCV (%) <26	% Cattle With PCV (%) >26
Abelty	118	Late rainy	24.03	81.36	18.64
Tiroshashama	64	Late rainy	26.03	46.88	53.12
Abelty	150	Dry	23.34	73.33	26.67
Tiroshashama	185	Dry	23.91	74.05	25.95
Mean			24.33	68.91	31.1

The mean PCV of parasitaemic (22.22%; CI =22.02-22.44) cattle was significantly lower (P<0.05, t-test) than the mean PCV (%) of aparasitaemic (24.33 %; CI= 24.11-24.57) cattle (Figure 10 and Table 7). There was no significant difference in the mean PCV between age and sex groups (P>0.05). The PCV (%) values of the parasitaemic cattle ranged from 16 to 30 (Figure 11).

Table 7: Mean PCV (%) of aparasitaemic and parasitaemic cattle observed during cross sectional study at Abelty and Tiroshashama villages, Sokoru district, Southwest Ethiopia.

Study site	Season	No. cattle examined	No. Aparasi -taemic cattle	No. Parasita-emic cattle	Mean PCV (%) of aparasi--taemic Animals	Mean PCV (%) of parasitaemic Animals	SE
Abelty	Late rainy	116	106	10	24.03	22.78	0.41
Tiroshashama	Late rainy	64	61	3	26.03	23.0	0..54
Abelty	Dry	150	142	8	23.34	21.13	0.35
Tiroshashama	Dry	185	165	20	23.91	21.95	0.29
Total		515	474	41	24.33	22.22	0.39

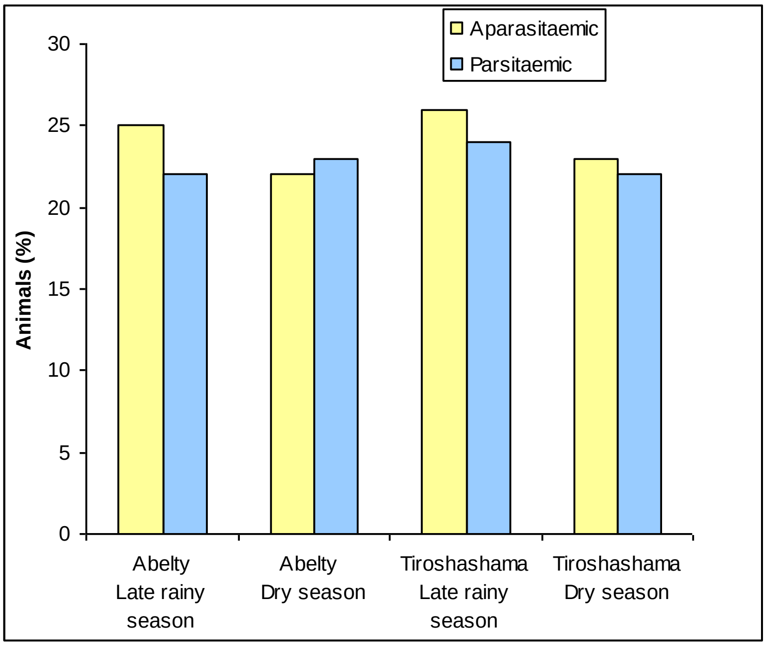

Figure10: Mean PCV % values of cattle in two study sites and seasons, Sokoru district, Southwest Ethiopia.

