Improved targeting and appropriate use of trypanocidal drugs for the control of African bovine trypanosomiasis in tsetse endemic areas of western and coastal Kenya within the context of primary veterinary care

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Declaration

I hereby declare that the research described within this thesis is my own composition, that the thesis is my own work and also certify that it has never been submitted for any other degree or professional qualification.

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Dedication

To my mother, Bertha Lukungwe

And

In memory of my father, Humphrey J. Malindi Machila

Abstract

The thesis examines smallholder livestock owners' perceptions of bovine trypanosomiasis and methods used for controlling it, as well as their veterinary treatment-seeking patterns and access to agricultural and veterinary information in tsetse endemic areas of Busia District, western Kenya and Kwale District, coastal Kenya. The thesis also describes a controlled communication intervention trial in these two study sites that was conducted by disseminating bovine trypanosomiasis information developed in the medium of leaflets and posters. The impact of these extension interventions was assessed in a follow-up household- and primary school-based survey on smallholder farmers' and children's understanding of trypanosomiasis identification and control.

The studies described employed qualitative (participatory research appraisal) and quantitative (structured questionnaires) survey methods of data collection.

The studies showed that approximately 15% of disease episodes in cattle were perceived by the farmers to be trypanosomiasis; however, the farmers' had difficulties in making diagnoses in that over half of the diagnoses were inconsistent with the clinical signs that they described. Trypanosomiasis knowledge appeared to be associated with location of farmers; respondents in Busia District were significantly more likely to have trypanosomiasis knowledge than those in Kwale District (OR: 6.58, 95% CI: 2.46-17.65).

Drugs were generally obtained from agro-veterinary shops, and the farmers themselves administered more than half of these. One third of drug treatments given to sick cattle were trypanocides, but over half of these trypanocidal treatments were given to cattle believed to have diseases other than trypanosomiasis.

Analyses of cattle owners' veterinary treatment-seeking patterns showed that sick cattle in Busia District were less likely to be treated than those in Kwale District. There was no significant association between use of trypanocides and any household social characteristics, but an association was observed between use of trypanocides and the biological nature of the disease.

Evaluation of the smallholder farmers' information networks revealed that radio, community leaders' meetings and school children were the most reliable sources of agricultural knowledge.

With respect to the communication intervention, the majority of the householder recipients of the extension materials rated the trypanosomiasis messages as being useful, and 54% of them indicated that the information on trypanosomiasis contained within the extension materials was new to them. Mean (2.0) trypanosomiasis signs knowledge score obtained by the householders exposed to the extension materials (median: 2, range: 0-6) was higher than that obtained by those not exposed to them (mean: 1.2, median: 1, range: 0-4), Mann-Whitney U = 5175.5, $p < 0.001$; similarly, farmers' exposure to extension materials resulted in higher trypanocidal drug knowledge scores (mean: 0.6, median: 0, range: 0-3) than non-exposure (mean: 0.2, median: 0, range: 0-3), Mann-Whitney U = 5902.0, $p < 0.001$. School children's pre-communication intervention trypanosomiasis signs knowledge was much lower (mean: 2.5, median: 3, range: 0-6) than that observed during the post-communication intervention survey (mean: 5.1, median: 5, range: 0-8), $Z = 16.23$, $p < 0.001$. More trypanocides were mentioned by school children during the post-intervention questionnaire survey (mean: 4.6, median: 5, range: 0-6) compared to those known during the pre-intervention survey (mean: 1.0, median: 0, range: 0-6), $Z = 17.12$, $p < 0.001$.

Improvement of farm-based trypanosomiasis control by poor livestock keepers can be achieved through provision of veterinary extension materials. Dissemination of such information through primary schools was seen to be an effective channel, as it has the advantage of reaching many households; this was observed by the frequency with which school children (33%) were cited by the householders as a source of the extension materials produced. Moreover, illiterate farmers can benefit from the children's explanation of the contents of the extension materials.

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Abbreviations used in the thesis

μm	Micro-meter
4K club	Young farmers club based in schools in Kenya
AAT	African animal trypanosomiasis
AEZ	Agro-ecological zones
Agrovet	Agro-veterinary retailers
AHA	Animal health assistant
AHP	Animal Health Programme
AHW	Animal health worker
AKIS	Agricultural Knowledge and Information Systems
ASAL	Arid and semi-arid lands
CAHW	Community animal health workers
CBO	Community-based organisations
DFID	Department for International Development
DVO	District Veterinary Office
DVS	Director of Veterinary Services
ECF	East Coast fever
EENET	Enabling Education Network
ELISA	Enzyme-linked immunosorbent assay
ER&D	Ethno-veterinary Research and Development
EVM	Ethno-veterinary medicine
FAO	Food and Agricultural Organisation
FFS	Farmer Field School
FGD	Focus group discussions
FITCA	Farming in tsetse controlled areas
FMCC	Funyula Milk Collection Centre
g/dl	Grams per deci-litre
GoK	Government of Kenya
GPS	Global Positioning System
ha	Hectare(s)
IAEA	International Atomic Energy Agency
IBAR	Inter-African Bureau for Animal Resources,
ICPTV	Integrated Control of Pathogenic Trypanosomes and their Vectors
IDS	Institute for Development Studies
IIED	International Institute for Environmental Development
IIRR	International Institute of Rural Reconstruction
IK	Indigenous Knowledge
ISNAR	International Service for National Agricultural Research
IT	Intermediate Technology
ITDG	Intermediate Technology Development Group

KAP	Knowledge, attitude and practices
KBC	Kenya Broadcasting Corporation
KIE	Kenya Institute of Education
LID	Livestock In Development
NARS	National Agricultural Research Systems
NGO	Non-governmental organisations
OAU	Organisation of Africa Unity
PA	Participatory Approaches
PAAT	Programme Against African Trypanosomiasis
Para-vet(s)	Para-veterinarian(s)
PCV	Packed cell volume
PRA	Participatory Rural Appraisal
PRM	Participatory Research Methodologies
RRA	Rapid Rural Appraisal
RTTCP	Regional Tsetse and Trypanosomiasis Control Programme
SAP	Structural adjustment programmes
SHG	Self-help group
SSI	Semi-structured interviews
T&V	Training and visit
TBD	Tick-borne disease(s)
ToT	Transfer of technology
Vet(s)	Veterinarian(s)

1 Chapter I: General introduction

1.1 Introduction

Agriculture is the mainstay of the economy of many sub-Saharan African countries including Kenya, in which the small-scale farming sector plays an important role in food production. In general, small scale farms (below 5ha) occupy about 90% of the land under agriculture (Masai, 1998). Livestock play a significant role in the livelihoods of the farming communities in rural Africa; they provide food and food products for home consumption and are a major feature in the farming systems practiced by the poor in terms of use of draught power and manure (Okali, 1992). Therefore, factors that affect the health and productivity of livestock are important constraints in the development and wellbeing of such communities. Livestock in Development (LID) (1999) estimates that approximately one billion households in developing countries rely on livestock production for food and security, and Ateneh (1989) puts the value of commodity output of livestock production in sub-Saharan Africa at an equivalent of 25% of the total food production. In Kenya, it is estimated that the livestock production sector contributes approximately 30% towards the agricultural Gross Domestic Product (GDP) and 10% towards the overall GDP (LID, 1999; Omore *et al.*, 1999).

Livestock production is, however, constrained by livestock diseases; FAO (1990) estimates that diseases reduce livestock products outputs by approximately 30%, a proportion that is twice that observed in developed countries. Major endemic diseases that impact on livestock production resulting in losses such as low productivity and death include trypanosomiasis, tick-borne diseases and helminthiases (Grandin *et al.*, 1991).

Trypanosomiasis caused by *Trypanosoma brucei*, *T. congolense* and *T. vivax*, and cyclically transmitted by the tsetse fly (*Glossina* spp.) vector, is considered to be the most important disease constraint to livestock production on the African continent, preventing full use of the land to feed the rapidly increasing human population (Murray and Gray, 1984; Murray *et al.*, 1991; Winrock International, 1992). The disease is most important in cattle but can cause serious losses in other domestic livestock including goats, sheep, pigs and camels (Stephen, 1986). Infection of cattle by one or more of the three trypanosomes results in sub-acute, acute, or chronic disease characterized by intermittent fever, anaemia and rapid loss of condition and often terminates in death. Morbidity and mortality due to trypanosomiasis is estimated to cost Africa US$4.5 billion a year (Budd, 1999). The presence of other endemic parasitic diseases exacerbates the situation in tsetse and trypanosomiasis endemic areas through secondary infections resulting from the immunosuppressive effects in trypanosome infected livestock. The supply and value of animal products and contribution of livestock to crop production is severely compromised in tsetse-infested areas of Africa through the effects of bovine trypanosomiasis. The presence of trypanosomiasis reduces the observed cattle density by 37%-70%, and the off-take of meat and milk by about 50%; calving rates and calf mortality are both reduced by up to 20% (Swallow, 2000).

Both cattle density and the integration of cattle and crops, as assessed by percentage of land cultivated (derived from aerial photographs) are closely associated with the presence of the disease (Hendrickx, 1998). In mixed farming systems where trypanosomiasis is so severe that it constrains the number of oxen that farmers own, it can reduce the average area planted per household by as much as 50% (Swallow, 2000). Kristjanson *et al.* (1999) estimate the indirect annual costs of tsetse-transmitted trypanosomiasis to livestock producers at US$1340 million across the whole of Africa.

1.2 Problem statement

Tsetse-transmitted bovine trypanosomiasis is endemic in 37 sub-Saharan African countries including Kenya. The only drugs that are used to control trypanosomes in cattle are trypanocides, namely isometamidium chloride and homidium chloride or bromide which have both therapeutic and prophylactic properties, and diminazene aceturate which only has therapeutic properties. Other control measures against trypanosomiasis involve targeting the tsetse fly vector, but to be effective, these measures require to be conducted at an area-wide and not individual level. Vaccination against trypanosomiasis has proved elusive, thus, individual control heavily relies on chemotherapy and chemoprophylaxis.

Historically, trypanocides were made available to farmers only through government veterinary departments. However, the current environment of liberalised economies and privatisation of veterinary services has meant that many veterinary pharmaceuticals including trypanocides are now directly available to farmers through local agro-veterinary traders and the informal sector. Unfortunately, this increased availability of trypanocides to farmers has also meant that there is an associated rise in the risk of misuse and overuse of the drugs. Trypanocidal drugs are reported to be the most widely used control measure against trypanosomiasis in most of sub-Saharan Africa (Leach and Roberts, 1981; Holmes and Torr, 1988; Jordan, 1992). They are often the first drug of choice to treat an animal showing any clinical signs without an accurate diagnosis in areas of varying degrees of tsetse challenge (Mdachi, 1999; Van den Bossche *et al.*, 2000). Trypanocides are not effective against other diseases and, therefore, require careful targeting in order to minimise wastage and to increase efficacy; however, the exception to this is diminazene aceturate which is also effective against babesiosis.

Trypanosomiasis is a difficult disease to diagnose at the farm-level without recourse to laboratory diagnostic tools due to the presence of other endemic vector-borne parasitic diseases that present similar clinical signs. Unfortunately, small-scale farmers and their local animal health workers do not always have access to parasitological diagnostic equipment in rural Africa, and therefore, have to rely on clinical signs of the sick animal to arrive at a diagnosis. Clinical diagnosis of trypanosomiasis is not made any easier, however, because it lacks pathognomonic signs. This means that skills in differential diagnosis need to be acquired in order to confidently narrow down the range of diseases that might possibly be affecting an animal. There is some documented (Kamara *et al.*, 1995; Kamuanga *et al.*, 1995; Doran and Van den Bossche, 1998; Van den Bossche *et al.*, 2000) and anecdotal (Murilla *et al.*, 1998; Sinyangwe *et al.*, 1998) evidence that farmers are unskilled at differential diagnosis and lack the expertise (or knowledge) in use of trypanocidal drugs.

Concerns about development of drug resistance in pathogenic trypanosomes have been raised (Sutherland and Holmes, 1991), with reported cases in at least 13 countries (Peregrine, 1994; Geerts and Holmes, 1998). However, these reports refer to isolated cases and the scale of the problem is not widely known (Eisler *et al.*, 1994; Geerts *et al.*, 2001). This is of considerable concern as there are no indications of new trypanocides being developed to fight this scourge in the foreseeable future. International pharmaceutical companies are reluctant to commit themselves to the development of new trypanocides due to the relatively limited market in Africa, coupled with the high cost of developing and licensing new drugs. Hence, it is imperative to safeguard the efficacy of these drugs by preventing, or at the very least, delaying the onset of parasite resistance to them.

Misuse of drugs by underdosing is thought to contribute towards the development of drug resistant trypanosomes (Geerts and Holmes, 1998). On the other hand, overuse or frequent treatment of cattle with trypanocides increases the risk of drug toxicity, especially when animals are in poor body condition (Stevenson *et al.*, 1993). More efficient and appropriate use of these products is therefore essential to improve livestock performance through trypanosomiasis control and prolong the efficacy of the products. The livelihoods of the small-scale farmers, in turn, will improve through enhanced supply and value of animal products and increased contribution of livestock to crop production.

For effective farm-level control of bovine trypanosomiasis, it is essential that livestock owners use trypanocidal drugs appropriately. There is a need to steer farmers towards practices that will avoid, or at least delay, the onset of trypanocidal drug resistance as well as drug toxicity through overuse. Agricultural extension – which Bolliger *et al.* (1998) defines as 'giving knowledge, motivating, enabling and providing insights, and ultimately joining in a common task' – should be used in the education of stakeholders for improved drug usage, which is imperative if productivity under trypanosomiasis challenge is to improve. This is particularly important in rural mixed crop-livestock production systems of western and coastal Kenya, where prevalences of bovine trypanosomiasis of up to 40% have been reported in recent studies (Angus, 1995; Murilla *et al.*, 1998; Mdachi, 1999). It is also especially important in the current environment of privatisation of veterinary services, since it has led to the drugs becoming increasingly available directly to farmers and informal agro-veterinary traders who are mostly untrained in their use (Bett, 2001).

Farmer-first approaches to communication have recently been advocated for by researchers and extensionists. Research messages are likely to have limited impact if they have restricted technical themes because it restricts the farmer's choice and ignores the fact that rural populations are heterogeneous in terms of motivation and available resources (Okali *et al.*, 1994). There is also the problem of how information is presented to the farmers. Chambers (1989) recommends the 'farmer-first' approach whose main objective is not to transfer technology, but to encourage farmers to learn and adapt through discussion and analysis of ideas with extensionists or field assistants. The information is presented as a series of choices from which farmers may select based on the needs and circumstances articulated by the farmer. While accepting the desirability for research to be conducted on-farm, it is not a realistic option with 'disease-diagnosis-treatment' studies where the survival of the animal is threatened. However, certain principles of the 'farmer-first' approach can be utilised. Bauer and Snow (1998) suggest training for key representatives of stakeholder groups such as farmers' associations using visual aids or leaflets explaining the proper use and dosage of drugs thus increasing their technical competence. In a cost-recovery scheme in Togo, trypanosomiasis control was approached economically and financially sustained by the beneficiaries (Bastiaensen *et al.*, 1997); cattle owners themselves undertook control operations, but they were coached by project field personnel and private veterinarians (vets) to ensure timeliness and correct block treatment of cattle. Planning for changes in the ways that farmers and animal health assistants use trypanocides will require insight into their present practices. There is a need to understand these animal health management practices if campaigns for disease control involving the participation of the affected farming communities are to be successful.

While it is apparent that farmers are increasingly providing veterinary care to their own livestock, there is not much information available on the scope of the problem in sedentary or small-scale farming communities in trypanosomiasis endemic areas. On the other hand, there is a fair amount of documented information about veterinary care provision in arid and semi-arid lands where pastoral livestock production systems predominate (Kajume, 1998; Catley, 2000; Catley, 2002; Catley and Leyland, 2001), but very few in sedentary mixed crop-livestock production systems.

A lot of the agricultural development activities that take place in the settled areas tend to be focused on crop production, a trend which is widely reflected in the literature. Where programmes have focused on livestock production in settled communities, the activities have largely been oriented towards promoting use of exotic breeds, or at least crossing the indigenous livestock with exotic breeds as they are regarded to be more productive than the indigenous ones. These activities have often neglected the farmers who own indigenous livestock as there does not appear to be any special programmes geared towards improving the productivity of these local animals. Ironically, this group of sedentary livestock farmers is larger than the group of farmers who own pure exotic breeds or cross-bred livestock.

1.2.1 Specific problems addressed by the thesis

Planning for changes in the ways in which farmers, extension workers with no veterinary training and frontline (or primary) animal health workers use trypanocides requires insight into their current practices. Communicating animal health information to the farmers will better equip them to meet animal health challenges that were traditionally handled on their behalf by the state. To achieve this, it is imperative that appropriate data is collected and analysed. Therefore, an attempt was made in this thesis to address the following specific problems:

1. Lack of empirical evidence of the major factors that influence small-scale farmers' trypanosomiasis knowledge and the impact this has, if any, on their veterinary treatment-seeking patterns, and ultimately on the extent of the problem of trypanosomiasis control. Further to this, there is a need to explore the veterinary treatment-seeking patterns, themselves, in order to highlight the obstacles, if any, that hinder disease control (other than knowledge of inadequate formal veterinary service provision).

2. Lack of parasitological methods for trypanosomiasis diagnosis to farmers or, indeed, to primary animal health workers. There is a need for promoting thorough physical examinations of sick livestock in order to have as much information as possible of the ailment to better target medications and thereby minimise indiscriminate use of trypanocides on conditions that they have no effect against. To this end, it is necessary to have a full understanding of the

range of clinical signs shown in endemic disease conditions present in the study sites that have some bearings on management of trypanosomiasis cases. An understanding of the farmers' perceptions of trypanosomiasis in relation to other diseases is thus required.

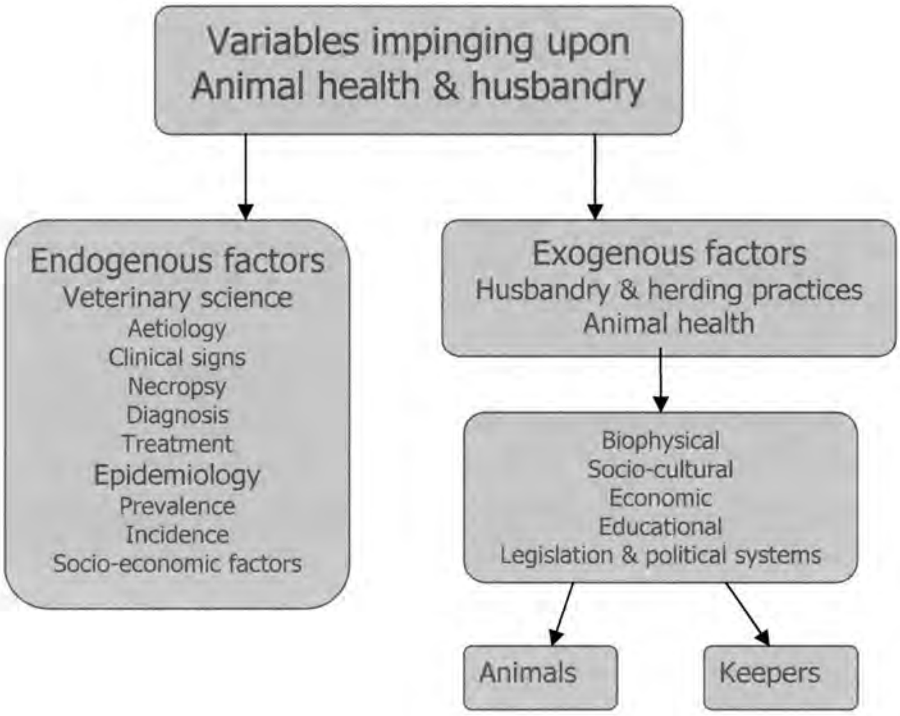
3. Lack of information on significant communication networks and patterns of access to them, if present, by livestock producers in the study sites. To arrive at the stage where trypanosomiasis management information can be disseminated to farmers, an understanding of the patterns of their communication networks needs to be gained beforehand. Any possible differences that exist between networks of men and women and other social indicators through which information and materials flow need to be investigated for successful planning of a communication intervention.

4. Lack of extension materials appropriate for use by farmers who are literate or semi-literate. Much of the literature on animal health is in a format that is most suited to researchers, academics, technical staff and development workers. This literature exists in form of text books, journal articles, newsletters, booklets/pamphlets and leaflets; it contains technical jargon and symbols that most lay people would not be able to understand, or are explained in a way that they cannot relate to. Therefore, there is a need to develop and design appropriate media formats and investigate sustainable pathways through which to disseminate the key clinical signs that farmers can look out for in order to decide whether an animal is likely to be suffering from trypanosomiasis or not before it is given any medicine; or at the very least, to minimise the circumstances under which trypanocides are misused or overused.

1.2.2 Conceptual framework for the thesis

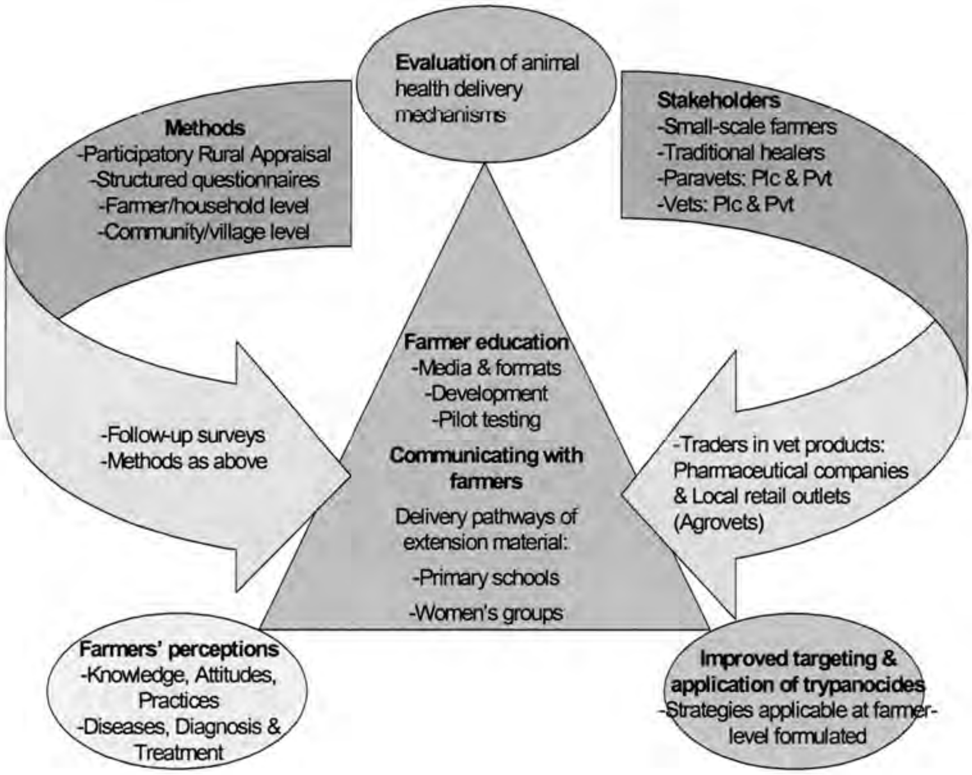
Busia and Kwale Districts are tsetse infested areas and are endemic to animal trypanosomiasis. High prevalences of trypanosomiasis have been recorded previously in both districts. Animal health and husbandry exists within the interplay of variables that impinge upon it, namely exogenous and endogenous factors. Endogenous factors pertain to the domain of veterinary science *per se*, whereas exogenous factors embrace all husbandry and herding operations with implications for animal health (Figure 1.1).

Figure 1.1: Factors that impinge upon animal health and husbandry practices



The studies presented in the thesis, therefore, try to examine which ones of these factors play a significant role on the knowledge, attitudes and practices (KAP) of the farmers in the study sites in an attempt to provide answers to the specific problems outlined above. The broad objective was to develop and design appropriate information for diagnosing and treating trypanosomiasis targeted at poor small-scale farmers who lack animal health information and services. The schema presented in Figure 1.2 shows an overview of the thesis activities and methodologies which were designed to be interactive such that data obtained in each study may be supplementary and complementary to each other.

Figure 1.2: Interactive study design and activities for the thesis



1.3 Hypotheses to be explored

The studies presented in the thesis were guided by the following hypotheses:

1. Small-scale farmers have limited knowledge of bovine diseases and how to manage them. Their limited knowledge, attitudes and practices towards these diseases may have an influence on their (inappropriate) usage of trypanocidal drugs.

2. Farmers' veterinary treatment-seeking patterns are influenced by their social characteristics and the biophysical factors of the diseases. Their approach towards management of bovine trypanosomiasis may be different to that taken when other diseases are perceived to be affecting their cattle.

3. Farmers have difficulties in differentiating trypanosomiasis from other vector-borne haemoparasitic diseases. On-farm disease differential diagnosis may be

enhanced by performing thorough physical examinations and making keen observations of clinical signs of sick animals.

4. Sedentary small-scale farmers in rural and peri-urban areas are involved in crop and livestock production to varying degrees of combination of the two enterprises. This results in their having complex agricultural information and communication networks which may, in turn, have an influence on their understanding of livestock disease transmission and specificity of veterinary drugs against these diseases.
5. Targeting appropriate trypanosomiasis messages to small-scale farmers and school children will improve knowledge of trypanosomiasis and its management during a community education campaign. Disseminating this information through school children may be effective and might enhance information uptake within communities.

1.4 Thesis outline

The thesis presents an assessment of the animal health and management practices of small-scale livestock farmers in tsetse and trypanosomiasis endemic areas of western and coastal Kenya within the context of primary animal health care. It also provides possible solutions to enhance primary animal healthcare in these communities.

The present chapter has focused on introducing the problems associated with providing quality primary animal health care on sedentary small-scale farms in trypanosomiasis endemic areas. The literature review is presented in Chapter II and expands on the issues discussed above. A description of the study sites using secondary data sources, selection of study households and participatory research methodologies are given in Chapter III.

The substantive research chapters commence with Chapter IV which provides data on farmers' perceptions of bovine diseases including trypanosomiasis and their animal healthcare-seeking behaviour. Chapter V investigates the specific problems associated with on-farm trypanosomiasis diagnosis and compares clinical information provided by farmers and that objectively collected by researchers and trained local animal health workers.

As the initial studies were the basis for preparing trypanosomiasis messages targeted at cattle-keeping farmers, it was important to collect data to understand the main agricultural communication networks of the study villages. Chapter VI is, therefore, devoted to assessing farmers' knowledge sources and information dissemination pathways. This then leads into Chapter VII which provides data from an impact assessment survey of a community education campaign trial that was conducted in the study villages.

The final chapter is composed of the general discussion and recommendations including a consideration of the external environment in which the smallholder farming community must respond to. This chapter assembles and puts into perspective the major findings from each research chapter and assess the relevance of the whole research.

2 Chapter II: Literature review

2.1 *Tsetse-transmitted trypanosomiasis*

African animal trypanosomiasis (AAT) is a disease complex caused by tsetse-fly-transmitted *Trypanosoma congolense, T. vivax*, or *T. brucei brucei*; mixed infections with one or more of these trypanosomes are known to occur (Nyeko *et al.* 1993; Mwangi *et al.*, 1998). Cattle infected by one or more of these trypanosomes manifest the disease as subacute, acute, or chronic, which is characterized by intermittent fever, anaemia, rapid loss of body condition and may terminate in death if untreated (Urquhart *et al.*, 1987). In southern Africa the disease is known as nagana (Bruce, 1895), which is derived from a Zulu term meaning "to be in low or depressed spirits", whereas the widely used term 'tsetse' is the word of the Tswana tribe of Botswana for the vector.

2.1.1 Transmission

The tsetse fly is the vector for *Trypanosoma congolense, T. vivax*, and *T. brucei brucei*. These trypanosomes undergo cyclical replication in the tsetse fly and are transmitted through tsetse fly saliva when the fly feeds on an animal (Soulsby, 1982, Urquhart *et al.*, 1987; Figure 2.1). The mammal infective forms of the parasites, the metacyclic trypanosomes, multiply at the site of inoculation into typical blood forms; this process results in the formation of a raised cutaneous inflammatory swelling called the chancre (Urquhart *et al.*, 1987). The three main subgenera of tsetse flies for transmission of trypanosomes are *Glossina morsitans*, which is found predominantly in the open woodland of the savannah; *G. palpalis*, which prefers the shaded habitat immediately adjacent to rivers and lakes; and *G. fusca*, which favours the high, dense forest areas (Mulligan, 1970). Although the grouping of *Glossina* subgenera generally follows their favoured habitats, it is in reality based on the morphology of their genitalia.

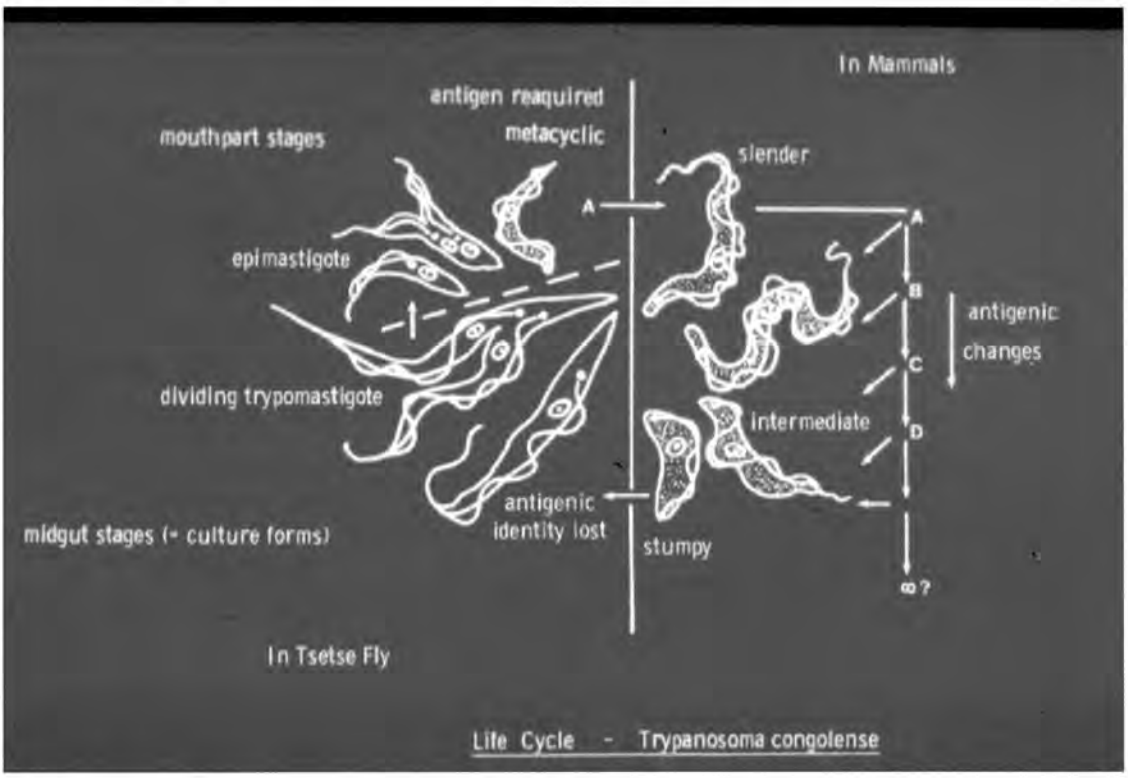
The incubation period varies between trypanosomes, with *T. b. brucei* having the shortest duration from 5 to 10 days; *T. congolense* takes as long as 4 to 24 days and *T. vivax*, from 4 to 40 days (Stephen, 1986).

2.1.2 Aetiology: the trypanosome organisms

African animal trypanosomiasis is caused by parasitic organisms known as *Trypanosoma* which belong to the protozoa subkingdom (Levine *et al.*, 1980).

Trypanosoma congolense belong to the subgenus *Nannomonas*, a group of small trypanosomes (9-22 μm long) which present a medium-sized marginal kinetoplast, no free flagellum, and a poorly developed undulating membrane in stained blood smears (Soulsby, 1982; Uilenberg, 1998). The other characteristics of *T. congolense* are their sluggish movements in wet blood films, and they usually adhere to red blood cells by the anterior end. In East Africa, *T. congolense* is considered to be the single most important cause of AAT. This trypanosome is also a major cause of the disease in cattle in West Africa. Sheep, goats, horses, and pigs may also be seriously affected. In domestic dogs, chronic infection often results in a carrier state (Stephen, 1986).

Figure 2.1: Cyclical transmission of *Trypanosoma congolense*



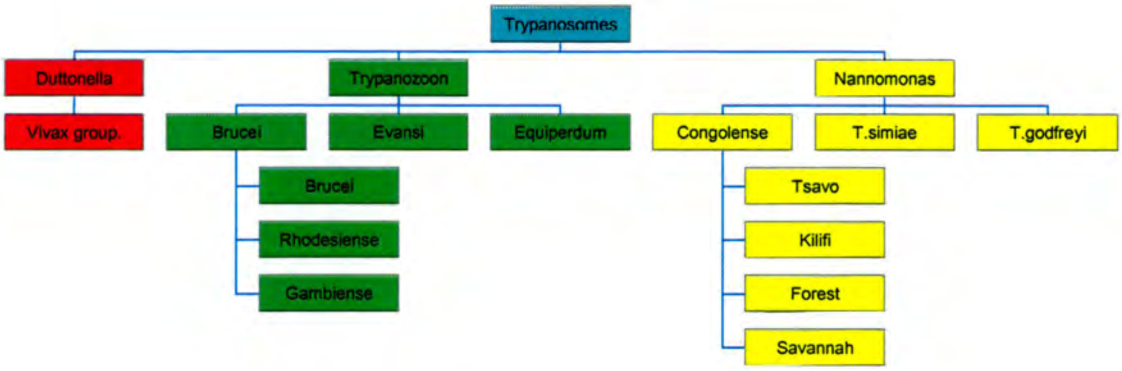
Source: Ian Maudlin

Trypanosoma vivax is a member of the subgenus *Duttonella*. This group of trypanosomes have large terminal kinetoplasts, distinct free flagella, but no prominent undulating membranes. *T. vivax* is a long and slender (18-26 μm long) organism that is very active and fast moving in wet blood films (Soulsby, 1982; Uilenberg, 1998). Cattle, sheep, and goats are primarily affected. Although this organism is considered to be less pathogenic for cattle than *T. congolense*, it is nevertheless the most important cause of AAT in West African cattle. *T. vivax* can be maintained in the absence of tsetse flies (for example, in the Sahel regions of Africa, Central and South America and in the Caribbean), through mechanical transmission by biting flies (e.g. *Tabanus*, *Stomoxys*, heamatophagus diptera) or contaminated needles, syringes, and surgical instruments (Ford, 1964; Wells, 1972).

Trypanosoma brucei brucei resides in the subgenus *Trypanozoon*. It is an extremely polymorphic typanosome occurring as short, stumpy organisms without flagella, long slender organisms with distinct flagella, and intermediate forms that are usually flagellated. Horses, dogs, cats, camels and pigs are very susceptible to *T. b. brucei* infection. Infection in cattle, sheep, goats and occasionally pigs is usually mild, and is therefore regarded as essentially non-pathogenic in animals with the exception of dogs where severe illness results (Mulligan, 1970). Cattle, however, are considered to be reservoirs for the human form of trypanosomiasis, sleeping sickness (Onyango *et al.*, 1966; Hide *et al.*, 1997; Welburn *et al.*, 2001a, 2001b). Moulton and Sollod (1976), however, earlier challenged this widely accepted view of low pathogenicity of *T. b. brucei*, citing evidence that this organism can cause serious disease and high mortality in cattle, sheep, and goats.

The relationship to each other of the different trypanosomes described above is presented in Figure 2.2.

Figure 2.2: Classification of pathogenic African trypanosomes



Source: Adapted from Uilenberg, 1998

2.1.3 Epidemiology of bovine trypanosomiasis in sub-Saharan Africa

High trypanosome prevalences have been recorded in several tropical African countries. Parasitological prevalences ranging from 10% to 53% have been recorded in eastern Zambia (Machila *et al.*, 2001); average prevalences of 1-10% in different zones in Kénédougou Province of Burkina Faso have been recorded (McDermott *et al.*, 2003) and 38% in coastal Ghana (Turkson, 1993). Similar levels of trypanosome prevalences have been observed in East African countries. In western Kenya, prevalences of up to 40% have been recorded in various cross-sectional trypanosomiasis surveys (Angus, 1995; Murilla *et al.*, 1998); earlier trypanosomiasis investigations in coastal Kenya showed a 30% prevalence of *T. vivax* infections in cattle (Mwongela *et al.*, 1981); more recently, trypanosomiasis studies also conducted in coastal Kenya by Mdachi (1999) revealed prevalence levels ranging from 11%-53% on Galana Ranch and up to 30% on the south coast. The Ugandan situation is no different in that high trypanosomiasis prevelences have also been recorded (Connor and Halliwell, 1987; Magona *et al.*, 1997). Mortalities due to *T. vivax* have been reported in Somalia (Dirie *et al.*, 1989).

Prevalence and distribution of trypanosomiasis is determined by tsetse densities (Leak *et al.*, 1993; Hendrickx *et al.*, 2000). Other determinants include season and management systems. Extensively managed livestock tend to have high prevalences of trypanosomiasis (Kalu, 1995); in Sudan, high trypanosomiasis prevalences have been reported in migratory herds of cattle (Hall *et al.*, 1983). Mortality due to trypanosomiasis has been observed to be at it's greatest at the end of the long dry season and in the early rainy season which coincide with the period when nutrition is at its poorest (Hornby, 1952).

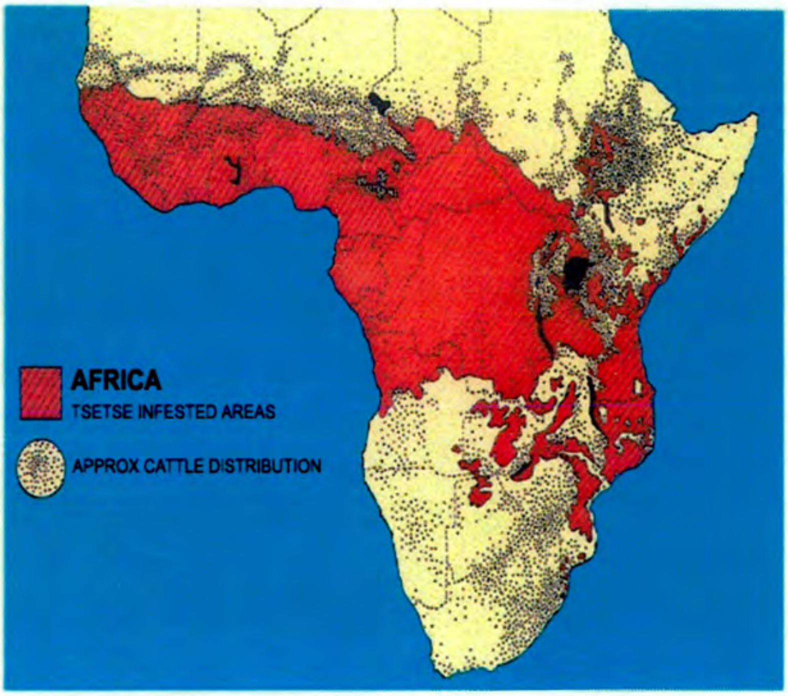
2.1.3.1 Zoonotic implications

The three African animal trypanosomes (AAT) are considered to be non-pathogenic for humans. *Trypanosoma brucei brucei*, although not causing human disease, is closely related to the two human-infective trypanosomes, *T. b. gambiense* and *T. b. rhodesiense* (Figure 2.2). Human sleeping sickness is a very debilitating and often fatal disease considered to be of major public health significance in 36 sub-Saharan countries of western, central, and eastern Africa, with 50 million people at risk (Nyeko *et al.*, 1990; Kuzoe, 1991; WHO, 1998). In West and Central Africa, a chronic form of human sleeping sickness is caused by *T. b. gambiense*; humans are its major hosts, but it also infects pigs (Okuna *et al.*, 1986; Waiswa *et al.*, 2000; Waiswa *et al.*, 2003). In East and Southern Africa, *T. b. rhodesiense* causes a much more acute form of human sleeping sickness (Hide *et al.*, 1996; Fèvre *et al.*, 2001; Welburn *et al.*, 2001a, 2001b). This trypanosome also infects cattle, bushbuck, and many other wild animals that are considered to be reservoirs of the parasite (Onyango *et al.*, 1966; Hide *et al.*, 1996; Fèvre *et al.*, 2001; Welburn *et al.*, 2001a, 2001b).

2.1.4 Geographic Distribution

The tsetse-fly-infested area of Africa extends from the southern edge of the Sahara desert (latitude 15° North) to Angola, Zimbabwe, and Mozambique (latitude 20° South) (Figure 2.3). Of the three African animal trypanosomes, only *T. vivax* occurs in the western hemisphere in at least 10 countries in the Caribbean and South and Central America. Tsetse-transmitted trypanosomiasis generally follows the distribution of the vector on the continent, and the type of trypanosome predominant in a region is in turn dependent on the *Glossina* spp. responsible for the transmission. Subgenera of *Glossina* are limited to certain regions, and their geographic distribution is determined principally by their different climatic and host requirements. In general, the climatic conditions created by the equatorial rain forest controls the habitats favoured by *G. fusca* and *G. palpalis*, and the drier savannah woodlands are inhabited by *G. morsitans*, (Mulligan, 1970; Jordan, 1986; Leak, 1999). Despite having these natural habitats, *Glossina* spp. have been known to invade human cultivated vegetation. *Glossina pallidipes* and *G. austeni* were found in mango and coconut plantations at the Kenyan coast (Snow and Tarimo, 1983).

Figure 2.3: Tsetse (*Glossina* spp.) distribution



Source: http://www.iaea.or.at/worldatom/Press/Focus/Tsetse/

2.1.5 Pathogenesis

Initial replication of trypanosomes is at the site of inoculation in the skin; this causes a swelling known as a chancre (Emery *et al.*, 1980). Trypanosomes then spread to the lymph nodes and blood and continue to replicate (Akol and Murray, 1982). *Trypanosoma congolense* attach to the endothelial cells of small blood vessels and capillaries. *Trypanosoma brucei brucei* and *T. vivax* invade body tissues resulting in extensive tissue damage. Antibody immune response to the glycoprotein coat of the trypanosomes develops; it kills the trypanosomes and results in the development of immune complexes causing inflammation which contributes to the signs and lesions observed in the disease. Antibodies, however, do not clear the infection as the trypanosomes have multiple genes that code for variable surface glycoproteins (VSG) that are not susceptible to the immune response. Thus, this antigenic variation causes a persistent infection that results in a continuing cycle of trypanosome replication, antibody production, immune complex development, and formation of VSG (Hudson and Terry, 1979). These continuous cycles are manifested by fluctuating fever (Taylor and Mertens, 1999). Immunologic lesions are significant in trypanosomiasis, and it has been suggested that many of the lesions (e.g., anaemia and glomerulonephritis) in these diseases may be the result of the deposition of immune complexes that interfere with, or prevent, normal organ function. The most significant and complicating factor in the pathogenesis of trypanosomiasis is the profound immunosuppression that occurs following infection by these parasites. This marked immunosuppression lowers the host's resistance to other infections and thus results in secondary disease, which greatly complicates both the clinical and pathological features of trypanosomiasis.

2.1.6 Trypanosomiasis diagnosis

A diagnosis is the label given to a disease with certain clinical or pathologic characteristics applicable to a particular case (Radostits *et al*, 2000b). The word diagnosis is derived from the Greek *dia*, between, and *gignoskein*, to know. Its literal translation means 'to recognise a disease and to know the difference between it and other diseases'. Types of diagnoses include differential, tentative, presumptive, definitive and aetiological, patho-anatomic, open and undetermined (Radostits *et al.*, 2000b). A presumptive diagnosis is based on finding an anaemic animal in poor condition in a trypanosomiasis endemic area, whereas a definitive diagnosis is achieved by demonstrating the trypanosome parasites in wet blood films or stained blood smears. A differential diagnosis with other infectious (and non-infectious) diseases that cause anaemia and weight loss such as anaplasmosis, East Coast fever (ECF), babesiosis and malnutrition should be considered in regions where they are endemic at the same time as trypanosomiasis. Failure to compile a list for differential diagnosis generally leads to incorrect diagnoses (Cockcroft, 1999). A presumptive (or tentative) trypanosomiasis diagnosis can be made when animals are suspected to have been in contact with tsetse flies and based on the clinical signs.

Any disease condition requires that it is diagnosed in order to apply appropriate therapy. For trypanosomiasis in particular, a diagnosis is central to appropriate targeting and use of trypanocidal drugs as they are the only drugs that will clear the infection. It also helps to provide an accurate prognosis and to make recommendations for cost-effective control and prevention of new cases when groups of animals are at risk. Trypanosomiasis has no pathognomonic signs that would help to pinpoint a diagnosis, and therefore, requires a thorough knowledge of the history (presence of or contact with tsetse flies), common clinical signs, its differential diagnosis and its epidemiology in order to have confidence in making treatment decisions and recommendations.