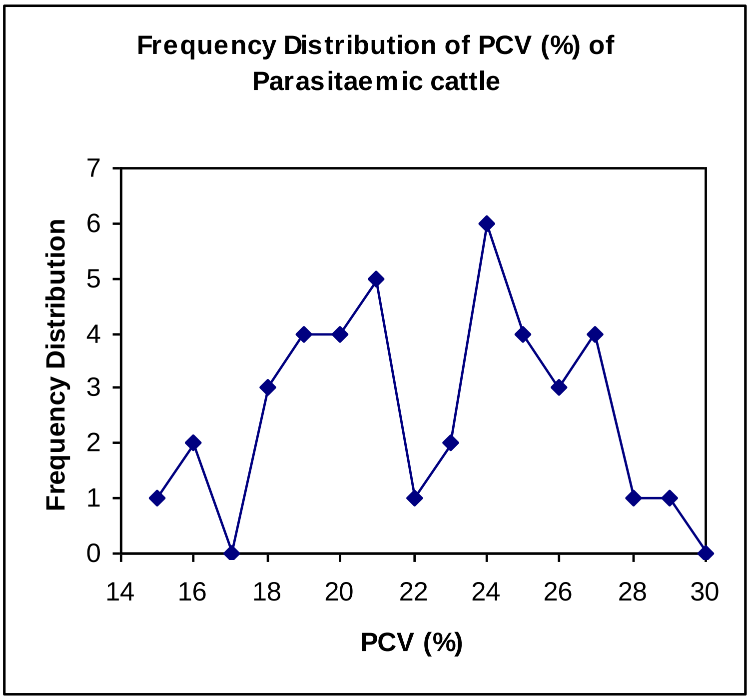

Figure 11: Frequency distribution of PCV (%) of parasitaemic cattle at Abelty and Tiroshashama villages, Sokoru district Southwest Ethiopia

The prevalence of trypanosome infection and the PCV values showed a negative correlation with low mean PCV value among population with high trypanosome infection (r = 0.941) (Figure 12).

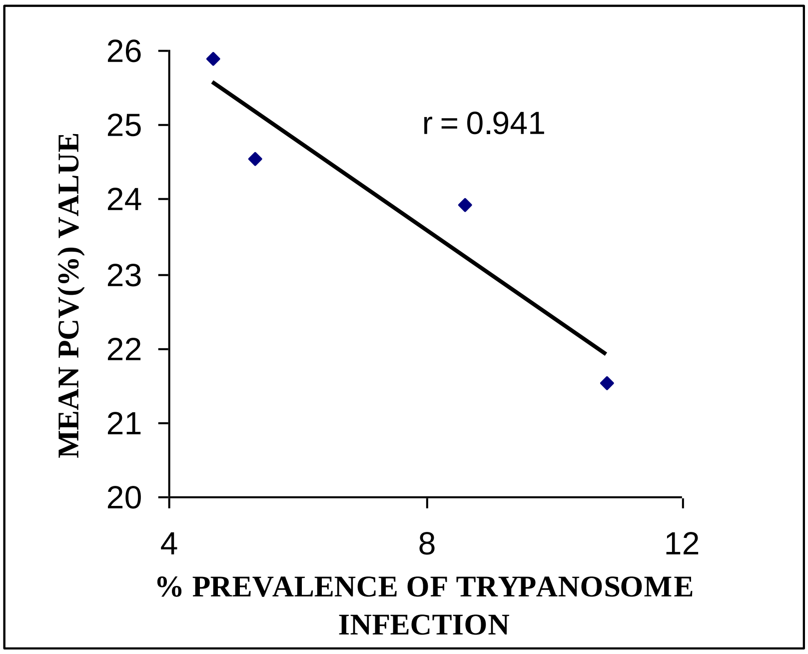

Figure 12: The correlation between the prevalence (%) of trypanosome infection and mean PCV (%) value of examined cattle populations.

4.4. Longitudinal Studies

4.4.1. Assessment of Trypanocidal Drug Efficacy

To evaluate the efficacy of trypanocidals, which are widely in use in two villages of Abelty and Tiroshashama, 100 local zebu cows,50 from each site, 25 for treatment group and 25 for control, were selected and examined .

The cross sectional study revealed the prevalence rate of trypanosome infection 7.22% in late rainy season in the eve of blanket treatment with Diminazene at both sites (Table 2).

The proportion of trypanosome species (*T. congolense, T. vivax* and mixed infections) were identified prior to the treatment with the help of parasitological procedures as indicated in cross sectional study (Table 3).

Fourteen days before the beginning of Isometamidium block treatment study a total of ten infections at Abelty and three trypanosome infection at Tiroshashama village were diagnosed respectively (Tables 8 and 9). Out of total infection *T. congolense* was the most prevalent trypanosome (84.6%). The prevalence of *T. vivax* and mixed infections constituted 7.8% each at Abelty and none at Tiroshashama.