2.1.6.1 Clinical diagnosis

Trypanosomiasis manifests itself in an acute and chronic form of disease. Clinical signs of acute bovine trypanosomiasis include anaemia, pyrexia, weight loss, abortion, and in the absence of treatment, death (Stephen, 1986; Holmes *et al.*, 2000). Cases progressing to a more chronic disease state may be characterised by anaemia, cachexia, poor productivity and infertility. Chronic trypanosomiasis associated with severe wasting of animals has sometimes been referred to as the "thin cow syndrome" (Dowler *et al.*, 1989). The clinical picture depends to some extent on the species of infecting trypanosomes, and the geographic location. Hyperacute disease associated with *T. vivax* may resemble an acute septicaemia or result in a haemorrhagic syndrome, cases of which may often be found dead. Outbreaks of this condition have been frequently reported in coastal Kenya (Mwongela *et al.*, 1981; Maloo, 1993) and in West Africa (Stephen, 1986). *Trypanosoma congolense* usually results in a more chronic condition that is nonetheless associated with poor productivity and frequently fatal. *Trypanosoma brucei* and *T. vivax* infection, particularly in East Africa, may result in milder disease (Jordan, 1986; Stephen, 1986, Olila *et al.*, 1997). Infection of cattle with *T. brucei* is nevertheless a cause for concern, since the domestic animal reservoir of these parasites is considered to be an important source of the *rhodesiense* form of sleeping sickness (Hide *et al.*, 1996).

Anaemia

The development of anaemia is a well recognised and inevitable consequence of trypanosome infections of cattle, in which measurement of anaemia gives a reliable indication of the disease status (Murray *et al.*, 1979; Murray and Dexter, 1988). Packed red-blood cell volume (PCV) is a commonly used parameter of the degree of anaemia, and is usually recorded in association with the buffy-coat technique (Murray *et al.*, 1977). Hendrickx (1999) used average PCV to investigate the close association between trypanosomiasis and cattle density and between trypanosomiasis and the integration of cattle and crops.

In many tsetse-infested areas, average PCV is itself closely correlated to trypanosome prevalence (Eisler and Holmes, 1998). Recent studies in the Eastern Province of Zambia show that 75% of cattle with trypanosome parasitaemias have PCVs less than 30%, whereas 75% of aparasitaemic cattle have PCVs above this value. These figures suggest that use of PCV as an indication for trypanocidal drug treatment would be a marked improvement over the current practice of farmers in this area (Doran and Van den Bossche, 1998) and indeed farmers in many areas of Africa (Swallow, 2000), who use trypanocidal drugs relatively indiscriminately and with little regard to prevalence of the disease.

Use of PCV may in fact be a better basis for treatment than parasitological diagnosis alone, although it should not be regarded as a definitive diagnostic test, and care must be taken in areas where other anaemia-causing conditions such as liver fluke are common (Bain, 1998). Other anaemia causing infectious diseases include anaplasmosis, babesiosis and East Coast fever (ECF); however, the level of anaemia caused by these afore-mentioned infectious diseases is not as severe as that observed from trypanosome infections (Molyneux and Ashford, 1983). Firstly, in the chronic phase of the disease, many infected cattle may be aparasitaemic, but nevertheless have low PCVs (Murray and Dexter, 1988). Secondly, some trypanosome-infected cattle may recover spontaneously, particularly if they are infected with parasites of low pathogenicity. Indeed, such cattle may develop a degree of resistance to infection particularly to *T. vivax* (Trail *et al.*, 1994). Finally, reduction in inappropriate drug usage has been advocated as a means to avoid development of trypanocidal drug resistance (Geerts and Holmes, 1998).

Unfortunately, measurement of PCV using the microhaematocrit method (normally performed in conjunction with the buffy-coat technique) requires expensive equipment including generators and centrifuges, as well as vehicles to transport them, and is rarely feasible outside the context of a well funded research project. Hence, it is not generally available to stakeholders in trypanocidal drug treatment of smallholder farmers' livestock. Use of the clinical appraisal of ocular mucous membranes has recently been used in the treatment of sheep infected with the blood-sucking nematode *Haemonchus contortus* (van Wyk *et al.*, 1997). This has led to the development of the Famacha©, a simple colour chart guide for farmers to be used as a basis for anthelmintic treatment. A simplified version of the colour chart has also been incorporated in the DFID/KARI Technical Manual of Integrated Helminth Control for diagnosis of liver fluke and haemonchosis (Bain, 1998). Preliminary investigations in Zambia have indicated a potential for use of the pallor of ocular mucous membranes in the assessment of anaemia in bovine trypanosomiasis (Machila, unpublished data). Other methods of assessment of anaemia which may be suitable for use at the animal health assistant level include simple colorimetric methods for haemoglobin determination such as the 'Lovibond 1000' comparator (Bush, 1975).

Cachexia

In the chronic stages of disease, bovine trypanosomiasis is a wasting condition (Plate 2.1), with progressive emaciation and cachexia becoming increasingly apparent (Stephen, 1986; Murray and Dexter, 1988). Tracey (1992) reviewed the role of the cytokine tumour necrosis factor (TNF-α) in the pathogenesis of septic shock and cachexia. Through the action of a number of secondary mediators this cytokine can induce a range of biological responses including the clinico-pathological manifestations of septic shock syndrome (not unlike peracute haemorrhagic *T. vivax* infection) and also chronic cachexic states such as occur in bovine trypanosomiasis. TNF-α together with other cytokines such as interleukin-2 and interferon has recently received increasing attention as an important immunological mediator in trypanosomiasis (de Baetselier, 1993).

Cachexia is a widely recognised feature of the disease under experimental and field conditions (Murray *et al.*, 1979; Murray and Dexter, 1988). For example, a thin cow syndrome described at Mkwaja Ranch in coastal Tanzania responded to trypanosomiasis control measures (Fox *et al.*, 1991).

A simple scoring system has been shown to be a repeatable and reproducible method of assessing body condition in cattle (Nicholson and Butterworth, 1986), and has been used extensively in studies into the epidemiology of trypanocidal drug resistance (Eisler and Holmes, 1998). This approach could be used to supplement the measurement of PCV for targeting of trypanocidal drug treatments, and has the advantage that no technology whatsoever is required making it highly appropriate for smallholder farmers.

Lympadenopathy

Swelling of superficial lymph nodes occurs in subacute cases of *T. vivax* infections, with the pre-scapular and pre-femoral lymph nodes being the most affected (Stephen, 1986). *T. congolense* infections usually have more obviously swollen lymph nodes compared to *T. vivax* infections.

Plate 2.1: Emaciated cow in tsetse-infested Busia District, Kenya

© Noreen Machila

2.1.6.2 Definitive and aetiological diagnosis

A definitive diagnosis of trypanosomiasis is reached based on parasitological findings by demonstration of the causal trypanosomes and associated clinical signs of the disease. Demonstration of trypanosomes may be attempted through direct methods, including wet blood films, Giemsa stained thick and thin blood films, the haematocrit centrifugation technique (Woo, 1970) in which trypanosomes are visualised in the buffy coat layer of a microhaematocrit centrifuge tube, and its subsequent modification, the phase contrast/buffy coat technique (BCT), in which the buffy coat is expressed from the microhaematocrit tube onto a glass slide and examined microscopically using phase-contrast or dark ground illumination (Murray *et al.*, 1977). Of these methods, the BCT is the most sensitive (Paris *et al.*, 1982). However, none of these methods are widely available to farmers or animal health assistants.

Sub-inoculation of blood from suspected cases of bovine trypanosomiasis into either clean cattle or laboratory rodents has been widely used as a research tool both for diagnosis and for isolation of trypanosome stabilates. However, it is generally time consuming and expensive, given the costs of maintaining suitable susceptible hosts in tsetse-free conditions, and not all trypanosomes are infectious for rodents (Godfrey and Killick-Kendrick, 1961; Robson and Ashkar 1972).

Serological tests for detecting exposure to trypanosomes exist; they include the immunofluorescent antibody test (Katende *et al.*, 1987) and the antibody enzyme-linked immunosorbent assay (ELISA) (Luckins, 1977; Hopkins *et al.*, 1998; Rebeski *et al.*, 2001; Machila *et al.*, 2001). The ELISA test is more suitable for large-scale epidemiological surveys and should not be used for making treatment decisions as presence of antibodies does not necessarily indicate current infection (Bocquentin *et al.*, 1990). An ELISA test for detection of circulating trypanosome antigens exists (Nantulya and Lindqvist, 1989), but has continued to show problems in its reliability of antigen detection (Eisler *et al.*, 1998). Advanced polymerase chain reaction techniques for detection of trypanosomes, but more suited to research use, are also available (Desquesnes, 1997; Solano *et al.*, 1998; Welburn *et al.*, 2002).

2.1.6.3 Patho-anatomic diagnosis

This is a diagnosis based on the pathological findings identifying the affected body system or organ and the morphological description of the lesions (Radostits *et al*, 2000b). The necropsy findings associated with *T. vivax* infections include splenomegaly due to response of haemopoietic system to anaemia resulting from haemolysis from trypanosomes, emaciation, pallor of organs, gelatinous atrophy of body fat and enlarged lymph nodes (oedematous and haemorrhagic). Those associated with *T. congolense* infections are similar but more severe; obviously anaemic blood, general pallor of viscera, extremely emaciated carcase. The lymph nodes become indurated and fibrotic and the spleen is invariably enlarged. The areas normally containing adipose tissue become depleted with a gelatinous texture of the remaining fat deposits.

2.1.6.4 Differential diagnosis

The chronic form of trypanosomiasis maybe confused with malnutrition and helminthiases, while the acute form maybe confused with East Coast fever (ECF), babesiosis, anaplasmosis, haemorrhagic septicaemia and anthrax (Radostits *et al*, 2000a, Stephen, 1986).

The distinguishing features for ECF include enlargement of superficial lymph nodes – these are not generalised as in trypanosomiasis but are restricted to the parotid and prescapular regions; the visible mucous membranes show petechiae signs which is not a common feature of chronic trypanosomiasis, but may be seen in acute haemorrhagic trypanosomiasis; respiratory distress and diarrhoea are the other key signs observed in ECF conditions.

The distinguishing features for anaplasmosis include signs of jaundice in the visible mucous membranes, extreme weakness and laboured breathing. In endemic areas, anaplasmosis is thought to flare up during conditions of stress such as may be caused due to trypanosomiasis. The major pathognomonic sign in babesiosis cases is blood in the urine (i.e. haemoglobinuria) – hence the term redwater disease; other signs such as anaemia can also be seen in babesiosis conditions as in trypanosomiasis, although the degree of severity is not as much.

Haemorrhagic septicaemia and anthrax might be confused with haemorrhagic trypanosomiasis in endemic areas because of the bleeding syndrome that is observed. Fascioliasis results in loss of body condition, but is not accompanied by lymphadenopathy unlike trypanosomiasis; submandibilar oedema may also feature in cases of fascioliasis. Parasitic gastroenteritis may cause anaemia but is usually accompanied by dysentery which is a useful (negative) indicator when differentiating it from trypanosomiasis. Schistosomiasis also exhibits anaemia and loss of body condition but can be distinguished from trypanosomiasis in that it also presents with diarrhoea tinged with blood and mucous. The state of malnutrition is common in tropical livestock especially during the dry season when availability of feed is scarce. The main feature is loss of body condition which will usually affect an entire herd or most of the livestock in an area, which is unlike an infectious illness where only some livestock will show this sign.

2.1.7 Control options for African bovine trypanosomiasis

Historically, trypanosomiasis control was mainly achieved by bush clearing and aerial-spraying with insecticides (Jordan, 1986). These historical methods aimed to eradicate the tsetse fly vector. The methods were found to be very expensive and environmentally unacceptable, and 'tsetse eradication' changed to 'trypanosomiasis control'. The basic approaches to modern trypanosomiasis control include passive control (or tsetse avoidance), trypanosome parasite control using chemotherapeutic and chemoprophylactic drugs, tsetse vector control, use of trypanotolerant livestock and integrated trypanosomiasis and tsetse control (i.e. a combination of the afore-mentioned methods). Most of these methods have been applied on an area-wide basis under international donor-funded programmes. However, there has been a shift in recent decades from the 'area-wide approach' to a 'community-based approach' (PAAT, 1999) as it has become increasingly difficult to control tsetse flies and trypanosomiasis because of the lack of investment in sustainable disease management programmes (Hursey, 1998). Failure of the top-down approach has meant that successful interventions in the control of bovine trypanosomiasis will be that of the cattle-owning farmer (Hursey, 1998 and Kamuanga, 2002). Currently available technologies targeted against the vector include insecticide spraying of tsetse habitats, insecticide impregnated traps and targets, insecticide-treated animals (live bait) and biological control (using the sterile insect technology); those targeted against the parasite include chemo-prophylaxis and chemo-therapy.

2.1.7.1 Trypanocidal drugs

Trypanocidal drugs remain the only widely available control method affordable by farmers. Currently available trypanocidal drugs for use in cattle are limited to the salts of just three compounds, diminazene aceturate (Berenil®; Veriben®; and various other generic formulations), homidium bromide (Ethidium®), homidium chloride (Novidium®) and isometamidium chloride (Samorin®/Trypamidium®; Veridium®).

There are two main strategies for the use of trypanocidal drugs in the control of bovine trypanosomiasis. Drugs may be used for the therapy of existing trypanosome infections, in which case they are termed chemotherapeutic, or alternatively drugs with a prolonged period of biological activity may be administered at intervals suitable to uninfected cattle at risk of becoming infected, in which case they are termed chemoprophylactic. Some drugs may be used for either purpose, although dose rates and routes of administration may be adjusted for the particular circumstances of use, while others, particularly those which are eliminated rapidly are limited to therapeutic use. Isometamidium chloride is the most widely used and efficacious chemoprophylactic drug, but also has chemotherapeutic activity. Homidium salts are used mainly for chemotherapy, but do have some prophylactic activity. Finally, diminazene aceturate is the most widely used chemotherapeutic agent, but has almost no prophylactic activity (Leach and Roberts, 1981).

Geerts and Holmes (1998) estimate that 35 million doses are administered each year, a figure consistent with the estimated amount of US$ 30 million spent annually by farmers (Borne, 1996), on the basis of a cost of approximately US$ 1 per dose (Swallow, 2000).

Numerous studies have demonstrated that cattle can be kept productively under tsetse challenge through the use of therapeutic and prophylactic trypanocidal drugs. Logan *et al.* (1984) demonstrated that Zebu-type cattle could produce beef in an area of West Africa infested with *G. palpalis gambiensis* and *G. morsitans submorsitans*. Ford and Blazer (1971) showed that drugs allowed susceptible cattle to be kept commercially in tsetse-infested areas, such as Mkwaja ranch in Pangani District of coastal north-east Tanzania, a commercial beef ranch infested with *G. morsitans morsitans*, *G. pallidipes*, *G. brevipalpis* and probably *G. austeni*.

One of the most comprehensive studies of the use of isometamidium prophylaxis was that of Trail *et al.* (1985), who examined a unique set of 10 years of matching productivity and health records from Mkwaja Ranch. The data set equated to 134 000 trait-years of new data, and amounted to approximately twenty times as much information on livestock productivity under chemoprophylaxis as had been available in the whole of Africa over the previous 25 years. Planned experiments demonstrated that cattle under challenge were unable to survive without trypanocidal drugs: untreated animals died or succumbed to predators. Isometamidium prophylaxis was shown to be clearly superior to chemotherapy using diminazene aceturate even in pre-weaning cattle in which isometamidium had not previously been used in large-scale commercial herds. Boran cattle at Mkwaja under isometamidium prophylaxis were 80% as productive as Boran cattle on trypanosomiasis-free ranches in Kenya, and 35% more productive than ranched trypanotolerant N'dama cattle under medium to high trypanosomiasis risk in West Africa. It was therefore concluded that profitable cattle ranching is possible in Africa in areas of high risk of trypanosomiasis through the use of isometamidium prophylaxis.

Another significant study on the use of trypanocidal drugs in the field was that of Bourn and Scott (1978), who described their use to control trypanosomiasis among 40 work-oxen introduced in 1972 to Angar-Gutin, a lowland area of south western Ethiopia for ploughing, traction and other purposes. This area is heavily infested with *G. morsitans submorsitans* and has a high trypanosomiasis challenge. Over the next five years, the success of the project, which relied on high standards of management and veterinary supervision, was such that the number of oxen introduced had increased to 450. Initially, diminazene was employed in a strategic curative regime, on average every 28 days, but later isometamidium prophylaxis was used successfully for the final three years of the study.

In a recent position paper on West African experiences in the control of animal trypanosomiasis, Bauer and Snow (1998) concluded that there are now the technical means to implement control mainly using drugs for improved animal health, supplemented where necessary with vector control. This conclusion was combined with the recommendation that chemotherapy be applied with the aim of reducing the incidence of trypanosomiasis and increasing the average packed red blood cell volume (PCV) to given target values referred to as a template. This template was termed the production opportunity set (POS) where a reasonable level of animal production can be expected if both values are within the given range. The use of trypanocides requires knowledge of the clinical signs of bovine trypanosomiasis to be effective and economical. Small-scale farmers' access to trypanocidal drugs has recently increased under the present environment of privatisation of public veterinary services (see section 2.2.2.2 below).

2.1.7.2 Trypanocidal drug resistance

With the increasing recognition that trypanocidal drug treatment will remain the mainstay of control of African bovine trypanosomiasis for the foreseeable future (Jordan, 1992; Doran, 2000), the development of resistance to the small number of available compounds is generally regarded as a cause for considerable concern. There has been some evidence of trypanocidal drug resistance in some studies conducted in eastern and southern Africa (Codjia *et al.*, 1993; Geerts and Holmes, 1998). Information on the actual extent and significance of the problem of drug resistance is not widely available. One reason for this is that methods for the detection of drug resistance are technologically demanding and expensive. Two DFID projects, Application of new technologies to the chemoprophylactic control of African bovine trypanosomiasis (R4653) and Field Evaluation and Application of Recently Developed Immunoassay Techniques for the Improvement of Chemoprophylactic and Chemotherapeutic Strategies for the Control of African Bovine Trypanosomiasis (R5955CB), have attempted to address this problem through the development of simpler methodologies. ELISA tests for the detection of trypanocidal drugs have since been implemented in a number of African veterinary laboratories (Eisler *et al.*, 1993; Eisler *et al.*, 1996), and have been used in field studies on the epidemiology, extent and significance of trypanocidal drug resistance in Kenya, Tanzania and Zambia (Mdachi, 1999; Eisler *et al.*, 2000; Delespaux *et al.*, 2002), Uganda (Olila, 1999) and Burkina Faso (McDermott *et al.*, 2003). Results indicate that drug resistance is indeed a problem to farmers in all countries that were studied, and that measures should be taken to retard its development. Moreover, these studies have highlighted the lack of understanding of correct usage of drugs at the level of stakeholders in the post privatisation scenario, which may itself be a major contributory factor to the development of drug resistance.

Whiteside (1958, 1961, and 1962) introduced the concept of "sanative pairs" of drugs; each of the two drugs comprising a sanative pair would be active against strains of trypanosomes resistant to the other drugs. The use of one member of the pair was recommended until resistant forms were detected, at which point the second member of the pair was substituted for the first, until the resistant strains had disappeared from both the cattle and the tsetse. The lack of cross reactivity between the diamidine, diminazene aceturate, and the phenanthridines homidium, prothidium, and metamidium suggested the suitability of diminazene with one of the phenanthridines for use as sanative pairs. With the withdrawal from the market of prothidium, the only sanative combinations currently available are homidium and diminazene, and isometamidium and diminazene.

Geerts and Holmes (1998), in their position paper on drug management and parasite resistance in animal trypanosomiasis in Africa, which was recently endorsed by the Advisory Group Co-ordinators of PAAT, recommended further guidelines to delay the development of drug resistance and measures which may be adopted to control drug resistance when it occurs. Although there is still a lack of knowledge about the mechanisms of resistance and the factors responsible for the development of drug resistance, urgent measures need to be taken to maintain the efficacy of the existing drugs. Based on the experience of the control of resistance to other drugs such as anti-malarials, antibiotics and anthelmintics it was suggested that reliance on the 'sanative pair' guideline might not be sufficient to control resistance to trypanocides. This guideline needs to be accompanied by other measures, i.e.:

- Avoidance of underdosing: Underdosing is an important cause of resistance development and commonly occurs in the field. Measures should be adopted to minimise the risks of underdosing. Better formulations of the existing prophylactic drugs may help to avoid the sub-therapeutic concentrations, which exert a strong selection pressure for resistant clones.

- Reduction in the number of treatments: The most efficient way to delay the development of drug resistance is to reduce the selection pressure by these drugs. Exclusive reliance on drugs for the control of trypanosomiasis especially in areas of high challenge and mass treatments at short intervals. More attention should be given to integrated control measures, involving the vector as well as the parasite.
- Quinapyramine should no longer be used in cattle: Cross-resistance with the other available trypanocides has now been clearly demonstrated at the level of individual trypanosomes. The use of this drug in cattle is therefore contraindicated.

2.1.7.3 Vector control

Historically, aerial and ground spraying were the major forms for tsetse control until the 1980s. These control efforts were managed by public funds. These methods have recently been brought into question because of undesirable environmental effects on one hand, and lack of funds to manage such large-scale programmes on the other hand. More environmentally friendly techniques in form of odour-baited traps and targets were developed to fight tsetse flies in response to these environmental concerns and consequent reduction in spraying. It was felt at the time of their introduction that they would lend themselves to community-based management. Unfortunately, this was not to be because of what has since been assessed as the 'public good' nature of tsetse control using traps/targets (Barrett and Okali, 1998). Other problems that became associated with this method of tsetse control was lack of maintenance of the traps, theft, damage from people, fire and reduction of attractant in the impregnated targets from rain water. There are also technical constraints to use of traps and targets in that they only offer a temporary reduction of tsetse fly populations whose numbers can increase again over time if trap and target use is not maintained.

Recently, there has been increased use of insecticide-treated cattle to control the tsetse flies, and the term 'live-bait' or 'moving targets' is sometimes used to describe this method (Leak *et al.*, 1995). The insecticides are synthetic pyrethroids that are available as a dip formulation or can be used as 'pour-ons'. Although synthetic pyrethroid treatment of cattle is becoming increasingly available at the farmer-level, their efficacy in tsetse control depends on community uptake (i.e. public good) and will be relatively ineffective unless all herds in an area are treated (Swallow *et al.*, 1995; Van den Bossche and Duchateau, 1998). Hence their direct "private good" benefits in terms of tick and nuisance fly control are probably more significant factors motivating farmers in their use. Moreover, they are not appropriate for tsetse control in all areas since their efficacy appears to depend on the relative spatial distribution of cattle and tsetse-infestation, and the proportion of tsetse blood-meals taken from cattle (McDermott, 1998; Hargrove, 1998). Recent data cast doubt over the persistence of some commonly used synthetic pyrethroids on cattle (Vale, 1998). Finally, concerns have been expressed that extensive use of synthetic pyrethroids on cattle may compromise control of ticks and tick-borne disease, either through accelerated development of tick populations resistant to this class of compounds (Beugnet and Chardonnet, 1995), or through loss of enzootic stability to tick-borne diseases (Norval *et al.*, 1992).

2.1.7.4 Trypanotolerant cattle

Farmers in West Africa have been keeping trypanotolerant cattle for centuries (Shaw and Hoste, 1987; d'Ieteren *et al.*, 1998). Increasing interest has been paid in recent years to the trypanotolerance trait in a number of cattle breeds, particularly the taurine breeds of West Africa such as the N'dama (Murray *et al.*, 1979). However, the trypanotolerant trait is not absolute, and cattle of trypanotolerant breeds may succumb to the effects of the disease under circumstances of stress, such as poor nutrition, overwork, intercurrent disease or particularly heavy tsetse challenge. Roelants (1986) analysed data from a number of experimental studies that compared the survival of Zebu and trypanotolerant cattle under different levels of natural tsetse challenge. Under conditions of light tsetse natural challenge, whereas 75% of Zebu cattle died, 98% of N'dama and cattle survived. However, under heavy natural tsetse challenge, overall mortality among Zebu cattle rose to 94%, and 31% of cattle of the trypanotolerant N'dama, Muturu and Baoulé breeds also died. The use of trypanotolerant livestock is thus often supplemented by the use of trypanocidal drugs in areas of heavy tsetse challenge (Roelants, 1986; Otesile *et al.*, 1991).

2.2 Socio-economic characteristics of trypanosomiasis control

Trypanosomiasis control, and indeed the control of other livestock diseases, is integrated within the delivery systems of veterinary services in Kenya and across much of sub-Saharan Africa. The delivery of veterinary services in Kenya has seen much change from colonial times up to an independent Kenyan government when they were delivered by the state, to the present times in which the role of the private sector is becoming increasingly recognised and accepted as a major player in the activities associated with provision of the services.

Traditionally, veterinary services were almost entirely provided by the public sector; these services were provided either free of charge or at highly subsidised levels (de Haan and Umali, 1992; Umali *et al.*, 1992; Mlangwa and Kisauzi, 1994; Holden, 1999; Tambi *et al*, 1999). Veterinary services were initially set up in Africa to control disease epidemics and these structures were maintained by many African governments to deliver a large range of animal health services. Many African governments have been undergoing structural reforms, and as a result, their priorities on the core obligations of the state have changed (FAO, 1997). The services that have been mainly affected by these structural adjustment programmes (SAP), which aimed to reduce public spending, are those whose activities are amenable to private sector provision, e.g. clinical treatments and the supply of veterinary pharmaceuticals and some extension activities (Ambruster, 1994; Farrington, 1994; FAO, 1997; Leonard, 2000). Hence, there has been a drastic reduction in budgetary allocations for animal health care and extension whilst maintaining the number of staff (Leonard *et al.*, 1999), and a more streamlined sectoral or systems approach to funding of development projects by donors either in partnership with state departments or directly with non-governmental organisations (NGOs) and research institutions. Therefore, similarities in funding crises have been observed between public provision of veterinary services (LID, 1996; Barrett, 1997; Holden, 1999, Leonard *et al.*, 1999) and agricultural extension services (Umali and Scwartz, 1994; Farrington, 1994; Alex *et al.*, 2002). The economic inefficiencies of most African governments have been blamed on the public sector's involvement in provision of many services including veterinary and extension services (Mlangwa and Kisauzi, 1994). Much debate has arisen in various fora and from evidence in published literature about recommendations targeted towards improvement and rationalisation of the delivery of veterinary services (Cheneau, 1985; Leonard, 1987; Leonard 1993; Leonard *et al.*, 1999; Umali *et al.*, 1992; Schillhorn van Veen and de Haan, 1995; LID, 1996; FAO, 1997) and in a similar vein the provision of agricultural extension services (Chambers, 1989; Farrington, 1994; Umali and Schwartz, 1994; Alex *et al.*, 2002). The major change recommended has been to privatise some of the services and products/goods provided by the public sector. To this end, the economic principles of excludability and rivalry (or subtractability) have been applied to encapsulate the natures of veterinary and agricultural extension activities (Figure 2.4) to determine whether their services and/or goods are in form of either a public or private good (Umali and Schwartz, 1994; Holden, 1999; Alex *et al.*, 2002), and therefore predict whether or not it would be profitable and sustainable for the private sector to invest in these activities. The term 'excludability' is used to convey a state of affairs where a consumer or provider of a service or good makes it unavailable for simultaneous use by others who thus cannot benefit from the same. On the other hand, the terms 'rivalry' or 'subtractability' are applied when use or consumption of a service or good by an individual reduces its availability to other people. Public goods are generally those whose excludability and rivalry are both low, where as private goods have high excludability and high rivalry. Van den Ban (2000) goes further and lists the areas in which extension services could be privatised.

In this view, livestock diseases have been categorised into epidemic (e.g. foot and mouth disease [FMD], contagious bovine pleuropneumonia [CBPP] and rinderpest), endemic (e.g. trypanosomiasis, helminthiases and ECF) and zoonotic (e.g. tuberculosis, brucellosis and trypanosomiasis [livestock reservoirs for human infective *T. b. brucei*]) diseases. In broad terms, the rationale for responsibility for disease control has been that epidemic diseases remain largely in the public domain as they are considered to be diseases of trade, and therefore, of greater economic importance if concerned governments wish to participate in wider international livestock markets. With respect to zoonotic diseases, their control also needs to remain a government priority because of public health implications, apart from the welfare of the livestock affected. Endemic diseases are increasingly regarded as production or management diseases, and thus, their control is considered to be a private good and should therefore be taken care of by the affected livestock owners; there is reason to believe that livestock owners are willing to pay for these services (de Haan and Bekure, 1991). Pure agricultural information intended to improve existing production and management practices is usually provided to farmers through traditional extension approaches and is therefore considered to be a toll good as its supply to a target group does not reduce its availability to other farmers. In the long-term, however, the diffusion to the rest of the community of the information originally given to a specific group of farmers renders it a public good (Alex *et al.*, 2002). The channel of communication used to disseminate information also determines whether it is private or public goods. Mass communication channels (public broadcasts, public distribution of published material) render the information supplied a public good by virtue of the medium. As such, provision of pure agricultural information is likely to remain a responsibility for the public or non-profit sectors. This balancing of public and private provision of veterinary services arise from a recognition that some situations as illustrated in Figure 2.4 require both public and private inputs (Armbruster, 1994; Umali *et al.*, 1994) and also where community development efforts must ensure equity in farmers' access to animal health services (Ross, 1992).

Figure 2.4: Economic characteristics of veterinary inputs and agricultural information and technologies

		Excludability	
		Low	**High**
RIVALRY (or subtractability)	**Low**	**Public goods** *Public funding* - Epidemic or zoonotic disease control (including surveillance, movement control, quarantine services) - Control of food borne diseases - Drug quality control - Mass media information - Time insensitive production information, management information of wide applicability - Some research	**Toll goods** *Private finance* - Vaccine production - Diagnostic services - Veterinary clinics - Dips - Time sensitive production information, management information of wide applicability
	High	**Common pool goods** *Public funding* - Tsetse control on communal land using traps, targets or aerial spraying - Information embodied in locally available resources or inputs - Information on organisational development	**Private goods** *Private finance* - Enzootic disease prevention and control - Sales of drugs and vaccines - Some extension - Some research - Information embodied in commercially available resources or inputs - Client specific information or advice

Sources: adapted from Umali and Schwartz, 1994; Holden, 1999; Alex *et al.*, 2002

Scarce resources, over-staffing and lack of motivating incentives for staff have rendered the delivery of livestock health and production services inadequate (Holden, 1999; Leonard *et al.*, 1999). The activities of private veterinary enterprises have seen an increase in urban and some peri-urban areas, while the rural areas have virtually been left un-serviced by the private vets (Mlangwa and Kisauzi, 1994), which is an unfortunate circumstance as these are the areas where the bulk of and most vulnerable livestock producers are located. The withdrawal of public livestock services, and in part their inadequacy at effective delivery where they still exist, has left a void in the rural livestock industry. This void is being filled by a range of actors in the provision of veterinary and extension services that include mainly para-vets, Agrovet traders, non-government groups such as co-operatives (e.g. dairy and poultry) (Schillhorn van Veen, 1993; LID, 1996; Roepke, 1996; FAO 1997; Bett, 2001) and community-based organisations (CBOs) in form of community animal health workers (CAHW) especially in arid and semi-arid lands (ASAL) (Sollod and Stem, 1991; Catley and Mohammed, 1996; Leyland *et al.*, 1998; Martin, 2001). The latter two groups have been collectively referred to as 'member organisations' or the 'third sector' (Farrington *et al.*, 1993; LID, 1996). Evidence from published literature suggests that some veterinary and extension activities may be sub-contracted to the private sector using public funds to finance the activities, or may be conducted by the third sector without any public fund input (Farrington *et al.*, 1993). Examples of the third sector veterinary services provision to their members include dairy co-operatives in Kenya, India and Indonesia. The National Federation of Central African Livestock Owners is another member organisation that has been successful in supplying drugs and vaccines to its members who previously had no access to public veterinary services (de Haan and Bekure, 1991; LID, 1996). However, this system may be disadvantaged in that the member organisations may have no access to professional resources and thus result in poor quality of animal health services (Leonard, 1987; Umali *et al.*, 1992).

2.2.1 Enabling private sector development: Legislation of veterinary service delivery in Kenya

Delivery of veterinary services in Kenya is governed by legislative parliamentary acts (Kajume, 1998). The acts that have a direct impact on the use of veterinary products including trypanocides are the Pharmacy and Poisons Act, Cap 244, the Prevention of Cruelty to Animals Act, Cap 360 and the Veterinary Surgeons Act, Cap 366. These legislations are considered to be in direct conflict with a conducive environment for private provision of veterinary services (Kajume, 1998; Kiniiya and Mukhebi, 2002). The Veterinary Surgeons Act only provides for fully qualified vets to treat animals, such that privately operating AHA and livestock officers are essentially operating illegally under the current laws. Fully qualified private vets also ostensibly conduct their activities illegally as the Pharmacy and Poisons Act only allows veterinary products to be used to offer chemotherapy and chemoprophylaxis but should not be sold to clients; this implies that private vets are supposed to provide their drugs free of charge which is obviously not practicable if they are to continue providing vet services to the farming communities. The laws are largely not enforced as has been evidenced from a study focussing on the role of Agrovet shops in the provision of vet services in Busia District in Kenya (Bett, 2001). Despite the large farmer clientele that these Agrovet shops receive, a large proportion of the shop managers have no technical training in animal health (Bett, 2001; Kiniiya and Mukhebi, 2002). A wide range of veterinary products including trypanocides are stocked in these shops. The DVS and DVO do not appear to have any control of the operations of the Agrovet traders; no visits are made for inspection of veterinary products stocked, but occasional inspection of pesticides stocked is made by the Pest control Products Board (Kiniiya and Mukhebi, 2002). The laws are currently undergoing review to fit in with the prevailing situation of privatised animal health service delivery (Kiniiya and Mukhebi, 2002).

2.2.2 Effects of privatisation of veterinary and extension services on trypanosomiasis control in East Africa

The discussions above highlight the framework within which trypanosomiasis control has been managed historically right up to the present; they also highlight how patterns of veterinary drug use are in a state of transition in sub-Saharan Africa. Unsurprisingly, the major effect of privatisation of public veterinary services on trypanosomiasis control has been a shift from large-scale operations to small-scale community- or village-level control programmes and from external funding to cost-recovery from the livestock owners themselves (Bauer and Snow, 1998). Indeed, in many sub-Saharan African countries, government veterinary services lack the funds and institutional capability required to implement large-scale drug programmes (Barrett, 1997). These shifts in area-wide trypanosomiasis control campaigns and move from project-driven to demand-driven campaigns has been a result of concerns about the sustainability of such operations – a much debated issue as evidenced by published literature and discussion fora within the tsetse and trypanosomiasis research and development community.

Armbruster (1994) has compiled most of the prerequisites for a functional relationship between organisations at village level and privatised or public veterinary services. Such village level organisations include stakeholder groups such as farmers associations, private veterinary services, government veterinary services and research institutes. Table 2.1 shows some of the principal stakeholders in the veterinary aspects of bovine trypanosomiasis control before and after privatisation.

Table 2.1: Stakeholders in veterinary aspects of trypanosomiasis control

Level	Pre-privatisation	Post-privatisation
National	Central veterinary research institutes Pharmaceutical companies	Government veterinary laboratories Private veterinary laboratories Pharmaceutical companies
Provincial	Regional veterinary laboratories	Private vets
District	District veterinary office	Animal health assistants Farmers' associations NGOs
Village	Animal health assistants Extension workers	Women's groups Schools Churches Extension workers Pharmaceutical retailers
Farm	-	Smallholder farmers

2.2.2.1 Community participation in trypanosomiasis control

Because of reasons of sustainability and funding, cost-sharing of control programmes with beneficiaries was considered to be the ideal approach. This resulted in attempts to involve communities in tsetse control activities in order that some of the costs could be met by the beneficiaries, i.e. cattle owners. The development of bait technologies (insecticide-treated traps, targets and cattle) has since accelerated the need to encourage beneficiaries in tsetse infested areas to take part in the control activities as their efficacy is dependent on widespread uptake. A range of participatory methods and tools have been developed to help rural people diagnose problems, gather information, explore options, and commit themselves to collective action (Chambers, 1992, Barret, 1997). The economic properties of these technologies are discussed in section 2.1.7.3 above. Studies on farmers' willingness to pay and/or contribute labour towards trypanosomiasis control measures have been studied in Busia District, Kenya, (Echessah *et al.*, 1997) and in Ethiopia (Swallow and Mulatu, 1994; Swallow *et al.*, 1995). These studies showed that community education and perception of personal benefits in own animals' welfare would enhance participation in tsetse control programmes. However, the inability to exclude non-participating livestock owners from benefiting in the trypanosomiasis control activities may constrain the willingness to contribute labour and money to the tsetse control programmes. Barrett and Okali (1998) concluded that failure of some community-based programmes stems from lack of inclusion of the beneficiaries at the onset of the project, and thus no sense of ownership or responsibility is felt by the communities.

Extensive accounts of community participation issues are discussed for trypanosomiasis control by Barrett and Okali (1998), Brightwell *et al.* (2001) and by Kamuanga (2003). Catley and Leyland (2001) offer a comparison of community participation between rinderpest campaigns and trypanosomiasis control in which they offer some explanations for the unsuccessful attempts at community involvement in trypanosomiasis control efforts; it has to be said though that the clinical picture of the two diseases compared in this article is very different in that rinderpest has a more dramatic clinical course and is highly contagious unlike trypanosomiasis.

Failure of sustainability of community-based programmes has not been limited to trypanosomiasis control in mixed crop-livestock farming systems, but has also been observed in other production systems in ASAL, agrarian and urban regions of Kenya. Heffernan and Misturelli (2000) reviewed the provision of veterinary services to the poor in six districts (Baringo, Garissa, Kajiado, Machakos, Nairobi [Kariobangi] and Samburu Districts) in Kenya and observed that CAHW did not play a significant role in those communities due to fragmented training programmes and poor support from the people within these communities. Local political interference in targeting selection of CAHW trainees within the communities was another problem mentioned by the CAHWs. Where CBOs are concerned, the major problem faced by members is disenchantment because of problems with accountability towards membership fees which invariably results in collapse of the associations.

2.2.2.2 Farmer-level trypanosomiasis control options

Farmer-level interventions involve the application of pour-on and dip-formulation insecticides and administration of trypanocidal drugs to cattle. Widespread uptake of these technologies by smallholder farmers may be explained in that they represent "private good" interventions, with benefits accruing directly to the individuals who use them rather than to the community as a whole (Bauer and Snow, 1998).

Use of trypanocidal drugs

In spite of decreased farmer motivation for animal health interventions as a result of privatisation, there is nevertheless a tendency among farmers to purchase and use drugs from a reliable and affordable supply rather than to dispense entirely with veterinary care (Bauer and Snow, 1998). Trypanocidal drugs are clearly regarded as a priority by smallholder farmers. Borne (1996) estimated that farmers spend $30 million per annum on trypanocidal drugs in Africa. Recently established cost recovery programmes in Zambia have been highly successful, with farmers purchasing drugs through a local supply network (Delespaux, *et al.* 1998). In Kenya, there is now an expanding informal market in trypanocidal drugs, with many small scale pharmacies selling products directly to farmers (Bett, 2001).

Use of synthetic pyrethroids

Applying synthetic pyrethroid insecticides on cattle is a measure that can be adopted at the farm-level to protect animals from contracting trypanosomiasis. Although they are best suited for use on a large area and on many cattle for effective tsetse control, the sporadic uptake by individual farmers is considered to be due to the mixture of private and public goods properties of the control technology as discussed above. Farmers perceive 'private good' benefits from reduced tick infestation whilst using insecticides (Swallow *et al.*, 1995); quantitative evidence for these effects and on tsetse flies is available from field studies (Young *et al.*, 1985; Thompson *et al.*, 1991; Bauer *et al.* 1992; Leak *et al.*, 1995).

2.2.2.3 Farmers' knowledge of trypanosomiasis control

Farmers have been shown to have varying levels of understanding of the aetiology of trypanosomiasis and other disease (Kamara *et al.*, 1995; Kamuanga *et al.*, 1995, Delehanty, 1996, Heffernan, 1996, Mwangi, 1996; Catley and Irungu, 2000; Catley *et al.*, 2002); farmers also lack knowledge on appropriate drug use (Doran and van den Bossche, 1998; Murilla *et al.*, 1998; Sinyangwe *et al.*, 1998; van den Bossche *et al.*, 2000). Despite wide availability, trypanocidal drugs are either not used or used improperly, e.g. to treat conditions for which they are ineffective (non-infectious diseases, tick-borne diseases, helminthiasis). Misuse or overuse of drugs is uneconomic, environmentally unsound and may lead to drug resistance and toxicity (Stevenson *et al.*, 1993; Eisler *et al.*, 1997a; Geerts and Holmes, 1998). Swallow (2000) estimates that over half of the cattle raised under trypanosomiasis risk are not given treatments of trypanocidal drugs. On the other hand, where treatments are given, this may be primarily on the basis of farmers' ability to pay, the breeds of cattle involved, and whether or not transhumance is practised, rather than on the magnitude of the disease risk. Studies in Uganda indicate that trypanocidal drug treatments are not given appropriately, that the treatment rate may not reflect the prevalence of disease, and treatments that may be given unnecessarily (Olila, 1999). In Yalé Province of Burkina Faso, the amount spent by livestock keepers on trypanocides was not related to the prevalence of the disease (Kamuanga *et al.*, 1997). Similarly, in Northern Côte d'Ivoire owners who raised trypano-susceptible cattle administered prophylactic trypanocidal drug treatments regardless of the disease prevalence (Pokou *et al.*, 1998). Furthermore, the choice between use of therapeutic drugs and prophylactic drugs may be made on the basis of cost per dose, without a clear understanding by farmers of the advantages of prophylactic drugs used in appropriate circumstances (Doran and Van den Bossche, 1998; van den Bossche *et al.*, 2000).

Ethno-veterinary medicine

Developing countries have seen an increase in alternative approaches to provision of animal healthcare, mostly instigated by international development agencies. This has been a direct effect of the privatisation of veterinary services as described above. These have largely been restricted to ASAL regions where nomadic pastoralists reside and to a lesser extent in some settled but marginalised rural communities (Schillhorn van Veen, 1993; Catley and Mohammed, 1996; Roepke, 1996; Leyland *et al.*, 1998). Further to this, a new field of study called ethno-veterinary research and development (ER&D) has recently received increasing interest (Mathias *et al.*, 1996; Stem, 1996; Schillhorn van Veen, 1997). ER&D covers traditional practices, ethno-botany and application of animal healthcare practices embedded in local traditions. It incorporates traditional practices in disease diagnosis, treatments, surgical manipulations and management of the herd, grazing and pasture. Some development agencies and individuals consider incorporation of livestock producers' indigenous knowledge (IK) as part of the alternative approach towards a sustainable animal healthcare system in marginalised areas, and as such, a sensible response to expensive and sometimes unreliable supply of veterinary drugs (Young, 1987; Mathias *et al.*, 1996; Schillhorn van Veen, 1997; Stewart, 1998). There has been a consensus on the importance of recording IK in various aspects of agriculture including animal healthcare (Inglis, 1995 as cited by Shillhorn van Veen, 1997) so as not to lose the valuable knowledge that has been acquired over the centuries. Understanding ethno-semantics and concepts (i.e. livestock producers' perceptions) of disease conditions is useful when considering disease control programmes as it helps dialogue with local livestock producers (Delehanty, 1996; Grandin and Young, 1996) and affords better application of extension through use of local concepts when designing animal health messages. To this end, various publications have been produced that describe local semantics and taxonomies or nomenclature (ethno-semantics and ethno-taxonomy) and concepts of disease conditions, medications and surgical manipulations, including two that are specific to Kenya (ITDG and IIRR, 1996; Brightwell *et al.*, 1998). More work on ER&D is compiled in an annotated bibliography (Martin *et al.*, 2001).

However, practicing ethno-veterinary medicine (EVM) runs the risk of abuse and malpractice as it is not regulated, and has been the brunt of scepticism largely due to the influence of western animal health paradigms and economic considerations (Schillhorn van Veen, 1997). As a result, there have been attempts to assess the value of EVM practices under the prevailing ecological and economic conditions and efforts to develop an acceptable framework to achieve quality control (Schillhorn van Veen, 1997; Anzuino, 1999; Mathias, 1999). Various botanical preparations have been studied for their efficacy against trypanosomiasis (Bodley *et al.*, 1995; Freiburghaus *et al.*, 1996; Atawodi *et al.*, 2002), and have been shown to have some modest *in vitro* trypanocidal activity.