At day zero (14 days after blanket treatment) of the study no trypanosome infection was diagnosed at any of the two villages.

During the 12 weeks of monitoring a total of 16 trypanosome infections was recorded at both sites. Trypanosome infection commenced at day 56, out of which 2 cases of *T.congolense* at Abelty, and one case with *T. congolense* and one case with T.vivax infection at Tiroshashama were registered. At day 70 a total of 7 infections recorded of which 4 cases of *T. congolense* and 1 case of *T.vivax* accounted at Abelty where as 2 cases of *T. congolense* registered at Tiroshashama village. In the same way at day 84 two animals with *T. congolense* and one with *T. vivax* occurred at Abelty and one case of *T. congolense* and one case of *T. vivax* registered at Tiroshashama village (Tables 8 and 9). During the 12 weeks of observations no animal showed repeated infection with trypanosome. All cases of relapses of trypanosome infections were treated with 7.0 mg Diminazene aceturate/ kg bw of which *T. congolense* and *T. vivax* constituted for 75% and 25% respectively.

Table 8: Isometamidium chloride efficacies treated at a dose of 1mg/kg/bw in naturally trypanosome infected local cattle at Abelty village, Sokoru district, Southwest Ethiopia.

Trypanosome species	No. infections in 50 cattle 2 weeks before treatment	**No. infections in 25 post isometamidum treated cattle in Abelty village**							Total infection
		0	14	28	42	56	70	84	
T. Congolense *T. vivax* Mixed(T.c & T.v)	8 1 1	- - -	- - -	- - -	- - -	2 - -	4 1 -	2 1 -	8 2 -
Total						2	5	3	
% Parasitaemic						(8%)	(20%)	(12%)	
95% CI						1.1-3.6	4.25-6.56.	1.75-4.59	

Table 9: Isometamidium chloride efficacy, treated at a dose of 1mg/kg bw in naturally trypanosome infected local cattle, at Tiroshashama village, Sokoru district, Southwest Ethiopia

Trypanosome species	No. infections in 50 cattle 2 weeks before treatment	**No. infections in 25 post isometamidum treated cattle in Tiroshashama village**							Total infection
		0	14	28	42	56	70	84	
T.congolense *T. vivax* Mixed(T.c&T.v)	3 - -	- - -	- - -	- - -	- - -	1 1 -	2 - -	1 1 -	4 2 -
Total						2	2	2	6
% Parasitaemic						8%	8%	8%	
95% CI						1.1-3.06	1.1-3.06	1.1-3.06	

During longitudinal study of Isometamidium chloride block treatment 50 animals, 25 cattle from each of the study site were ear tagged and left untreated for control purposes and monitored for infection of trypanosome for the duration of 12 weeks. Blood samples were taken every two weeks from auricular vein and examined for the presence of trypanosome infection. During the study period all together 28 cases of trypanosome infection were diagnosed from day 14 up to day 84, out of which T. *congolense* conistituted 67.86 % and *T.vivax* 32.14 % respectively (Table 10). All cases of break though infection (relapses) were treated with Diminazene aceturate with the dose rate of 7 mg /kg bw. In case of the cattle treated with Isometamidium chloride block treatment the relapses or break through infection were 16 animals, which constituted 5.5 % through out of the 300 (50 animals x 6 examination days) monitored cattle during 12 weeks period. In the existing situation Isometamidium untreated herds were more victimized to trypanosome infections than the treated group.

Table 10 : Trypanosome infection identified in control (untreated) groups of animals during longitudinal study at Abelty and Tiroshashama.

Study Site	Species Of trypanosome	No.of Cattle examined	Day 14	Day 28	Day 42	Day 56	Day 70	Day 84	Total
Abelty	*T.congolense*	25	2	1	2	2	2	1	10
	T.vivax		0	1	1	1	1	1	5
Tiroshaashama	*T.congolense*	25	1	1	0	1	1	5	9
	T.vivax		0	0	1	1	0	2	4
Total infection			3	3	4	5	4	9	28
Percent			6%	6%	8%	10%	8%	18%	

4.4.2. PCV Findings.

During the efficacy study of Isometamidium chloride treated cattle at both sites there were significant ($P<0.05$) increases in the mean PCV values. However the development of gradual relapses of infections was followed by the decline of heamatocrit values from day 56 onwards of post-Isometamidium treatments at both villages (Tables 11 & 12).