2.2.3 Community education

For the bottom-up farmer driven approach to control of bovine trypanosomiasis to be effective, it is essential for livestock owners to use trypanocidal drugs appropriately, and it is also necessary to promote wide-spread uptake of insecticide-treated cattle as this control method is only effective if it is used in a large population of livestock (Hargrove *et al.*, 2000). Education of livestock producers within rural communities and other important stakeholders in animal healthcare at the village-level such as Agrovet traders and frontline extension workers is one way to achieve these outcomes. In this context, adequate and sustainable access to livestock health and production extension services is a key to constrained livestock development. Improving disease management practices and increasing livestock productivity is dependent on the individual actions of millions of rural families, whose decisions are shaped by the information available to them (Subedi and Garforth, 1996; Alex *et al.*, 2002). Agricultural extension – broadly defined as the process of introducing farmers to information and technologies that can improve their production, income and welfare – is the means by which these rural household decisions can be informed and influenced (Purcell and Anderson, 1997; Alex *et al.*, 2002).

Traditionally, transfer of technology (ToT) was used as the model for initiating favourable change in rural development programmes by providing knowledge and expertise which has been successfully used elsewhere to a community in a new area where such knowledge is considered to be lacking or backward. This extension approach is considered to have significantly contributed to the growth of agricultural production in many developing countries (Eponou, 1996). However, the ToT approach has received much criticism from other practitioners because it is considered to cause social and economic inequality among the target farmers and the information flows in a one-way top-down direction (Chambers, 1989 and 1993). The late 1960s saw a reformation of the delivery of extension services, and the result was the training and visit (T&V) extension system (Benor and Harris, 1977; Farrington, 1994). In an evaluation of the T&V extension system introduced in 1982 in Kenya, Bindlish and Evenson (1993) found that 61% of the farmers whose main income was from agriculture reported having received extension advice since its introduction. The majority rated this advice as being useful, and indicated that they had not been advised by extension before the T&V system was introduced. There was no discrimination in the proportion of farmers receiving extension advice with respect to farm size owned or gender of the head of household. However, there was continued dissatisfaction with results from traditional national extension services and this led to the development of alternative strategies based on the knowledge systems concept (Röling, 1986 and 1988). In this concept, which is commonly known as agricultural knowledge and information systems (AKIS), researchers, public and private sector workers and tradesmen and NGOs all form a system within which extension and farmers are enmeshed. In other words, it is "a system of people and institutions that generates, transfers, and uses agricultural knowledge and information" (AKIS/FAO, 2000). The key sub-systems are agricultural research, agricultural extension, and agricultural education. Their importance is increasingly being recognised in alleviation of rural poverty and promotion of sustainable agriculture. Achieving sustainable agriculture requires investing in human and social capital (Pretty, 1995; World Bank, 2002). Social capital is defined by Woolcock (1998) as the 'norms and networks facilitating collective action for mutual benefit'. He characterises social capital in two dimensions, namely embeddedness and autonomy, and at two scales – the macro-scale of the state and the micro-scale of the community. This gives four distinct dimensions of social capital, all of which are important in successful rural and regional development. It captures the idea that social bonds and social norms (i.e. majority position or opinion) are necessary for sustainable livelihoods (Pretty and Ward, 2001).

Knowledge systems use local knowledge of the producers together with external knowledge (research findings), and the role of outsiders is one of facilitation and learning. The FAO developed a methodology of extension termed Strategic Extension Campaign (SEC) which is based on this concept of knowledge systems and it systematically incorporates farmers' participation into national extension programmes (Adhikarya, 1994). This was considered to be an improvement because of the possibility for feedback from the end-users on the efficacy of the technologies being promoted. Farmer participatory research is considered to be as much about creating and managing a specific interface between local and external or scientific knowledge as it is about indigenous technical knowledge *per se* (Okali *et al.*, 1994). Other formats include client-group targeted extension that focuses on specific types of farmers who are usually marginalised such as small-scale farmers, women farmers or disadvantaged ethnic minorities. Farmer-led (or producer-led) extension is an approach that involves farmers and extension staff in a multi-directional communication process and draws on farmers' experiences, knowledge and resources (Farrington *et al.*, 1997; Scarborough *et al.*, 1997). Various terminologies have been applied to this extension approach such as participatory extension and participatory communication (Chambers, 1989; Garforth, 1993, Coldevin, 2001; Dagron, 2001) which harness farmers' own capacities to organise group meetings, identify needs and priorities and employ indigenous knowledge to improve their production systems (the participatory communication concept is discussed further in section 2.2.3.1 below). In response to the criticisms of the T&V extension system as a "one-size-fits-all" approach, the World Bank proposed four principles for extension investments. These included (i) situation specificity which required that programs be tailored to local conditions, goals, targets, and management capacities; (ii) economic sustainability requiring development of commitment for long-term financing, minimising recurrent costs, adopting cost-recovery strategies (wherever possible) and maximising operational efficiency; (iii) system flexibility in order to allow for extension programs to test and refine approaches and organisational structures as they develop; and (iv) system-wide participation to enable linkage between farmers and researchers in planning, implementing, and evaluating extension activities (World Bank, 1990). The idea is that information is presented to farmers as a series of choices from which they may select based on the needs and circumstances articulated by them. Otherwise, research messages are likely to have limited impact if they have restricted technical themes because it limits the farmer's choice and ignores the fact that rural populations are heterogeneous in terms of motivation and available resources (Okali *et al.*, 1994). Further insights into the evolution of extension and communication approaches over the last three decades are presented in Chapter III of this thesis in the context of participatory research methodologies as the extension processes or approaches and methods of execution appear to have evolved together.

Extension, as a practice, is underpinned by a body of knowledge and accumulated experience which has, at one time, been called 'extension science' (Röling, 1988), and as such, is based on the theories of communication, perception, psychology and development philosophy (Bolliger *et al.*, 1998). Extension science attempts to answer questions such as how to get one's ideas across, how to segment rural populations into target categories, how to design appropriate messages, how to organise extension services, how to evaluate extension impact, and other problems. It also needs to study the ways in which people use information sources, process information, utilise knowledge and the long-range consequences of extension behaviour. Furthermore, extension focuses on a number of different target processes and outcomes in individuals; and these target behaviours include attitudes, knowledge, decision-making, and opinion formation.

To this end, AKIS have been studied in selected parts of Kenya by the KARI/DFID NARP II Project (Rees *et al.*, 1999, 2000). These systems describe the existing networks of information exchange for smallholder farmers. The picture painted by this study was one of an extremely complex range of actors in the network including governmental bodies, parastatal companies, NGOs, churches, self-help groups, local traders and service providers. While up to 260 different routes of information flow were identified in one of the survey sites, the relative importance of these pathways varied between groups in the communities, based on gender and other social differentiations. Some problems in information flow were identified which included aspects of the external actors in terms of inadequate human resources leading to inadequate extension activities, and also aspects pertaining to internal actors exemplified by farmers' failure to attend meetings, 'ignoring' information received, inadequate material resources, dishonesty of community leaders and use of technical and unfamiliar terms in extension materials (e.g., use of units of measure inappropriate to smallholders' circumstances). Other regions where AKIS studies have been conducted include the Philippines (FAO, 1995) where the aim was to improve the exchange of relevant information between research, extension networks and farmers.

2.2.3.1 Participatory Communication

Agricultural extension is one of the major policy instruments a government can use to stimulate agriculture development. However, extension can only achieve these goals if it meets also the interests and needs of the farmers it is trying to serve, especially in this post privatisation era in which livestock productivity is increasingly dependent on livestock producers and the decisions they make regarding the health of their livestock (Tambi *et al.*, 1999). As farmers are free to follow or ignore the advice of extension, it becomes important to be able to communicate effectively with them and to stimulate learning. As a result, communication becomes an instrument for extension to induce the desired change.

Communication was traditionally treated as a simple one-way transmission of messages from a source to a receiver with the intention of producing some effect (Rogers, 1973, as cited by Piotrow *et al.*, 1997) without considering the social process or influence on behaviour of communication (Piotrow *et al.*, 1997; Stewart, 1998). The 1990s saw an expansion of the conceptual framework for communication to include audience participation, recognition of behaviour change as both a social and an individual process, use of mass media and development of entertainment for educational purposes (Piotrow *et al.*, 1997). It soon became recognised that effective communication was a two-way or multi-way interactive process in which all participants both encode (create or share) and decode (perceive and interpret) information until the goals of each are adequately met (Kincaid, 1979 as cited by Piotrow *et al.*, 1997). The definition and practice of communication thus changed from 'monologue' to 'dialogue'; Figure 2.5 presents an illustration of this concept of inclusive or participatory communication. Communication has since been redefined as 'the process in which the participants create and share information with one another in order to reach a mutual understanding" (Rogers and Kincaid, 1981; Rogers, 1983 and 1995) and can be said to be the diffusion and promotion of ideas and new technology.

Figure 2.5: Inclusive or participatory communication

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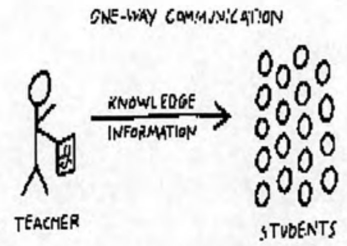
<td>
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- The teacher gives out information
- The students receive information from the teacher
- The teacher is active, the students are passive
- The teacher stands, the students sit down in rows
- The teacher possesses valuable knowledge
- The knowledge and experience of the students do not enter into the communication process
- There is a very unequal distribution of power between teacher and students

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- The teacher does most of the talking
- The students do not talk much, but sometimes ask the teacher questions or make comments to the teacher
- The teacher stands, the students sit down
- The students do not talk with each other

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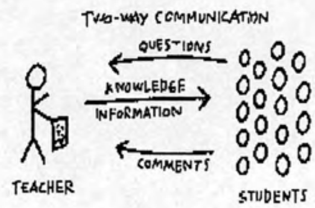
<td>
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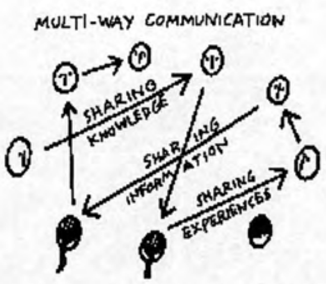
<td>
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- Learners and facilitator sit together in a circle
- Learners participate actively
- Everybody talks - no one dominates the discussion
- Everybody's knowledge and experience is valued
- There is a relatively even distribution of power within the group
- Nobody falls asleep

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Source: Linney, 1995 as cited by EENET, 2001

Traditionally, learning in agriculture has been defined as the adoption process, a farmer's encounter with an external innovation, first becoming aware of it, then gaining additional information about it and becoming convinced to adopt or reject it (Rogers, 1995). The change to sound agriculture is, however, not comparable to the adoption of an add-on innovation, but a complex learning process which can take a few years. The transformation, therefore, does not only involve a change of farm management practices, but also, a transformation of people, institutions and policies. The introduction of sound agriculture (such as animal health messages on disease indicators) does not seem to occur in a diffusive manner (unlike the diffusion of adoption: early adopters, followers, laggards). This is mainly due to the fact that market forces do not propel technological change towards sustainability as in the case of productivity enhancing innovations. It has been suggested that information and knowledge is transformed during the process of communication, e.g. upon introduction of a new technology to an existing farming system, it acquires a new meaning(s) and use(s), often other than that intended by the implementers (Long, 1985 as cited by Arce and Long, 1992). This is illustrated by Arce and Long (1992) who indicate that the production and transformation of knowledge is encompassed within the process by which social actors interact, negotiate and accommodate each other's life-worlds[1], leading to the reinforcement or transformation of existing types of knowledge or to the emergence of new forms of knowledge. When local people respond differently to the introduced knowledge the implementers refer to them as laggard, and conversely, achievement tends to be measured in terms of the number of adopters of a particular technology over a period of time (Rogers, 1983). The adoption and diffusion theory has given way to communications and systems theory, with the guiding concepts being discontinuity and transformation as opposed to the transfer of meaning.

Within this context, a communication intervention can be defined as a systematic effort to strategically apply resources to manipulate seemingly causal elements in an ongoing social process, so as to permanently reorient that process in directions deemed desirable by the intervening party (Röling and de Zeeuw, 1983, as cited by

[1] Arce and Long (1992) (after Schutz and Luckmann, 1973) define life-world as a lived-in and largely taken-for granted world, and is *actor* rather than observer defined.

Röling, 1988). The intervening process includes formulating objectives, designing and testing strategy, deploying resources, implementing and evaluating. It aims at changing people's behaviour, and not things. In veterinary science an example of a 'technical' intervention can be illustrated as follows (adapted from Roling, 1988):

vet science→vet→animal

On the other hand, intervening through people, i.e. 'extension' intervention can be illustrated as follows:

extension and vet sciences→vet→farmer→animal

The attitudes and predisposition of potential audiences need to be taken into consideration when communication is designed to address them. Research and extension messages based on scientific explanations are likely to be re-interpreted by local people to fit their own concepts of issues or phenomena (Warburton and Martin, 1999). In order to ensure that the target audience interprets the messages as they are intended, the intervening party needs to make sure that the messages are based on information from the audience members themselves and they must be pre-tested with them to make sure that they are appropriately designed. Market research uses this communication theory as the underlying feature and also uses formative research techniques such as focus-group discussions, audience surveys and message pre-testing; in other words, communication research is a systematic dialogue with members of the target audience (Piotrow *et al.*, 1997).

An understanding of the farmers' motivating factor to learn is a key to whether or not they will attend a training/awareness campaign or accept/adopt the extension message(s). Adults are voluntary learners who perform best when they have decided to attend a training/awareness campaign for a particular reason. They need to know why a topic is important to them. A non-formal education set-up would be a suitable form of systematic teaching outside the formal system for farmers (Adams, 1988). Farmers are best taught with a real-world approach, and they learn best when it is clear that the context of the training is closer to their own tasks and production objectives (van den Ban and Hawkins, 1988). In view of this, information transfer to farmers should be based on teaching through discussion, practical demonstration and participation. Farmers have experience and can help each other to learn, and this sharing of experiences should be encouraged. They do not require definitive and ready-to-use solutions, but principles, ideas and suggestions that can be tested in their own specific situation. Locally specific knowledge that farmers have supports sustainable agriculture; this can best be served by an intensive interaction between scientific knowledge and the knowledge generated by farmers. In conventional agriculture, facilitation of learning is often equated with extension, and more specifically with transfer of technology (e.g. Chambers and Jiggins, 1987, as cited by Röling and Jiggins, 1998). Learning in agriculture has further been defined as the adoption process (or diffusion of innovations), a farmer's encounter with an external innovation, first becoming aware of it, then gaining additional information about it and becoming convinced to adopt or reject it (Rogers, 1995). The change to sound agriculture is, however, not comparable to the adoption of an add-on innovation, but a complex learning process which can take a few years. The transformation, therefore, does not only involve a change of farm management practices, but also, a transformation of people, institutions and policies. Diffusion of innovations was based on the model developed in the 1940s and 1950s and was later updated to include five stages, namely knowledge, persuasion, decision, implementation and confirmation (Rogers, 1983 and 1995). The elements of the communication process have further been revised into another five steps to behaviour change, and they include perception, interpretation, understanding, agreement and action. For group interventions, mutual understanding, mutual agreement and collective action have been added to this revised model (Kincaid, 1987 and Rogers and Kincaid, 1981 as cited by Piotrow, 1997). Research shows that people usually do not take any action – especially with regard to something new – unless they have sufficient knowledge of it, have a positive attitude towards it, and have talked to others about it; the more of these things they have done, the greater is the likelihood that they will take action (Kim *et al.*, 1996). Adoption studies generally divide sample populations into adopters and non-adopters, and analyse the reasons for adoption/non-adoption, at a static point in time, in terms of the population's socio-economic characteristics (Feder and Umali, 1993 as cited by Jabbar *et al.*, 1998) and sometimes include farmers' subjective assessment of technology attributes as explanatory variables (Adesina and Zinnah, 1993; Adesina and Baidu-Forson, 1995), where as others perform the analysis in a more dynamic process by incorporating decisions made at different occasions as more knowledge is obtained about a technology by the user (Jabbar *et al.*, 1998). Furthermore, assessment must not be limited to farmers' attributes, but must include those of the extension workers as well. A study with Costa Rican farmers showed that adoption of technologies increased when information bulletins distributed to farmers were combined with dialogue between extension workers and client farmers (Wadsworth, 1994).

Non-formal dissemination and uptake pathways for livestock husbandry and health information

Dissemination and uptake pathways for extension messages include many social networks existing in communities. Farm Field Days, Group extension, school-based campaigns, community meetings, community-based organisations, clinics and health centres and religious organisations all offer strategic opportunities for information dissemination to small-scale rural farmers. The FAO developed the Farmer Field School (FFS) approach as a means towards non-formal participatory adult learning (Gallagher, 2000; Coldevin, 2001), and was first established in Indonesia in 1989 as part of an FAO integrated pest management project. The FFS has recently been trialled in Kenya in the smallholder dairy livestock sector and a training manual based on this project has been produced (Minjauw, 2002).

Formal sources of livestock husbandry and health information: Primary schools

The major sources of formal (or scientific) knowledge and information about agriculture for farmers include extension departments and agencies, agricultural shows, research institutes, agricultural co-operative societies, vets (public and private), agri-businesses, pharmaceutical companies, schools and local sources such as fellow farmers and community leaders. Schools are recognised as an especially important source of information as they are one of the few formal institutions that can be found in nearly every rural community in the developing countries. Furthermore, agriculture is a subject studied in all schools.

In the primary school agriculture syllabus in Kenya, agricultural science is taught starting from Standard 4 to Standard 8. There is a series of textbooks developed for Kenyan primary schools based on the 8-4-4 system of education. The main text book used in the government funded schools is called Primary Agriculture (1987a, 1987b, 1988a, 1988b and 1986); it is produced by the Kenya Institute of Education (KIE) and published by the Kenya Literature Bureau. There are various contributors of this series including staff of KIE, Primary Agriculture Panel Members, Primary school teachers and lecturers from Primary teachers' colleges. In this series of courses pupils are expected to fully participate in all the set activities to enable them to acquire a good knowledge of the subjects and develop useful skills. The courses also aim at guiding the pupils to adopt a problem-solving approach in studying agriculture. Each year's course is divided into units, at the end of which there are some exercises, which the pupils are expected to attempt. The topics studied in each course are presented in Table 2.2. In the Primary Agriculture Standard 6 textbook, anaplasmosis is referred to as 'hard-dung' disease; the other diseases mentioned are nagana described as sleeping sickness and East Coast fever. They also mention the condition of being anaemic as 'lack of enough blood in the body'. Livestock external parasites taught in Standard 7 include ticks, tsetse flies, chicken mites, lice, itch mites and fleas; control of these external parasites is also discussed. The internal parasites described include liver flukes, tapeworms, roundworms, hookworms, lungworms and wireworms. A general list of diseases of farm animals is given in the textbook in a tabular format consisting of three columns – disease name, livestock attacked and 'symptoms' (*sic*). Disease control measures are also described.

The 4K clubs that are run in many Kenyan schools aim to develop an interest and pass information on agricultural subjects to the pupil members. The term '4K' refers to the Swahili words *kuungana* (to unite as club members to learn better farming and home making methods), *kufanya* (to work with one's hands for the member, his family and his community), *kusaidia* (to aid one's country by assisting in its progress as a better farmer and homemaker) and Kenya (to develop Kenya's greatest resource – its rural youth – to improve their minds, hearts and health). Staff from the Ministry of Agriculture contribute to this flow of information and participate in demonstrations and field days attended by 4K club members. It is intended that information should diffuse from students to their farming parents; it is also acknowledged that many of the pupils will eventually become farmers in their own right.

Table 2.2: Agricultural topics studied by Kenyan primary school children

Year of study	Topics studied
Standard 4	Weather Crop and animal projects Land mapping Farming land Soil Water utilisation Farm tools Crop production Tree planting Animal production Marketing 4K clubs
Standard 5	Land mapping Soil erosion Farm structures How water is used in a farm Water conservation Crop production Marketing Farm records
Standard 6	Soil erosion Farm structures Animal management: breeds and rearing Farm labour
Standard 7	Pests and diseases Balanced diet Soil conservation Fish farming Farm storage Youth organisations Methods of grazing Farm accounts
Standard 8	Farm tools and equipment Poultry keeping Rabbit keeping Bee keeping Agricultural resources and services in the community Economic factors affecting agriculture

Source: Primary Agriculture (1987a, 1987b, 1988a, 1988b and 1986)

2.2.3.2 Communication campaigns

Communication campaigns have been widely used to promote a variety of development and political issues including general and reproductive health, nutrition and agriculture. Various mass media formats are used to support extension activities through provision of pure information. Information communication technologies (print, audio, television/video, folklore and interpersonal communication) have become popular tools of extension in many development and agricultural programmes. Even without any communication media, people communicate, exchange ideas and change their behaviour. However, the growth of the mass media has (initially print, then radio, television and now computer communication) raised new possibilities for rapid global communication (Coldevin, 2001). The general consensus by the end of the 1970s was that the mass media were effective for increasing awareness but only interpersonal communication could persuade or motivate action (Rogers, 1983).

The foregoing discussions highlight the importance of providing appropriate information to farmers for quality service provision in smallholder animal production systems. Evidence exists of community education programmes that have attempted to increase farmers' awareness and knowledge of endemic and epidemic diseases, as part of the strategy of increasing the chance of controlling them. For example, the KETRI tsetse fly control research project in Busia District of Kenya used posters and local drama to promote a community-based tsetse control programme in order to raise awareness of tsetse and trypanosomiasis (Mwangi, 1996). Other examples of communication campaigns in Kenya include a KARI/DFID project that used a comic book (KARI/DFID, 1998) to test the efficacy of targeting schoolchildren as a means of conveying extension messages to parents about husbandry of smallholder dairy cattle. Initial results from impact analyses showed this had achieved a 30% unprompted recall rate and a 10% knowledge conversion rate (Bain *et al.*, 1999). Another output of the NARP II DFID/KARI project was from the helminthology OVI group who produced a technical manual targeted at stakeholders and containing the important extension messages resulting from research conducted under NARPs I and II (Bain, 1999). The PARC/VAC rinderpest campaign used communication tools as a strategy for controlling and, in some regions, eradicating the disease in

Africa (Villet, 1988). As a result, the project succeeded in encouraging farmers to bring their cattle for vaccinations and to participate in sero-surveillance. Public health and reproductive health campaigns in human medicine also offer a wealth of examples and lessons learnt from use of communication campaigns for disease control and health promotion (Kim *et al.*, 1996) and use of schools as a dissemination pathway (Yuan *et al.*, 2000).