Table 11: Mean PCV (%) values after Isometamidium treatment and mean PCV (%)of control group at Abelty, Sokoru district, Southwest Ethiopia.

Days after treatment	No of examined animals		Mean PCV (%)		95% CI
	Treated	Control	Treatment	Control	
0	25	25	25.56	24.72	23.22- 27.9
14	25	25	28.76	26.96	25.48-31.23
28	25	25	29.84	28.4	28.05-31.62
42	25	25	29.72	26.48	28.61-30.82
56	25	25	27.72	25.92	26.38-28.73
70	25	25	25	24.56	24.62-26.50
84	25	25	23.5	22.96	23.35-25.61

Table 12: Mean PCV (%) values after Isometamidium treatment and mean PCV (%) of control group at Tiroshashama, Sokoru district, Southwest Ethiopia.

Days after treatment	No of examined animals		Mean PCV (%)		95% CI
	Treated	Control	Treatment	Control	
0	25	25	23.32	23.76	22.07- 24.57
14	25	25	24.48	25.28	23.06- 25.89
28	25	25	26.28	26.60	25.41-27.15
42	25	25	27.28	25.68	25.12-29.04
56	25	25	29.29	28.24	27.83- 32.10
70	25	25	26.04	27.72	24.50-27.58
84	25	25	22.16	25.68	20.10-24.21

5. DISCUSSION

Even though various conventional diseases induce livestock mortality and result economic losses in Ethiopia, tsetse transmitted trypanosomosis has crucial effect which is becoming unchallengeable to treat. Vector control actions as a strategy option are not widely implemented in Ethiopia (NTTICC, 1996). For this very reason trypanosomosis disease control methods basically relayed on the widely use of curative and prophylactic drugs for more than three decades.

The main objective of this study was to identify the prevalence and magnitude of trypanosomosis in the Sokoru district, to investigate drug efficacy of trypanocidals that are currently and widely in use. The study was aimed to provide a concrete analysis and magnitude of the disease in the Woreda, to provide base line data for future studies and to point out the direction of essential control options of trypanosomosis challenge based on tangible circumstance. The questionnaire survey disclosed that the disease has been prevailing since long and 99% of the responders appealed that among other diseases, trypanosomosis is a priority and a serious constraint which retard livestock production, cause mortality, decline traction power of their oxen and induce economic losses. In questionnaire survey in selected sites of FITCA project areas Afework (1998) and Tewolde (2001) reported trypanosomosis to be the most important livestock disease in the area of Metekel district, Northwest Ethiopia. In the present survey the interview revealed a similar statement.

About 50% of interviewed farmers claimed that they used to treat their livestock themselves with Diminazene aceturate and Isometamidium chloride against trypanosomosis. This condition points out the severity of the disease in rearing animals in the study areas. However, 40% and 30% of the interviewed farmers claimed that they used underdoses and unknown doses of trypanocidals respectively. The interviewed farmers disclosed that trypanocidal drugs were applied only to sick animals. Vander Boche and Tewolde (2001) found the similar results during questionnaire survey in Zambia and FITCA project sites in Ethiopia. In West Africa Bauer (2001) found that 90% of animal handlers used the trypanocidal drugs with out confirmed diagnosis.

In the present observations 80% of the respondents claimed that animals were treated by farmers themselves and unauthorized individuals. Afework (1998) and Tewolde (2001) had also reported that about 43% and 57% farmers used drugs against trypanosomosis in the village cattle of Metekle district, Northwest Ethiopia and FITCA project sites in Western Ethiopia respectively. The present study revealed that about 30% and 40% farmers treated their livestock 6 and 4 times in a year respectively. This report corroborated with the report of Afework (1998) where he observed that farmers treated their animals in every 4 months and above. The number of intervention of treatments over a year reflected the magnitude of trypanosomosis challenge in an area (Uilenberg, 1998).

The finding of tsetse survey revealed two types of tsetse species at Abelty and Tiroshashama study sites. The main vectors detected were *G. m. submositans* and *G. pallidipes*, which was similar with the result obtained in Ghibe valley (Peregrine *et al.* 1994). During the late rainy season 0.194 flies /trap /day of *G.m.submorsitans* at Abelty and 0.028 flies /trap /day at Tiroshashama village were recorded. In dry season 0.017 flies /trap /day of *G. m. submorsistans* and 0.017 flies/trap /day of *G. pallidipes* species recorded at Tiroshashama villages and none at Abelty study site. The reason for the decline of apparent fly density in the dry season during the survey might be due to uncontrolled bush fire, which damaged the savannah grasslands and the bush, few weeks prior the survey period. Such circumstance might have suppressed the fly density and forced the flies to move to the moisture areas of the sides of valley and riverbanks of extreme low altitudes. In the present observation the fly density was found to be relatively increased in late rainy season at both study sites (November) than the dry season. This fact is in agreement with the result of Leak *et al*. (1993) that the apparent density increased from September to December during survey conducted from 1986-1990 at Ghibe valley, which was the boundary of the present study sites. According to Leak (1999) the increase in fly density was due to the growth of vegetation and formation of new habitat in the rainy season.

In the current study *G. m. submorsitans* can be considered as the principal and important vector of animal trypanosomosis due to their higher abundance than other tsetse species at Abelty and Tiroshashama villages.

The result of the study revealed that *T.congolense* is the most prevalent trypanosome species in the study population that constituted 60.98% followed by *T.vivax* 36.59% and mixed infection (2.43%). An earlier study by Rowlands *et al.* (2001) reported a prevalence rate of 37% by *T. congolense* in cattle in Southwest Ethiopia. Abebe and Jobre (1996) also indicated the infection rate of 58.5% with *T.congolense,* 31.2% with *T. vivax* and 3.5% with *T. brucei* in the tsetse-infested areas of Ethiopia. Further more Afework (1998) indicated 17.2% of *T. congolense* infection at Metekel district and Tewolde *et al.*, 2001 recorded 75% and 93% of cases in kone and village one-settlement areas respectively in western part of Ethiopia.

D'lteren *et al*. (1998) and Maclennan (1980) suggested that cattle developed immunity more readily against *T. vivax* than *T. congolense*. Also *T.vivax* is less virulent and consequently cattle develop tolerance to *T. vivax* more easily than T. *congolense*. The present study also revealed much less abundance of *T. vivax* from the study areas, which might be due to the development of immunity in the cattle.

In the current cross sectional study an over all mean PCV (%) value was recorded as 24.33%. Cattle with PCV value less than 26% was considered as anemic (Tewolde *et al*., 2004; Rowlands, 2000) which is said to be the principal sign for trypanosomosis in the livestock (Ilembade *et al.*, 1979, Gardiner, 1989). In the present study 68.91% of the sampled cattle had the PCV (%) value <26%. Afework (1998) at Pawe, Northwest Ethiopia found 90% of cattle having PCV (%) value <26%. Similar result was also found by Muturi (1999) at Merab Aabya (88.9%) and Daya (2004) at Ejacho (55.3%) in Southwest Ethiopia. Work done at Ghibe in Southern Ethiopia showed that few animals were parasitaemic when the PCV (%) was greater than or equal to this value (Rowlands *et al*., 2001). In the present findings parasitaemic animals had mean PCV 22.78 %.

Rowlands *et al.* (2001) also observed increase in PCV value with a decrease in the proportion of parasitaemic samples at Ghibe valley in Southern Ethiopia. The present study also revealed a negative correlation (r = 0.941) showing a decrease in mean PCV value with an increase in the proportion of infected animals. Therefore, average PCV could be better indicator of the status of cattle herds. Vanden and Rowlands (2001) indicated one disadvantage of the reliance in mean PCV value could be that it is affected by many factors other than trypanosomosis. However, these factors are likely to affect both trypanosomosis positive and negative animals. The difference between mean PCV of parasitaemic and aparasitaemic animals indicates that trypanosomosis is involved adversely by lowering the PCV value less than 26%. The low PCV value in the aparasitaemic animals might be due to the delayed recovery of anaemic situation after recent treatment with trypanocidal drugs or due to compound effects of poor nutrition and haematophagus helminths infestation such as haemonchosis and bunostomosis (Afework, 1998)

The current investigation revealed an increase in infection rate with the age of the cattle and this observation agrees with the result of Muturi (1999). The difference in prevalence of trypanosomosis in different age group was significant.