3 Chapter III: Study sites and participatory research methodologies employed in the studies

3.1 Introduction

This chapter provides an overview of the study sites and the participatory data collection methodologies used that were common to all the studies within this thesis. The aspects of the materials and methods that were specific to individual studies are described in the relevant chapters. The studies employed both qualitative methods by means of participatory research appraisals/approaches (PRA), and quantitative methods by means of structured questionnaires in order to ensure triangulation of the data and the sources, and therefore, have a collection of complementary and supplementary information for each dataset. The methods also ensured inclusiveness of the views of the participating farmers and other local stakeholders through feedback during face-to-face key informant interviews and focus group discussion meetings. These aspects of the research were considered to be important in order to minimise research and methodology biases in the data collected. The results from the studies are presented in Chapters IV-VII.

A description of the study sites is given in order to highlight their geographical and socio-economic profiles in as much as they pertain to the present study. The location of an area, its topography and climate all have a bearing on the presence or absence of livestock diseases and the vectors of the diseases, as well as the prevailing livestock production systems. Human and livestock statistics are important as they are indicative of the productivity of farming activities. A description of the types of animal health services available and the history of trypanosomiasis within the study sites are given in order to put them into context of the present study. The information used to compile the description of the study sites was sourced by the author from the respective District and Division Veterinary Offices run by the Government of Kenya (GoK). Secondary sources of information about the study sites came from the respective District Development Plan documents produced by the GoK (Anon, 1997a; Anon, 1997b). Other secondary sources included monthly and annual reports of the veterinary and agricultural departments, reports commissioned by the Farming in Tsetse Controlled Areas (FITCA) project (Mosi and Nyandega, 2002; Kiniiya and Mukhebi, 2002) and other relevant literature cited in the relevant sections below.

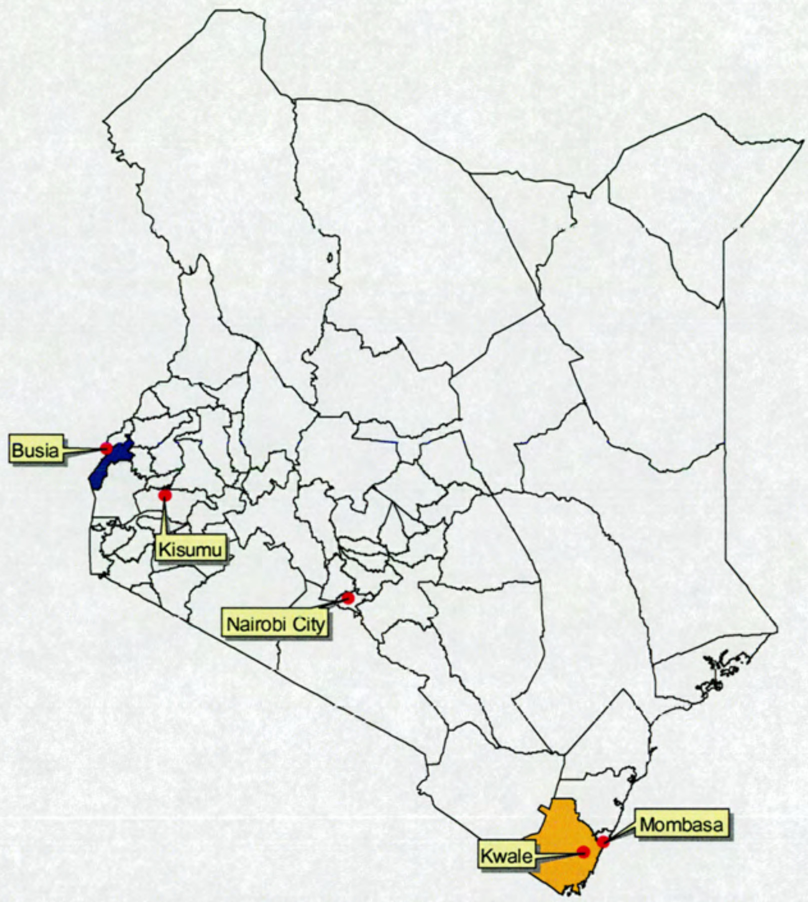
3.2 Study site and household selection

The present study focuses on trypanosomiasis control and animal health delivery in western and coastal Kenya because they are considered to be the most important constraints to livestock production in high potential and peri-urban areas. In Kenya, trypanosomiasis is an endemic disease in western, coastal, southern aspects of the rift valley and in the north-eastern regions of the country. A regional INCO-DC project studying the epidemiology of drug resistance in Kenya, Tanzania and Zambia randomly selected study sites based on trypanosomiasis prevalence reports from the respective veterinary departments and national research centres. Researchers from Kenya Trypanosomiasis Research Institute (KETRI) collected a list of all the vaccination centres and dip sites from the District Veterinary Offices (DVO) in three districts endemic to tsetse in western Kenya (Busia, Teso and Bungoma Districts) and Kwale District at the Kenyan coast (Murilla *et al.*, 1998). The vaccination centres and dip sites were numbered in series, from which a random numbers table was generated. From this, 11 sites in Busia, six in Bungoma, two in Teso and 19 in Kwale Districts were selected at random.

Busia District in western Kenya and Kwale District in coastal Kenya (Figure 3.1) were purposively selected for the present study as there was detailed information available on trypanosomiasis prevalences from the afore-mentioned project and other epidemiological studies conducted in the areas (Angus, 1996; Murilla *et al.*, 1998; Mdachi, 1999).

This study was also selected in these areas because it complements a wider spectrum of animal health research for improving rural livelihoods in East Africa including Kenya. The study sites were considered to provide an opportunity of comparing the situations of two different ethnic groups both living in trypanosomiasis endemic areas. In Busia District, the households were selected by following transects through the selected sub-locations, whereas in the less densely populated selected sub-locations of Kwale District, most households with cattle were included in the study. The administrative sub-locations in the two districts were selected based on trypanosomiasis prevalences in cattle of at least 6% in recent cross-sectional surveys (Murilla *et al.*, 1998). However, these selected sub-locations were known not to have been subjected to intensive investigations of trypanosomiasis that might have sensitised the population to this disease problem. Sub-locations were used as a sampling frame as this is how the vaccination/dip sites are organised to serve a group of villages that fall within their administration; hence, cattle-owners who brought their animals to be sampled during the drug resistance project came from the villages included in the present study.

Figure 3.1: Geographic position of study sites, Busia and Kwale Districts, Kenya



3.2.1 Description of the study sites

3.2.1.1 Busia District

Location and size

Busia District is one of six districts in the Western Province of Kenya. It is bordered by Teso and Bungoma Districts to the north, Kakamega District to the east, Siaya District of Nyanza Province to the south and Uganda to the west (Figure 3.1). The district is located between latitudes 0°1' South and 0°33' North and longitudes

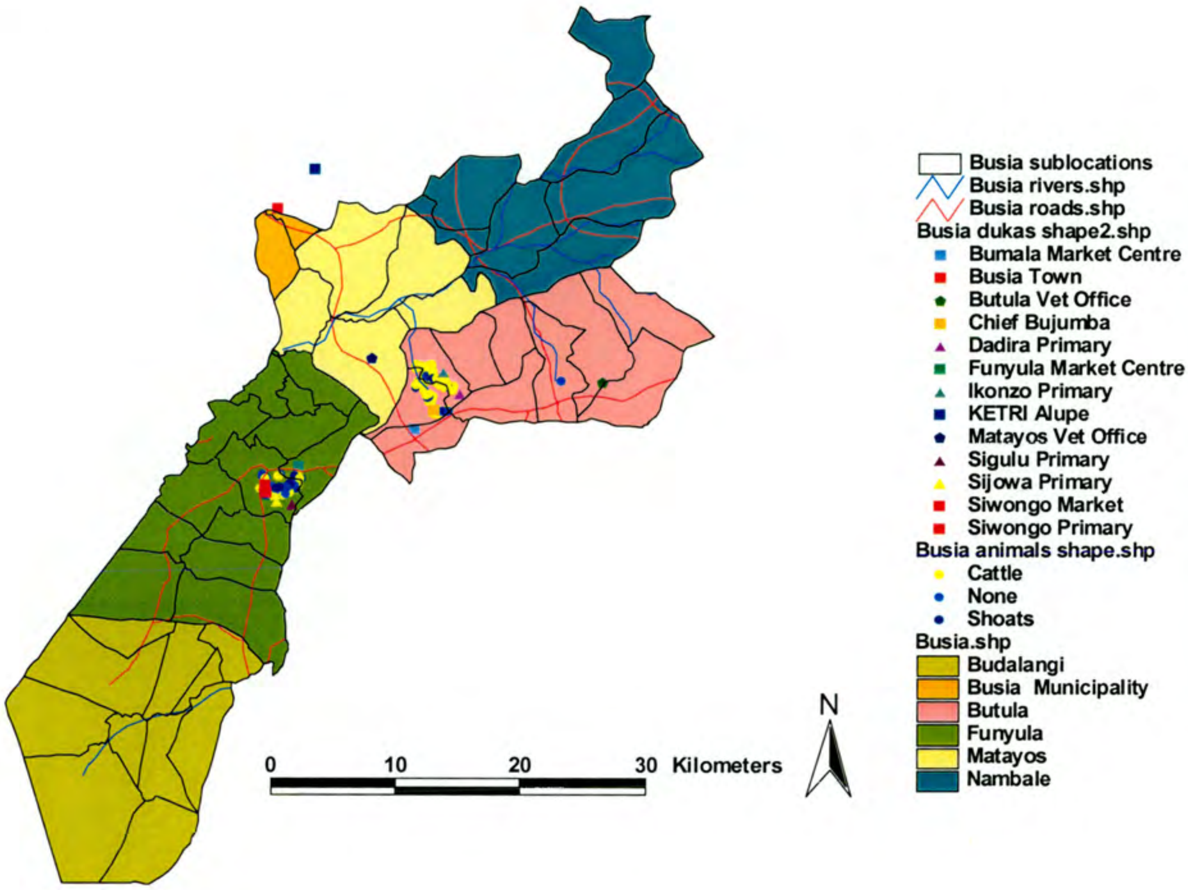
33°54' East and 34°25' East and covers a total area of 1262 km^2, with 11% of it under a permanent water surface.

Busia District has six administrative divisions including Budalangi, Busia Township, Butula, Funyula, Matayos and Nambale Divisions. These divisions are further divided into 24 locations and 82 sub-locations. The smallest administrative and political units are villages located within the sub-locations. The administrative divisions of Busia District included in the present study are Funyula (Bukhulungu, Sigulu and Wakhungu Sub-locations) and Butula (Bujumba, Ikonzo and Namwitsula Sub-locations) Divisions (Figure 3.2).

Agro-ecological zones and climate

A large proportion of Busia District lies within the Lake Victoria basin with an altitude ranging from 1130m above sea level on the shores of Lake Victoria to 1375m in the central and northern parts of the district. The district lies in the Lower Midlands agro-ecological zones (AEZ) 1-4, with the main land use being cultivation of maize, sugarcane, cotton, pigeon-peas and sisal (Jaetzold and Schmidt, 1983a). The central and northern regions of the district are characterised by flat plains with a swampy drainage system suitable for growing maize, robusta coffee and sugarcane. The southern part of Busia District is covered by a range of hills and also has a swampy area which forms a colony of papyrus growth broken by irregular water channels. Two main rivers, Nzoia and Sio Rivers, drain Busia District into Lake Victoria. Although the numerous water systems and undulating topography support agriculture production in Busia District, they also hinder construction of road networks due to the large number of bridges and culverts required to do so.

Figure 3.2: Location of study sites, households and veterinary care delivery centres in Busia District, Kenya



Busia District experiences fairly uniform annual mean minimum (14° C to 18° C) and maximum (26° C to 30° C) temperatures. The district has a bi-modal rainfall pattern; the long rains begin in March and continue into May, while the short rains begin in August and continue into October. The dry seasons are from November to February and another shorter dry spell occurs between June and August. The mean annual rainfall in the district is 1500mm. Most parts receive a mean annual rainfall of 1270mm to 1790mm; however, the driest parts of the district found along the lakeshore receive less rainfall between 760mm and 1015mm, while the southern region of the district receives rainfall between 1020mm and 1270mm.

The climate and topography of swampy land that exists in Busia District is an ideal habitat for *Glossina fuscipes fuscipes* and forms part of the contiguous tsetse fly belt with the sleeping sickness areas of South Eastern Uganda (Ford and Katondo, 1977; Leak, 1999). The drier undulating hilly topography of the southern aspects of the district offers a suitable environment for *Glossina palidipes* (Ford and Katondo, 1977; Leak, 1999).

Human population

Busia District is made up of mostly *Luhya* speaking (Bantu) people as well as some *Luo* speaking (Nilotic) people. Busia Township has a representative of most of the ethnic groups of Kenya and some of the Ugandan people. Intermarriages between the two main ethnic groups are common.

The 1999 census records indicate that the human population for Busia District is 370,608 with 81,697 households (Mosi and Nyandega, 2002; Table 3.1). The overall sex ratio of males to females was 0.89. The Busia District Statistics Office projected a human population increase of up to 391,913 by the year 2001 and a density of 347 persons per square kilometre. A summary of the household demographics obtained from a census conducted by the author and colleagues in the study villages of Busia District is presented in Table 3.2.

Table 3.1: Human population and household distribution in the 1999 National Population and Housing Census, Busia District, Kenya

Division	Male	Female	Total	N Households	Mean family size
Budalangi	25338	28018	53356	12773	4.2
Butula	43929	51560	95489	21495	4.4
Funyula	34610	39265	73875	15707	4.7
Matayos	25954	29232	55186	11799	4.8
Nambale	32269	35275	67544	13911	4.9
Township	12268	12890	25158	6012	4.2
Total	**174368**	**196240**	**370608**	**81697**	**4.5**

Source: Mosi and Nyandega, 2002

Table 3.2: Household (HH) demographics in study villages, Busia District, Kenya

Division	Village name	n HH	n Males	n Females	n Children	Total	Mean family size	% Female-headed HH
Butula	Bujumba	123	108	150	354	612	5.0	40.7
	Bukhulumi	106	90	123	287	500	4.7	30.2
	Bukhwako	128	111	148	339	598	4.7	35.9
	Ikonzo B	114	96	132	261	489	4.3	22.8
	Kengo	89	92	119	208	419	4.7	25.8
	Khukali	31	28	40	72	140	4.5	19.4
	Nebolola	118	110	151	313	574	4.9	19.5
	Sirikhaya A	43	36	58	93	187	4.3	18.6
	Sirikhaya B	66	66	77	149	292	4.4	21.2
	Siroba	60	43	74	135	252	4.2	25.0
Funyula	Bolori	66	60	91	157	308	4.7	39.4
	Gulumwoyo	82	74	90	238	402	4.9	30.5
	Magogongo	61	64	87	153	304	5.0	31.1
	Mashebi	55	71	82	152	305	5.5	10.9
	Oyato	90	89	116	195	400	4.4	27.8
	Sigulu B	80	61	91	195	347	4.3	26.3
	Sijowa	76	62	87	168	317	4.2	38.2
	Siwongo A	66	85	91	177	353	5.3	19.7
	Siwongo B	98	87	115	229	431	4.4	29.6
	Grand Total	**1552**	**1433**	**1922**	**3875**	**7230**	**4.7**	**28.1**

Source: DFID-AHP Project No. R7360 household census, 2001

Livestock production

Livestock production in Busia District is a diverse enterprise. It comprises of local zebu cattle rearing, dairy farming with pure or crossed (grade) exotic breeds of cattle, poultry keeping, sheep, goats and pigs rearing and bee keeping (Mosi and Nyandega, 2002). Poultry production is the largest activity as it is practiced by nearly every household in the district. Sheep and goat are also a reasonably large production activity. Dairy farming is practiced in every division of Busia District. The numbers of dairy cows have risen in the district since the introduction of the Finnish-funded Livestock Development Programme in 1991 from 2560 to 5030 in 1995. Meanwhile, a decrease in zebu cattle was recorded between 1992 and 1995; this was attributed to an outbreak of trypanosomiasis that affected Nambale and Budalangi divisions. Zebu cattle contribute to the incomes of the households through products such as milk (home consumption and some sales), meat consumption and sales, ploughing, manure and sale of live animals. A summary of the livestock census conducted by the Farming in Tsetse Controlled Areas (FITCA) project in Busia District is presented in Table 3.3.

Table 3.3: Livestock population* in Busia District, Kenya 2000/2001

Division	Zebu cattle	Grade cattle	Sheep	Goats	Pigs	Donkeys	Rabbits	Local chickens	Exotic chickens
Budalangi	9823	17	2704	9483	812	77	1628	77941	635
Butula	23350	235	9175	12582	2853	184	4577	165452	826
Funyula	7118	89	2666	8738	2481	57	1861	89340	583
Matayos	11248	115	4705	6526	5618	178	2352	81213	1439
Nambale	12648	88	4082	4115	4050	1091	2697	83800	952
Township	78924	1163	4862	8697	5466	531	3699	95254	13312
Total	**73111**	**1707**	**28194**	**50141**	**21280**	**2118**	**16814**	**593000**	**17747**

Source: Mosi and Nyandega, 2002

*Livestock population based on 72% of households in Busia District

Management systems for ruminant stock that exist in the district include zero-grazing, semi-zero-grazing (i.e. a combination of stall feeding and occasional free-range grazing near households) and free-range grazing (Mosi and Nyandega, 2002; own observations). Zero-grazing and semi-zero grazing practices tend to be reserved for exotic or crossbred cattle. Management of chickens and other poultry are either intensive in cases where they are housed or extensive when left to roam freely around the households.

A summary of the livestock population obtained from a census conducted by the author and colleagues in the study villages of Busia District is presented in Table 3.4.

Table 3.4: Livestock population in study villages, Busia District, Kenya

Division	Village	n Cattle	% Grade cattle	n Goats	n Sheep	n Pigs	n Chickens	n Other livestock
Butula	Bujumba	86	4.7	31	27	22	1033	47
	Bukhulumi	85	3.5	46	35	29	1177	17
	Bukhwako	100	7.0	66	44	19	1033	24
	Ikonzo B	88	1.1	51	38	4	1175	23
	Kengo	67	0	38	38	7	798	14
	Khukali	29	3.4	1	11	7	298	21
	Nebolola	101	10.9	24	37	46	732	11
	Sirikhaya A	43	2.3	8	10	5	571	41
	Sirikhaya B	47	2.1	15	17	12	625	4
	Siroba	18	0	19	8	4	368	16
Funyula	Bolori	40	0	42	7	20	754	21
	Gulumwoyo	45	0	58	1	1	530	15
	Magogongo	27	0	17	16	1	640	98
	Mashebi	40	0	40	14	17	605	52
	Oyato	27	0	39	14	16	731	11
	Sigulu B	64	1.6	80	27	16	872	40
	Sijowa	53	0	55	42	15	620	14
	Siwongo A	18	0	28	12	14	629	23
	Siwongo B	29	10.3	47	17	34	963	57
	Grand Total	**1007**	**3.3**	**705**	**415**	**289**	**14154**	**549**

Source: DFID-AHP Project No. R7360 household and livestock census, 2001

Livestock production in Busia District is constrained by the presence of many endemic livestock diseases including trypanosomiasis, ECF and helminthiasis (Table 3.5).

Table 3.5: Livestock diseases reported between January and June 2002 in Funyula Division, Busia District, Kenya

	Funyula Dec 2001-May 2002						
Disease	**December**	**January**	**February**	**March**	**April**	**May**	**Total**
Helminthiasis	6	26	46	43	72	31	224
Trypanosomiasis	26	33	35	48	48	29	219
Anaplasmosis	15	14	14	17	17	11	88
Unthriftness	6	4	4	6	4	0	24
Pneumonia	0	0	0	5	8	3	16
Eye infections	0	0	0	0	4	11	15
Retained placenta	0	0	0	9	5	1	15
Diarrhoea	0	4	0	7	4	0	15
ECF	1	4	0	6	0	2	13
Metabolic disorders	0	0	0	8	0	0	8
Mastitis	0	0	0	2	2	1	5
Red urine	1	1	0	0	1	0	3

Source: Funyula Division Veterinary Office, 2002

Infrastructure

Busia district has a fairly well networked road system comprising 532.7km. Tarmac roads link Busia District to Kisumu and Mumias Districts. There is approximately 377.3km of classified roads and 147km unclassified roads. Seventy percent of the roads in the district are seasonal. Funyula Division has more access roads than Butula Division which has the least number of classified roads. Post and tele-communication services are well distributed in the district with nine departmental and 16 sub-departmental post offices. An airstrip serves the district and is located in Busia Township. Water supply to the communities in the study sites of Busia District is from rivers and small lakes as well as piped water that is supplied by the government water department in Funyula Division and by the Busia council in Butula Division. Energy supply in the district comes from the Ministry of Energy and Funyula and Bumala trading centres are well supplied, whereas Butula Division is not serviced as well as Funyula Division.

Education facilities are reasonably well distributed in Busia District; it comprises of 241 pre-primary schools (58 in Butula and 62 in Funyula Divisions), 225 primary schools (60 in Butula and 61 in Funyula Divisions), 27 secondary schools (eight in Butula and six in Funyula Divisions), eight youth polytechnics (two in Butula and one in Funyula Divisions), a farmers' training centre and three family life training centres. The health facilities consist of two hospitals and 17 health centres and dispensaries run by the government and another hospital, five nursing homes and four health centres and dispensaries run by non-governmental organisations (NGO) and the private sector. Butula and Funyula Division command four and eight of these health facilities, respectively.

The local authorities that operate in the area include Busia Municipal Council and Busia County Council. These two councils offer facilities such as slaughter houses, rural market centres, residential housing estates and livestock holding grounds. Voluntary agencies include several NGOs which conduct development projects including improvement of agricultural productivity.