For over a couple of decades trypanocidals have been used to treat livestock and control trypanosomosis in Abelty and Tiroshashama villages. Drug therapy has been the main strategy used in the past to control trypanosomosis throughout Ethiopia (Slingenbergh 1992b). In present study the questionnaire survey disclosed that in most cases the trypanocidals used for treating were purchased from illegal traders. This phenomenon is similar to investigation of questionnaire survey done by Afework *et al.*, 2000. There is a flourishing black market and farmers can purchase a variety of trypanocidal drugs in most village market (questionnaire result).

To evaluate the prophylactic and curative capacity of Isometamedium and curative efficacy of Diminazene aciturate at Abelty and Tiroshashama villages longitudinal study was performed. No trypanosome infection was detected up to 42 days after blanket treatment. The appearance of parasites was first observed on day 56 after blanket treatment. Works of Habtewold (1993) at Wolayita revealed 8.3% - 21.9% recurrent infection after treatment with Isometamidium (trypamidium) (0.5mg/kg bw). Cherinet (1996) reported 22.2% infection on 12 days after curative dose (0.5mg/kg bw) of trypamidium. The capability of these doses were less efficient than the present curative and prophylactic dose (1mg/kg bw) of Isometamidium chloride which resulted 22.67% relapses only from day 56 up to 84 after Isometamidium treatment.

The current result indicates a better protection of Isometamidium chloride than that of Afework *et al*. (2000) which demonstrated 13% break through infections of which *T. congolense* coutributed 80% of infection within 30 days of treatment with prophylactic dose of Isometamidium. Muturi (1999) revealed 3% recurrent parasitaemia in four weeks time after treatment with prophylactic dose of introduction, which also indicates lesser period of protection than the efficacy of current dose of Isometamiduim chloride.

Similar works were carried out in the Southwest Ethiopia on the most prevalent drug resistant trypanosome species (Codija *et al.*, 1993 and Leak *et al*., 1993). More over recent field observations in Ethiopia based on cloned population showed that the drug resistant phenotype of *T.congolense* had not altered over a period of 4 years (Mulugeta *et al*., 1977) and argued resistant strains remain resistant after passage through tsetse flies (Moloo and Kutuza 1990).

The output of the findings of the efficacy of Diminazene aceturate revealed that the use of the drug in all new cases was still effective at both the study villages. There was recurrent trypanosome infection in Southwest Ethiopia where drug resistant trypanosomes against Diminazene aceturate was reported (Rowlands *et al*., 2001).

6. CONCLUSION

The current finding indicates trypanosomosis as a major disease of livestock production at the study villages, Abelty and Tirishashama in Sokoro district. The questionnaire survey also revealed the inavailability of adequate veterinary services and insufficient allocation of trypanocidals, which have forced the livestock keepers to use adulterated drugs and non-ethical drug administration.

Among all the biting flies found, the tsetse fly of the species *Glossina m. submorsitans* can be considered as the major vector for trypanosome infection of livestock in the study areas.

Regarding the trypanosomosis of cattle, the adult males were found to be more susceptible than adult females and young ones.

Among the species of *Trypanosoma* identified, *T. congolense* was found to be more prevalent than other species.

The mean PCV values indicated an overall poor health status of livestock at both study sites. And the trypanosome infection has been found to cause further poor condition indicated by a more decline in PCV values among the infected cattle.

The prophylactic efficacy of Isometamidium chloride at a dose rate of 1mg/ kg bw. conferred a protection against the infection. Moreover, administration of Isometamidium chloride and the subsequent treatment with Diminazene aceturate provided an increase in PCV during the two month period. Diminazene aceturate was effective and curative for new cases of trypanosome infection.