3.2.1.2 Kwale District

Location and size

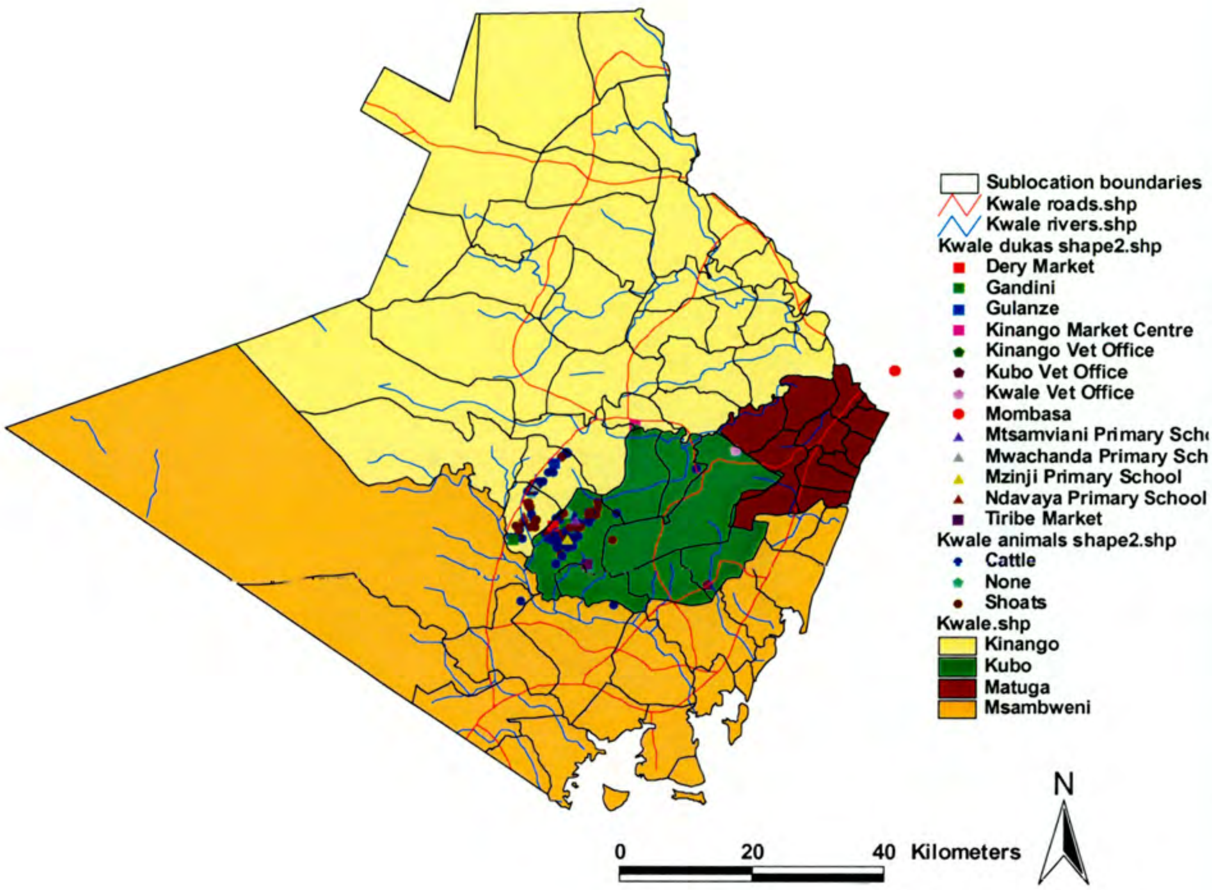
Kwale District occupies the south-eastern corner of Kenya and is located between latitudes 3°3" and 4°45" South and longitudes 38°31" and 39°31" East. It is one of the six districts in the Coast Province of Kenya and is bordered by Kilifi District to the north, the Indian Ocean to the east, Tanzania to the south and Taita-Taveta District to the west (Figure 3.1). The district occupies an area of 8,322km^2 of which less than 1% (62km^2) is under permanent water.

Kwale District has five administrative divisions namely Kinango, Kubo, Matuga, Msambweni and Samburu Divisions. The administrative headquarters is Kwale Township located in Matuga Division. The divisions are further subdivided into 24 locations and 72 sub-locations. The administrative divisions of Kwale District included in the present study are Kinango (Gulanze and Ndavaya Sub-locations) and Kubo (Mkongani Sub-location) Divisions (Figure 3.3).

Agro-ecological zones and climate

Kwale District lies in the Coastal Lowlands (CL), with the main land use being cultivation of sugarcane, coconut, cassava and cashewnuts (Jaetzold and Schmidt, 1983b). The AEZ for the district range from CL2 (sub-humid) to CL6 (arid), with those suited to mixed agriculture being CL2-CL4. The semi-arid to arid zones (CL5-CL6) are most suited to ranching activities.

Figure 3.3: Location of study sites, households and veterinary care delivery centres in Kwale District, Kenya



Kwale District has four major topographical features and they include the coastal plain, the foot plateau, the coastal uplands and the Nyika plateau. Altitudes range from sea level to 462m above sea level in the Shimba Hills and 842m in the Kilibasi Hills. The coastal plain has an altitude of less than 30m and extends about 10km inland behind which the foot plateau is located. The coastal plains, locally known as the Shimba Hills, rise steeply from the foot plateau to an altitude between 150-462m; this is an area of medium to high agricultural potential. The Nyika plateau, occasionally known as the hinterland, rises gradually from approximately 180-300m on the western perimeter of the district. The main agricultural activity in this region is livestock production. Kubo Division is located in the coastal uplands while Kinango Division is in the dry Nyika plateau region.

Kwale District experiences a monsoon type of climate. It is hot and dry from January to April and coolest between June and August. Kwale District also has a bi-modal rainfall pattern with the long rains commencing in March/April and continuing until July, whereas the short rains occur in November and December. Annual rainfall varies from 900-1500mm along the coast to 500-600mm in the hinterland. Average annual temperatures range from 26.3°C to 26.6°C in the coastal lowlands and from 25°C to 26.6°C in the Shimba Hills, whereas temperatures ranging from 24.6°C to 27.5°C may be experienced in the hinterland.

Human population

The main ethnic group found in Kwale District is the *Mijikenda* speaking (Bantu) people which consist of several dialects including *Duruma* and *Digo*. Other ethnic groups include the *Kamba* people who have settled in Kwale District from the Machakos District region.

The human population for Kwale District was projected to rise to about 556,577 people in the year 2001 based on the 1989 National Population Census which recorded 382,874 people (56,421 in Kinango and 39,238 in Kubo Divisions). The 1989 census indicates a male to female population ratio of 95:100. The population density for the entire district was estimated to be 46 persons per square kilometre; that for Kinango Division was 31 persons/km^2 and that for Kubo Division was estimated to be 57 persons/km^2. This sparse population is attributed to the harsh climatic conditions of the hinterland areas of the district, with most of the population being concentrated along the coastal area where agricultural potential is higher.

Livestock production

Rainfall and vegetation influences the intensity of livestock production activities in Kwale District. The district is divided into two main livestock production areas namely: low potential areas which include Kinango, Samburu and parts of Msambweni Divisions; and the medium potential areas comprising Kubo, Matuga and parts of Msambweni Divisions. Table 3.6 shows estimates of the livestock population and diversity in the study sites.

Table 3.6: Livestock population in Kinango and Kubo Divisions, Kwale District, Kenya

Division	Zebu cattle	Grade cattle	Sheep	Goats	Local chickens	Layers	Broilers	Rabbits
Kinango	29575	100	11550	49535	196200	200	0	180
Kubo	8620	194	2790	5570	29150	33520	1500	2040

Source: Kinango and Kubo Division Veterinary Offices; estimates for the year 2001/2002

The main activities for Kinango Division (also Samburu Division and the semi-arid parts of Msambweni Divisions) include rearing of local cattle (officially referred to as beef cattle), sheep, goats and bee-keeping. The beef cattle are reared in local group and commercial ranches as well as in herds owned by individual households. There are a total of 15 ranches, eight of which are managed by local groups. Kubo Division and the remainder of the district are mainly involved in poultry, dairy goats, sheep and beef cattle rearing. Bee-keeping is also a major activity in the hinterland regions of the district.

Zebu cattle are the main cattle breeds found in Kwale District with approximately half of them being located in Kinango and Samburu Divisions. The milk produced by these cattle is largely consumed within the households, with a little surplus being sold in the market places. Dairy cattle, largely cross-breeds, are very few and account for less than 1% of the cattle population and are found mainly in the high potential areas along the coastal strip.

A major constraint to livestock production in Kwale District, apart from inadequate veterinary services, is the presence of endemic diseases. These include trypanosomiasis, ECF, FMD, babesiosis, Newcastle Disease and fowl pox. The recorded prevalence of some of these disease occurrences in the study sites of Kwale District is indicated in Table 3.7.

Table 3.7: Livestock diseases reported recently in Kinango Division, Kwale District, Kenya

Disease condition	1999	2000	2001
Anaplasmosis	123	149	112
Babesiosis	7	4	2
Dermatitis	12	5	2
Diarrhoea	24	51	22
ECF	60	120	162
Foot rot	18	20	7
Heartwater	31	11	0
Helminthiasis	267	467	204
Lumpy skin disease	40	3	7
Pneumonia	20	32	148
Trypanosomiasis	296	393	311

Source: Kinango and Kubo Division Veterinary Offices, 2002

Infrastructure

Kwale District has total classified road networks of 1,129.6km categorised as bitumen (187.7km), gravel (293.8km) and earth (648.1km). The condition of some of the feeder roads within the district is poor and is worse during the rainy season. Postal and telephone services are available in Kwale Township, Msambweni, Kinango, Ukunda, Shimba Hills and Lunga-lunga. The district has two ports, Shimoni and Vanga, and they are managed by the Kenya Ports Authorities. An airstrip located in Ukunda serves the district and is managed by the Kenya Airports Authorities. Water supply to the district is mainly from the Department of Water Development and the National Water Conservation and Pipeline Corporation. The urban centres (Kwale Township, Kinango Market, Matuga and Diani) are the major recipients of piped water, with the remainder of the district relying on water from boreholes and wells. Springs and rivers are an important source of water in the Shimba Hills region while the hinterland relies mainly on dams. The most common source of energy in the district is from wood fuel, with an increasing reliance on kerosene. Electricity is only available in Kwale Township and main market centres like Kinango, Ukunda and Diani Beach.

The distribution of education facilities is fairly even throughout Kwale District. The 1995 Kwale District Education Office statistics (Anon, 1997b) indicated that there were 255 pre-primary schools (47 in Kinango and 34 in Kubo Divisions), 265 primary schools (45 in Kinango and 34 in Kubo Divisions), 25 secondary schools (two in Kinango and six in Kubo Divisions), seven youth polytechnics (two in Kinango and two in Kubo Divisions) and four training institutions (rural health, medical and family life training centres and a District Development Institute). There are a total of 50 health centres in Kwale District, including 18 dispensaries (six of which are managed by NGOs and the private sector). Kwale Township and Kinango market centre have a hospital each, with a further seven dispensaries in Kinango Division. Kubo Division is served by five dispensaries and one health centre.

The local authorities managing the district include Kwale County Council and the recently established (1992) Kwale Urban Council. The county council manages the education and water facilities and maintains all the market centres in the district. Revenue for the councils is derived from issuing licences. A number of NGOs operate within Kwale District and are involved in various community development programmes including water, health, financial, children, women and agricultural projects.

The National Dairy Development Project had a special livestock development programme running in which participating farmers were encouraged to purchase dairy cows. The 1996 records from the District Livestock Production office indicated that 163 farmers (16 from Kubo Division) had acquired at least two cows each, and 320 more (36 in Kubo Division) were waiting to acquire some. This dairy project was constrained by lack of reliable sources of obtaining them and high purchasing prices resulting in low numbers of participating farmers; furthermore, the high tsetse and trypanosomiasis challenge also prevented uptake of dairy cows.

3.2.2 Availability of veterinary services

The headquarters of the government district veterinary and agricultural departments are both located in Busia and Kwale Townships, respectively (Figure 3.2 and Figure 3.3). The administrative structure of the veterinary department is hierarchical in that the District Veterinary Office (DVO) falls under the Provincial Veterinary Office, and that in turn is under the control of the Director of Veterinary Services (DVS) at the Nairobi headquarters (Kajume, 1998). Every division within the districts has a divisional veterinary office, and each of them shares their premises with the agricultural department. The Divisional Veterinary Officers (degree qualification) or Livestock Officers (diploma qualification) are supported by subject matter specialists and frontline technical staff (certificate qualification), the number of which differs from each administrative division depending on the volume and diversity of the activities. The frontline staff include animal health assistants (AHA), junior AHA, hides and skins inspectors, meat inspectors, artificial inseminators, dip attendants and laboratory technicians. Other professionals involved in the delivery of animal health services include zoologists who are involved in the control of tsetse flies and trypanosomiasis. The major governing body in charge of tsetse and trypanosomiasis control in Kenya is the Kenya Trypanosomiasis Research Institute (KETRI) which also employs a number of vets and zoologists in its employees. A KETRI sub-station is located approximately 6km north of Busia Township in Alupe in Teso District (Figure 3.2). It was located there because of the historical presence of sleeping sickness and attends to human sleeping sickness patients as well as dealing with other endemic human illnesses such as malaria.

Most dip facilities are dysfunctional due to disrepair and lack of public funding to restore them. Shortage of water has also worsened the use of dips, especially in Kwale District. A well defined network of agro-veterinary (Agrovet) shops in Busia Districts has been characterised recently (Bett, 2001, Figure 3.2). The study sites in Kwale District do not appear to have as huge a network of Agrovet shops (Figure 3.3) as does Busia District. There were no shops that vend trypanocides and other veterinary products in Kwale Township, and only one Agrovet shop was identified in Kinango market centre; however, on market day, traders in veterinary products sell their wares on the makeshift stalls (Kwale District DVO, *pers. comm.*). A new Agrovet was identified on the last field visit to the Kubo Division study site in June 2002 which had been in operation for about six months.

Donor funded animal health programmes in the study sites include FITCA Kenya in Busia District. This project has been on-going in this study site throughout the duration of the present study. Kwale District has an on-going community-based animal health workers (CAHW) project sponsored by the NGO Action Aid Kenya which is located in Kinango Division. As the present field studies were coming to an end in 2002, another community development programme (sponsored by the Danish government) had commenced in Kubo Division, Kwale District which also aimed to promote animal health delivery systems within the community by training CAHW.

3.2.3 Trypanosomiasis in Busia and Kwale Districts

Previously, various attempts to control tsetse flies and trypanosomiasis in the study sites and other affected areas have been made by the Kenyan government. These included bush clearing, use of traps and targets, insecticide spraying of tsetse habitats, application of synthetic pyrethroids, chemoprophylaxis and chemotherapy. The recent budgetary constraints encountered by the veterinary department have led to a drastic reduction of public inputs into tsetse and trypanosomiasis control.

More than 80% of Busia District is infested with tsetse flies (*G. f. fuscipes* predominatly and *G. palidipes* in the hilly areas). The distribution of tsetse flies in Kenya is presented in Figure 3.4. In Busia District, the tsetse fly control activities (bush clearing and insecticide spraying of habitats) before the 1990s were usually indirectly targeted at controlling sleeping sickness in humans, such that control efforts were sporadic and tended to coincide with outbreaks of sleeping sickness in the villages (Angus, 1996). More than 75% of the sleeping sickness cases between 1977 and 1992 occurred during an epidemic in 1989-1990 (Angus, 1996). Following this outbreak, use of Lancien traps (Gouteaux and Lancien, 1986) was introduced to many areas in the district. There are crushpens being constructed by farmers currently in Busia District which are being overseen by the FITCA project and the veterinary department. Farmers have been encouraged to form groups, and are then supplied with synthetic pyrethroid insecticides and a foot-pump spray at a subsidised rate.

Trypanosomiasis is endemic in most parts of Kwale District and the Coast Province as a whole. The increasing human population near the urban areas is thought to have disrupted the tsetse habitats resulting in the distribution being confined to the coastal strip in sparsely populated areas and those within and adjacent to the national parks around Shimba Hills, preserved forested areas and national game reserves. The species of tsetse flies found in this region are *G. palidipes*, *G. austeni*, *G. brevipalpis* and *G. longipennis* (Heckalau, 1986 as cited by Mdachi, 1999). In the absence of domestic livestock, these tsetse populations are maintained by wildlife hosts (wild pigs, buffalo, sable, waterbucks and other antelopes) (Snow, 1979). Trypanosomiasis prevalences of 30% have been recorded in cattle in the district (Mwongela *et al.*, 1981). The Kwale DVS conducted a tsetse prevalence survey in a large part of the district including the Shimba Hills in the mid-1990s. One thousand and five hundred farmers received training in tsetse control and animal health in the arid and semi-arid regions of the district.

Figure 3.4: Tsetse fly distribution in Kenya

Source: http://kism.iconnect.co.ke/Tsetse.gif

3.3 Participatory research methodologies

Animal health and production interventions provide major contributions towards community development (Ghirotti, 1993). Availability of appropriate community-specific data (Okali *et al.*, 1994) is vital for planning, implementation, management and evaluation of the interventions. Epidemiology and economics tools for evaluating interventions are available (Putt *et al.*, 1980 and 1987), however, the collection, consolidation and feedback of data through these means is usually time consuming and expensive. Furthermore, background information in most developing countries is scarce and their availability is exacerbated by poor communications networks and limited resources (Ghirotti, 1993). Participatory research methodologies (PRM) are frequently used in development work to inform practice and policy. Chambers (1992) defines PRM as a family of approaches and methods to enable local people to share, enhance and analyse their knowledge of life and conditions in order to plan and act. Cooperation between farmers and researchers and development workers is considered to be the key to sustainable agriculture (Chambers *et al.*, 1989; Okali *et al.*, 1994; Scoones and Thompson, 1994). This principle has given rise to diverse PRM to agricultural research and development studies in the last two decades (Pretty *et al.*, 1995; Guijt and van Veldhuizen, 1998). The key feature of the range of participatory approaches is the involvement of the beneficiaries or end-users in the development processes, although the degrees (or types) of involvement/participation differ. Catley and Leyland (2001) provide a classification of the types of participation (Table 3.8) that they adapted from Pretty (1994) and Cornwall (1996).

Table 3.8: A typology of community participation

No.	Type of participation	Description
1	Manipulative participation (co-option)	Community participation is simply a pretence, with "people's" representatives on official boards who are unelected and have no power
2	Passive participation (compliance)	Communities participate by being told what has been decided or already happened. The process involves unilateral announcements by an administration or project management without listening to people's responses. The information belongs to external professionals only
3	Participation by consultation	Communities participate by being consulted or by answering questions. External agents define problems and information-gathering processes, and so control analysis. Such a consultative process does not concede any share in decision-making, and professionals are under no obligation to accept people's views
4	Participation for material incentives	Communities participate by contributing resources such as labour, in return for material incentives (e.g. food, cash). It is very common to see this called "participation" – yet people have no stake in prolonging practices when the incentives end
5	Functional participation (cooperation)	Community participation is seen by external agencies as a means to achieve project goals. People participate by forming groups to meet predetermined project objectives; people might be involved in decision making but only after major decisions have already been made by external agents
6	Interactive participation (co-learning)	People participate in joint analysis, development of action plans and formation or strengthening of local institutions. Participation is seen as a right (not just the means to achieve project goals). The process involves interdisciplinary methodologies that seek multiple perspectives and make use of systemic and structured learning processes. Because groups take control over local decisions and determine how available resources are used, the groups have a stake in maintaining structures or practices
7	Self-mobilisation (collective action)	People participate by taking initiatives (independently of external institutions) to change systems. People develop contacts with external institutions for needed resources and technical advice, but retain control over how resources are used. Self-mobilisation can spread if governments and NGOs provide an enabling framework of support. Such self-initiated mobilisation might or might not challenge existing distributions of wealth and power

Source: Catley and Leyland (2001); adapted from Pretty (1994) and Cornwall (1996)

Participatory rural appraisals (PRA) were first applied in 1988 in Kenya and India and originated from the rural rapid appraisal (RRA) which evolved in the 1970s and 1980s (Guijt and van Veldhuizen, 1998). RRA was used in agricultural development studies as an alternative to conventional surveys using structured questionnaires as they were felt to overlook poorer farmers' specific problems; their main feature was that they focused on the farmers' role in decision-making processes of whether or not to adopt new practices as represented by the farming systems research/extension (Chambers, 1981; McCracken *et al.*, 1988). PRA is also said to have evolved from the disciplines of anthropology (participant observations, dialogue or conversations and the importance of attitudes, behaviour and rapport), geography as a result of use of pattern analysis of space, time, flows and relationships, relative values and decisions; hence, transect walks, informal mapping, diagramming, scoring and ranking to assess innovations (Chambers, 1994a and 1994b; Pretty *et al.*, 1995; Spradley, 1980 as cited by Gladwin *et al.*, 2002). PRAs are regarded as part of the 'bottom-up' poverty alleviation efforts such as the sustainable livelihoods approach that aims to direct development processes away from 'top-down' interventions to those that enhance existing methods of making a living and managing human and natural resources (Chambers and Conway, 1992).

PRA methods have been used in agricultural studies in numerous countries by various organisations (Chambers, 1997). They have also been applied in livestock health and production studies in general (Ghirotti, 1993; IIED, 1994; Catley and Aden, 1996; Catley and Mohammed, 1996; Heffernan and Misturelli, 2000; Catley and Leyland, 2001; Catley *et al.*, 2002; Heffernan *et al.*, 2003), ethno-veterinary studies (Sollod and Stem, 1991; McCorkle *et al.*, 1996; Anzuino, 1999) and trypanosomiasis studies in particular (Kamara *et al.*, 1995; Kamuanga *et al.*, 1995; Mwangi, 1996; Snow and Rawlings, 1999; Catley and Irungu, 2000).

PRAs focus on structured dialogue using a variety of methods (or tools) to share knowledge and analysis and open up suggestions on how sustainable control programmes might be implemented. They open up debate and afford an understanding of local perceptions of problems and resource values and complexities of social development and structure (Guijt and van Veldhuizen, 1998). In this way, PRAs provide a double function: that of generating data as well as establishing dialogue between the participating parties (Mikkelsen, 1995). A catalogue of tools and techniques exist that offer different functions for researchers and practitioners at different stages of projects – from planning, implementation through to monitoring and evaluation. These tools and techniques include teamwork methods such as use of interview guides and checklists and process notes and diaries; sampling methods such as transect walks and wealth ranking; discussion and interviewing methods which include semi-structured interviews (SSI), focus group discussions (FGD), key informant interviews and direct observation; and visualisation methods (also communication techniques) including preference and pair-wise ranking, matrix scoring, mapping and seasonal calendars (Mikkelsen, 1995; Guijt and van Veldhuizen, 1998; Pretty *et al.*, 1995). PRA tools offer a complementary and supplementary dataset to more formal methods. They offer methodological triangulation when used in conjunction with other methods such as structured questionnaires in the same study/project (Mikkelsen, 1995; Pretty *et al.*, 1995). They can be preliminary exercises that lead up to more detailed analyses or can be used to inform the next stage of a study or project.

The aim of PRA during field work is to aid in communication between the external team members and local people, and in case of group discussions, amongst local people themselves (Pretty *et al.*, 1995). The methods enhance the understanding and analysis of local situations, problems and possible opportunities. The PRA tools used in the present study include semi-structured interviews with individuals (key informants) and groups of people (focus group discussions). The exercises performed include preference and pair-wise ranking. The more traditional research tool, individual face-to-face interviews using structured questionnaire, was also used as one of the main data collection methods.