7. RECOMMENDATIONS

1. Strong and sustainable extension works should be done to creat awareness of the livestock keepers to wisely use communal pastures, feed conservation preparation and its use. This may help to minimize the degree of exposure of their livestock from traveling long distances for search of feed and water in the tsetse habitat.

2. Attempt should be made to expand Government and private veterinary services to serve well the community, which suffer from trypanosomosis.

3. The livestock keepers should be advised to avoid the use of non-ethical and inadequate doses of drugs, which may develop drug-resistance in trypanosomes.

4. Sustainable community based tsetse and trypanosomosis control program should be designed and implemented.

5. Practical, economical and environment friendly tsetse control systems like the use of targets and traps should be widely used and advocated.

6. New technology of sterilized insect control technique (SIT) has promising effect in tsetse control intervention. The practical use of this technology may be implemented alongwith other conventional control options.

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10 ANNEXES

Annex 1questionnaire for interviewing farmers in the study area

1. **Location and identity**

Wereda________________________ PA______________________

Date_______________

Livestock owner ______________________________ Age _______ Gender ______

2. **Livestock management**

2.1. When do you start dwelling in this area, when do you start keeping livestock?

Cattle________,

Small ruminant__________,

Equine__________,

Others________(specify)

2.2. How do you manage cattle?

Free grazing ________

Tether ___________

Stall feed ______________

2.3. Where do cattle graze?

____

____

2.4. Location of watering point ____

____

2.5. In which season livestock feed is available? _______________________________

In which season livestock feed is scarce? _____________________________________

3. **Major livestock diseases**

3.1. What are the most common livestock diseases occur in the area?

____

____

____

____

____

3.2. Does Trypanosomosis occur in the area? (Yes/ No, other)

If yes, how do you rank Trypanosomiasis with regard to cattle losses compared to other diseases?

____

____

____

3.2. Which livestock does Trypanosomiasis mostly affect?

Cattle _________

Small ruminant ___________

Others __________ (specify)

3.4. What sign do you observe when your animal is sick with Trypanosomosis?

____

____

____

3.5. In which season /Month do livestock get disease (trypanosomosis)________________

3.6. When does trypanosomosis started in the area? _________________________

3.7. Is trypanosomosis getting worse, better or unchanged in this area since you first encountered in the area?

A. It is getting worse

B. It is getting better

C. It is the same

D. I don’t know

3.8. Do you know that flies transmit trypanosomosis? (Yes/ No)

3.9. If yes in which season/ month are these flies most abundant?

____

3.10. When is the tsetse population high?

A. In area close to the river

B. In graze scheme

C. In the bush

D. In Savanna areas

4. Opportunity of treatment and use of trypanocidal

4.1. What is the source and possibilities of treatment?

A. Traditional treatment at home

B. B. Veterinary clinic

C. Smugglers

D. Others (specify)

4.2. Who administers the treatment?

A. Your self

B. Animal health personnel

C. Drug smugglers

Others (specify)

4.3. Which kind of drug commonly used in your area? (name, type/color, etc)

____________, _______________,

_______________, ______________________

4.4. In what quantity do you use the drugs? (doses)

If Berenil________________________For adult cows or oxen

If Trypamidium___________________For adult cows or oxen

If Novidium______________________For adult cows or oxen

4.5. How long have you been using each of these drugs?

A. Since 30 years

B. Since 20 years

C. Since 10 years

D. Since 5 years

4.6. Which drug do you think is most effective________________________?

4.7. In what time frequency you treat your animal in a year?

Once_____________________

Two times _________________

Three times________________

More than 3 times___________

4.8. Do they cure after these treatments? Yes/No

4.9. How much do you pay for treatment in a year for tryapanomosis?

____

4.10. Do you treat?

A. All your animals
B. Only sick animals
C. Only oxen
D. Only cows
E. Others(specify)

4.11. Do you use traditional treatment methods to cure your animals?

____

4.12. Do you think trypanosomosis is expanding to other areas? (Yes/No)

If yes what are the new areas affected?

____

5. **Socio economics**:

5.1. For what purpose do you keep livestock?

A. For milk production
B. For meat production
C. For sell
D. For draughting
E. For manure
F. For dowry .

Thank you

Name of interviewer____

Date____

Signature____

Annex 2photographes illusterating different duties of prevalence of trypanosomosis study at Abelty and Tiroshashama villages .Sokoru Woreda South west Ethiopia .

11 CURRICULUM VITAE

1 Personal data

Name: Yeshityila Amede Yemer

Date of birth: October 28^{th}, 1959

Marital status: Married

Children: One

Religion: Christian

Position: Head, Woreda Agricultural development office and team leader of Animal health services

Membership: Ethiopian Veterinary Association.

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2 Educational back ground

Sept.1956-June1960 EC : Medihane Alem primary school ,Gecha in the former Illubabor .

Sept. 1962-June1963 EC : Masha and Mettu st. Gebriel Junior secondary schools.

Sept. 1964-1969June EC: Gore Hailessilase 1^{st}. high school and Mettu high schools Achievement: ESLCE certificate

Jan.1967-July 1968 EC: Participated in Ediget behibret (the so-called development Though campaign

	Achievement: participation Diploma and Medal.
Sept.1970-July 1971 EC:	Jimma institute of Agriculture Achievement: Diploma in general Agriculture.
July 1974 –May 1974 EC:	Berneveld Collage of Agriculture. The Netherlands. Achievements Diploma in pig husbandry and feed Processing technology
April 1974.EC	I have participated an international work shop on integrated Animal feed technology as a part of animal feed course of The Barneveld collage (The Netherlands) , which was held In United Kingdom.
Sept. 1975 –June 1981EC	Kishinove Institute of Agriculture, Moldavia the former USSR. Achievement: Doctor of Veterinary Medicine
Jan.1985-July1985 EC	Fries land Dairy Training Center, The Netherlands. Achievement: Diploma in Dairy husbandry and Extension Training.
April 1985	I have followed a one-week international workshop on Practical training of dairy as apart of dairy training course Of Fries land dairy training center, which was held in Great Britain
Nov. 11^{th}-.25=1991 EC	International work shop on the roll of rural appraisal small Scale dairying and milk processing held at Chana Achimota University, Accra. Achievement: Certificate

Jan 1st-Jan. 30 th. 1994 EC Ministry	Computer training (Word, Excel Access) courses. Of Agriculture. Addis Ababa

2 Work experience

July 19971-Augest 19973 EC	Site manager and field supervisor at Anger Gutin Settlement project. Wellega province.
June1974 – August 1974 EC	Livestock officer Hararge province in Relief and Rehabilitation commission
Sept.1982-Augest 1985EC	Team leader of Animal and fishery development and Veterinarian of Nadadedo Awraja
Sept.1986-January 1989EC	Team leader of Animal and fishery resources Kersa Woreda.
February 1989 July E 1994	Team leader of Jimma Zone animal health service.
Sept.1995-March 1995EC	Team leader of Animal health services of Sokoru Woreda.
April 1995-Augest 1995 EC	Head of Sokoru Woreda Agricultural development office.

3 Research papers

Prophylaxis of parasitic diseases in sheep. DVM thesis (1989) Kishinove institute of Agriculture Moldavia state USSR (unpublished)

Tsetse transmitted Trypanosomosis in Africa current control options in Ethiopia . A paper presented for the course seminar on current tpopices FVM. AAU. Debre Zeit (un published)

Prevalence of bovine trypanosomosis in Sokoru Woreda Jimma Zone, Oromia region South West Ethiopia. Msc thesis (2006), FVM, AAU.

4 Language proficiency

Amharic	read	spoken	written
Oromic	read	spoken	written
English	read	spoken	written
Russian	read	spoken	written

12. SIGNED DECLERATION SHEET

I the under singed, declare that this thesis is my original work and has not been presented for a degree in any University

Name Yeshitila Amede Yemer ______________________________

Signature

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Date of submission ______________________________

This thesis is submitted for examination with my approval as university advisor

DrAsoke Kumar Basu ______________________________