3.3.1 Semi-structured interviews

Interviewing is one of the main data collection techniques used in developing countries and elsewhere. Semi-structured interviews (SSI) have resulted from participatory methods through adjustment of the formal interview into a more conversational but controlled and structured format (Mikkelsen, 1995). Pretty *et al.* (1995) define SSI as "guided conversation in which only the topics are predetermined and new questions or insights arise as a result of the discussion and visualised analyses". SSIs are often conducted in conjunction with formal surveys in order to provide in-depth complementary information. These interviews tend to take the format of informal conversations where the questions emerge from the immediate context without any predetermined question topics or wording; the second format of SSI is the interview guide approach in which topics and issues to be covered are specified in advance (Patton, 1990 as cited by Mikkelsen, 1995). These interviews are generally undertaken with individuals (key informants) or groups (focus group discussion or interview) and the questioning is always open-ended using the six helpers: who, what, why, where, when and how (Pretty *et al.*, 1995). The responses and observations are fully recorded, and cross-checked for validation.

3.3.2 Key informants

Key informants are individuals who are considered to possess special knowledge on a given topic, but are not necessarily the leaders in that topic. Farmers who experience production practices and constraints have knowledge of their experiences and are therefore considered to be key informants in that particular experience. Using animal health provision as an example, AHA, Agrovet traders and livestock owners are key informants with respect to livestock diseases and availability of veterinary services.

3.3.3 Focus group discussions

Focus group discussions (FGD) or interviews focus on a specific topic. They ideally consist of six-to-eight individuals who are specifically invited to attend the meeting. A facilitator normally guides the group as they discuss the topic in detail.

3.3.4 Ranking methods

Ranking and scoring methods are widely used to assess people's beliefs, expectations, attitudes, opinions and to elicit their criteria regarding a wide range of topics (Pretty *et al.*, 1995). These methods are generally used during interviews but may be used separately. The ranking methods make the process visual through use of pictures or symbols. Ranking and visualisation methods aim to focus analysis around specific issues (Guijt and van Veldhuizen, 1998) and they make it possible to be used with illiterate and literate people to participate in the process as equals by enabling them to follow what is going on, thereby enhancing the reliability of results by generating collective knowledge (Chambers, 1994a and 1994b; Pretty *et al.*, 1995). Kirsopp-Reed (1994) provides a review of the visual, ranking and scoring methods that can be adapted for use in livestock research and development studies.

3.3.4.1 Pair-wise ranking

Pair-wise ranking is sometimes referred to as the preference matrix. It is normally used when trying to determine the main preferences or priorities of individuals or groups for a set of items and to compare priorities of different groups against one another such as men and women, young and old (Pretty *et al.*, 1995). The ranking process involves conducting SSI to identify the target group's concerns, options and criteria from which a list is drawn. Each individual item is compared directly against the others until they are ranked from highest to lowest by making two identical lists of items, one across the top (x-axis) and the other down on the left side (y-axis). A paired comparison of two items thus results from each open cell in the matrix. Pair-wise comparisons were used in an animal health development programme in Somaliland to gain an insight into livestock herders' perceptions of animal health and livestock management (Catley and Aden, 1996; Catley and Mohammed, 1996).

3.3.5 Structured questionnaire interviews

A questionnaire can be defined as a series of questions designed to obtain answers from a respondent on a topic(s). The structured questionnaire interviews were used to collect data that might be used to identify and quantify the practices and knowledge of trypanosomiasis control by the small-scale farmers. They were designed to adopt some of the features of PRA in that despite being a formal structured tool, the questions were presented in a manner that afforded interaction between the interviewer (hereafter called the enumerator) and interviewee (hereafter called the respondent). The responses were recorded verbatim as there were no predetermined answers provided, especially in the diseases and drug use sections. Where lists of possible answers were provided on the form, the enumerators were trained to present the question in an open-ended fashion, taking note of the responses given by ticking or marking on the appropriate answer, or if not on the list, there was a space provided for including any other responses. Questions were mostly asked in an open-ended fashion, but some of them were posed in a close-ended manner. Appendices I-V present the questionnaires used in the studies.

The questionnaires for the data described in Chapters III-VII were designed around the respective themes of the studies. A list of the questions that needed to be answered in each study was drawn from which a formal questionnaire was designed. Each questionnaire had a title and an initial section for recording the enumerator and interview details including date of interview, householder's and respondent's names. The geographic location of each household was recorded using a hand-held Garmin® 12 and Garmin® 12XL Global Positioning Systems (GPS). The GPS readings (latitude and longitude) were recorded in decimal degrees using the ARC 1960 datum.

3.3.5.1 Training of enumerators and conducting interviews

The training of enumerators took place at the beginning of each field study. Local enumerators were recruited through the respective veterinary offices in the study sites. The enumerators were selected based on their experience in administering questionnaires from other agricultural household surveys, a good command of the English language, as well as by recommendation by the staff at the DVO. However, they had no prior background in animal health and were deliberately recruited and trained so that there was no enumerator-bias when recording the farmers' responses.

The purpose of the study was explained to them and they were requested to introduce themselves to the target farmers politely and explain what the interview was about when requesting permission to conduct the interview. Training consisted of explaining to the enumerator participants the type of information that was being sought and explaining the principles of having a dialogue with a respondent that ensured their trust (Plate 3.1). Emphasis on behavioural conduct during interviews was made to the enumerators. The enumerators were trained to follow some basic rules when questioning the respondents (Miller, 1991 as cited by Pfeiffer, 1996), thus: (i) to read questions exactly as worded in the questionnaire; (ii) to read each question slowly; (iii) to use correct intonation and emphasis; (iv) to ask questions in the order that they are presented in the questionnaire; (v) to repeat questions in full where necessary if misheard or misunderstood; and (vi) not to add explanations to questions if not indicated in the questionnaire. When recording the answers the enumerators were trained to make sure they understood each response before recording it and that it was adequate; they were not to answer for the respondent and to record all responses; and they were encouraged to use the respondent's own words.

Apart from the behavioural aspects of conducting the interviews, they were made familiar with each questionnaire by going through it section-by-section. The enumerator trainees later enacted the interviews through role-play in pairs, with one person being the enumerator and the other the respondent and *vice-versa*. Two to four farms not in the study sites were visited as part of the training process for the enumerators in which some of them conducted interviews with the farmers. These interviews were then evaluated and any outstanding problems discussed and solutions offered by the trainees and the researchers. Each enumerator was also trained in the use of a GPS.

The interviews were conducted mainly in the local languages (dialects of *Luhya* in Busia District and *Mijikenda* in Kwale District), as well as the more widely spoken Swahili in both districts (Plate 3.2). The interview responses were recorded in English, but where equivalent disease and clinical signs terms were not known, the enumerators were requested to record them in the local languages to be translated by the researchers at a later stage. The enumerators worked closely supervised by the researchers. At the end of each household visit day, the researchers examined the completed questionnaires to check for errors so that appropriate corrections could be made while the memories of the enumerators were still fresh and the farmers still accessible in case a repeat visit was required (Putt *et al.*, 1987).

Plate 3.1: Enumerator training session facillitated by a sociologist, Kwale District, Kenya

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Plate 3.2: Enumerator conducting a household questionnaire interview in Kwale district, Kenya

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3.3.6 Sources of error from participatory research methodologies

PRA may provide sources of error through biased views of a limited number of individuals in the case of key informant interviews. To counter the effects of the inevitably distorted views arising from these few key informants, the information collected should be investigated and verified by use of other field techniques. Focus group discussions also have their own limitations in that not everyone might be able to participate in the discussions because they feel intimidated by other participants; furthermore, some cultures do not allow women to speak freely.

The limitations described above can be rectified by forming groups that are reasonably homogeneous and not very large to ensure that all participants are involved in the discussions. In some communities, people may live in fear of outsiders and see them as government representatives and thus avoid expressing their views freely during public meetings (Ghirotti, 1993). The other notable constraint about interviews is that the presence of outsiders tends to influence the behaviour and responses of the local people such that their information may be altered to please, confuse or deceive the interviewer (Putt *et al.*, 1987). Such biases can be reduced through careful sampling and respectful questioning.

The success or failure of structured questionnaires largely depends on its design (Adams and Megaw, 1997) and how it is administered during face-to-face interviews. Pilot-testing of a draft questionnaire is necessary in order to see how usable it is and make any appropriate adjustment if required. The tone or body language of the enumerator's voice may bias the respondents' answer and thus result in interviewer bias (Alreck and Settle, 1995; Thrusfield, 1995; Pfeiffer, 1996). Other biases from interviews may result from asking, probing and recording errors and flagrant cheating. These types of errors can be minimised by appropriate training in interviewing techniques (Pfeiffer, 1996) and selection of trustworthy enumerators, and close supervision by sitting-in on some interviews. Visits were made to non-participating households in Busia and Kwale Districts with the enumerators in a pilot-testing exercise of the questionnaires, which also served as part of the training of the enumerators.

3.4 Data management and analyses

Milk production was estimated by converting farmers' measuring containers, which included a 750ml Tree-Top™ brand fruit cordial bottle, a 500ml plastic cup or a standard 500ml beer or soda bottle. Farm sizes were recorded in acres as it is the expression familiar to the farmers, and they were later converted to hectares during the analyses. Farmers reported cattle diseases using local and/or English terms. The equivalent English terms were used in the analyses. For example, trypanosomiasis included conditions described as *mabuko*, the *Luhya* name for tsetse fly.

Farmers' disease diagnoses were either accepted as being possibly consistent with the clinical signs they described, or rejected as being inconsistent with the clinical signs. The descriptions of clinical signs given by farmers were first standardised, e.g. descriptions such as 'water from eyes' and 'tears from eyes' were both recorded as lacrymation. Each clinical sign was then compared with those given in two reference veterinary texts (Hunter, 1994; Radostits *et al.*, 2000). A farmer's diagnosis was accepted when at least half the clinical signs described were consistent with those given in these texts, otherwise it was rejected. In this respect, all clinical signs were given equal weighting.

Analyses of drugs used on the farmers' cattle in response to disease episodes were performed separately from those that were used for controlling external parasites. Analysis of the indications for use of trypanocides was only performed on disease episodes data that farmers assigned a name to and also where they named the drug used. For the purpose of analysis, the term ecto-parasiticides was used for veterinary drugs targeting control of ticks and/or tsetse and other biting flies.

All household data were entered in a fully relational database specifically designed for this purpose using Microsoft® Access (Microsoft Corporation). The relational database structure minimises data entry errors, increases data entry efficiency and maintains a high level of data integrity. Database queries were used to calculate summary descriptive statistics. The descriptive analyses are presented in either tabular or graphical formats. The maps presenting the study households, veterinary offices and market places where the Agrovet shops are located were generated from the GPS recordings which were entered into the geographical information systems (GIS) software ArcView 3.2 for Windows (ESRI).

Resources status of individual households were estimated by combining the number of livestock (cattle, sheep, goats, pigs and chickens) owned, farm-holding size owned and whether or not cash crops are grown on the farm as shown in Box 3.1. Similarly, animal healthcare input levels were estimated by combining the attribute scores of the person providing animal healthcare services and type of treatment given (Box 3.2).

Statistical analyses consisted of non-parametric tests, chi-square (χ^2) tests and logistic regression models where relevant. In general, significance was accepted at $p < 0.05$. Statistical software packages used included Microsoft© Excel and SPSS© 11.0 for Windows. Logistic regression is appropriate when analysing datasets with binary response variables (see Chapters IV and VII for detailed descriptions)

Box 3.1: Household resources categories

Size of livestock owned (in Tropical Livestock Units [TLU]*)

1. >10 (Large)
2. >5-10 (Medium)
3. 0.7-5 (Small)
4. <0.7 (Negligible)

Size of farm-holding owned

1. >10 acres (Large)
2. >5-10 acres (Medium)
3. <=5 acres (Small)

Cash crops grown**

1. Yes
2. No

Attribute	Level	Attribute score
Livestock size	Large	3
	Medium	2
	Small	1
	Negligible	0
Farm size	Large	3
	Medium	2
	Small	1
Cash crops grown	Yes	1
	No	0

Number of combinations expected from this is 4X3X2=24:

The total attribute scores from these combinations are further grouped into 3 levels of "resource status" categories:

1. Total attribute score 5-7 – "Resource-rich"
2. Total attribute score 3-4 – "Modest resources"
3. Total attribute score 1-2 – "Resource-poor"

* TLUs were calculated at a conversion rate of 1 for bulls, 0.7 for cows, 0.5 for weaned calves, 0.2 for suckling calves and pigs, 0.1 for sheep and goats and 0.01 for chickens (Ghirotti, 1993).
** Cash crops grown: Busia District – sugar cane, cotton, tobacco, beans; Kwale District – Citrus fruits, Bixa, Cashew nuts, coconuts.

Box 3.2: Smallholder farmers' animal healthcare input levels

Animal healthcare service provider

1. Animal health workers
2. Agrovet shops
3. Farmer treatment with professional advise
4. Farmer treatment without professional advise

Treatment type given

1. Allopathic
2. Traditional

Attribute	Level	Attribute score
Animal healthcare provider	1. Qualified Animal health workers	3
	2. Agrovet /Farmer treatment with advice	2
	3. Farmer treatment without advice	1
Treatment type	1. Allopathic	2
	2. Traditional	1

Number of combinations expected from this is 3X2=6:

(Animal healthcare input categories; score)

1. Animal health worker; Allopathic; 5
2. Animal health worker; Traditional; 4
3. Agrovet /Farmer with advice; Allopathic; 4
4. Agrovet /Farmer with advice; Traditional; 3
5. Farmer without advice; Allopathic; 3
6. Farmer without advice; Traditional; 2

The total attribute scores from these combinations are further grouped into 3 "animal healthcare input level" categories:

1. High input; 4-5
2. Low input; 2-3
3. No input ('do nothing or no treatment given' category where cattle were left untreated)

4 Chapter IV: Farmers' perceptions of trypanosomiasis and their veterinary care-seeking behaviour

4.1 Introduction

Livestock production forms a major part of the livelihoods of rural people in Kenya and most of the developing world (LID, 1999). In the African rural setting, cattle are kept for a variety of reasons including milk, meat, manure, draught power, dowry and funeral rites (Okali, 1992). An insight into small-scale farmers' general knowledge, attitudes and practices (KAP) in animal husbandry and health is necessary in order to aid implementation of intervention programmes; these interventions can only be effective if they coincide with the needs and aspirations of the target populations. Studying farmers' KAP enables the focus to be on the livestock owner's perceptions of his/her livestock husbandry and health management systems (McCrindle *et al.*, 1996).

One of the key strategies to reduce trypanosomiasis-related severe morbidity and mortality is early diagnosis and treatment. An early response to an illness in an animal enhances the chances of recovery and reduces production losses that result from prolonged illness. The importance of social, cultural and economic factors in trypanosomiasis control using a community-based approach has been emphasised (Barrett and Okali, 1998). Similarly, in order to promote farm-based trypanosomiasis control, sufficient consideration of the socio-economics context of infection and disease is required. Since the key to effective trypanosomiasis control is early detection, an understanding of the veterinary treatment-seeking behaviour of a population of livestock keepers in relation to the various animal health options (including traditional remedies/healers, public and private animal health workers, Agrovets, livestock keepers, veterinary drugs), as well as the characteristics of the livestock producers themselves, is essential.

This chapter reports on semi-structured interviews (SSI) and two structured questionnaires of livestock owners, animal health workers (AHWs) and agro-veterinary traders (Agrovets). The first objective was to obtain baseline data to use in formulation of extension material aimed at improving control of trypanosomiasis by farmers, and also to enable quantitative analyses of the scope of the trypanosomiasis problem in terms of farmers' KAP. The second objective was to gain a fuller understanding of the socio-economic and biophysical factors that might have an influence on farmers' animal healthcare-seeking behaviours in response to illnesses in their cattle. The final purpose of this study was to investigate differences, if any, in the frequency of disease occurrences and animal health management practices on the farms by comparing data from the baseline questionnaire to that obtained three years later during a follow-up questionnaire survey.

The specific aims were to:

1. Assess farmers' knowledge of trypanosomiasis diagnosis and its control in western and coastal Kenya
2. Evaluate the importance of trypanosomiasis to farmers
3. Evaluate the availability and accessibility of veterinary services and sources of agricultural information for farmers
4. Answer the general question "what influences farmers animal health management practices in trypanosomiasis endemic areas of western and coastal Kenya"

4.2 Materials and methods

4.2.1 Study households

The households included in this study were selected as described in Chapter III from the villages in Funyula and Butula Divisions of Busia District and those in Kinango and Kubo Divisions of Kwale District.

4.2.2 Participatory appraisal

Semi-structured interviews were conducted with key informants and focus groups (see Chapter II for detailed descriptions of the methodologies). Most of the SSIs were conducted at the beginning of the entire thesis study in May and July 1999 in Busia District and October 1999 in Kwale District; subsequent interviews were conducted during field trips for surveys on information networks (Chapter VI) and the follow-up post communication (Chapter VII) surveys. A large proportion of the interviews with the Agrovet traders were conducted between February and November 2000 which coincided with field visits described in Chapter V.

4.2.3 Structured questionnaire surveys

4.2.3.1 Baseline questionnaire

The interviews were conducted by local enumerators according to the description in Chapter III. The baseline questionnaire was divided into six sections, which included demography, farming enterprise, cattle inventory, cattle management, animal production and animal health (Appendix I). The animal health section was divided into two parts. The first part detailed the farmers' descriptions of the cattle diseases experienced in their herds and the management thereof within the last year prior to the interview. The second part detailed the treatments given to their animals and the reasons for giving them, also within the last year prior to the interview. Hence, these two sections acted as a crosscheck of each other. The final question was about respondents' knowledge of trypanosomiasis cause, clinical and post mortem signs and control measures. The questions were asked in an open-ended manner, for example, farmers were asked "What disease do you consider to be the most important in this area?" rather than giving them a limited list of diseases to choose from. The respondent was a member of the household involved in taking care of cattle. The baseline study was conducted in July 1999 in Busia District and October 1999 in Kwale District.

4.2.3.2 Follow-up questionnaire

A second structured questionnaire (Appendix II) was administered to 267 smallholder livestock-keeping farmers in Busia (59.2%) and Kwale (40.8%) Districts of Kenya in July 2002. Approximately 60% of these households were also interviewed in the baseline household survey described above. This survey also provided information on socio-demographic and socio-economic characteristics of the farmers. However, more demographic information from farmers was obtained from this survey including age of household head and respondent and education level. Other information obtained includes 683 disease conditions observed in cattle and farmers' attitudes towards trypanosomiasis, 669 allopathic veterinary and traditional medications and 135 ecto-parasiticidal remedies used, during one year prior to the interviews, as well as practices for tsetse and tick control. Statistical analyses were performed on the clinical signs most commonly observed by farmers, which were mentioned by them in at least 10% of the disease episodes described.

4.2.4 Data analysis

Most of the descriptive analyses of farmers' animal health management practices and disease knowledge are based on the data collected during the baseline household survey. Information obtained during the follow-up survey that is similar to that obtained during the baseline survey is used to compare and contrast the general patterns of these practices. The statistical analyses of the factors influencing different aspects of animal health management on small-scale farms are based on information obtained during the follow-up survey, mainly because this questionnaire was designed to obtain extra respondent farmers' personal details and extra details of disease episodes that were not previously collected.

4.2.4.1 Baseline survey

The data collected from semi-structured interviews was summarised using narrative text, whereas the questionnaire findings were analysed using descriptive statistics as well as chi-square, t-tests and non-parametric statistics where appropriate. Farmers were allocated to three resources groups according to the criteria described in Chapter III. Trypanosomiasis knowledge was determined by assigning scores; thus, a score of two was assigned if a respondent mentioned tsetse flies in the transmission of trypanosomiasis, one if they mentioned environmental conditions associated with tsetse habitats such as grazing/watering near rivers (especially in the case of Busia District), forests (especially in the case of Kwale District) and/or high incidences during the rainy season, one for each clinical sign consistent with trypanosomiasis and finally, one for each trypanocide and/or insecticide mentioned as control measures. The maximum score possible for each individual respondent depended on the total score obtained once all the individual scores were added up. The highest individual score obtained was then divided by two, and this was used as the cut-off point from which basis respondents were either assigned to the 'Has knowledge' group when they attained this score or exceeded it, or to the 'Lacks knowledge' group when the scores attained were less than this cut-off point. However, respondents who mentioned tsetse flies for trypanosomiasis transmission were immediately assigned to the 'Has knowledge' group regardless of whether their total score was less than the cut-off point.

For assessment of factors associated with trypanosomiasis knowledge, the variables tested using χ^2 statistics included gender of the head of household and respondent (female/male), location (Busia/Kwale), had trypanosomiasis in previous year prior to interview (yes/no), household resources status (poor/moderate/rich), cattle keeping experience (less experienced/some experience/experienced) and sources of information for trypanosomiasis control (AHA/own experience/fellow farmers/Agrovet). To calculate the odds ratio of 'having knowledge', the significant factors from the χ^2 tests were fitted into a logistic regression model.

4.2.4.2 Follow-up survey

The disease episodes dataset from the follow-up survey was subjected to chi-square and logistic regression statistical analyses to assess potential predictive factors of farmers' veterinary care-seeking behaviour. The sample's explanatory (or independent) variables were the following: (a) socio-demographic profiles of farmers (gender; age; district; cattle rearing experience; education level), (b) socio-economic profiles of farmers (household resources status; level of dependency on farm produce for farmers' livelihoods; main socio-economic activity), (c) biophysical factors (sex/age of animal affected; disease cause perceived by farmer; clinical signs observed by farmer; and number of signs observed per disease episode) and (d) animal health-care providers (person examining sick animal; person choosing drugs; person administering drugs). The variables that had a statistically significant association to the animal health management practice being investigated ($p < 0.05$ from chi-square cross-tabulations) were then fitted into logistic regression models to determine their usefulness in predicting farmers' behaviour from their Wald statistics, odds ratios and 95% confidence intervals.

The animal health management practices (i.e. the dependent variables with binary responses) investigated included (a) whether or not a disease episode observed in cattle was treated (Yes/No); (b) time taken to respond to disease conditions by administering medication (Early/Late); (c) type of treatment given (allopathic or modern drugs/traditional remedies only); (d) type of drug used (trypanocides/non-trypanocides); and (e) animal health care provider chosen for drug administration (AHA/Farmer).

In order to assess the influence of farmers' social characteristics on animal health management practices, those who described more than one disease episode were assigned with the most commonly occurring animal health practice variable (i.e. treatment – Yes/No, timeliness of treatment – Early/Late, type of treatment – modern drug/traditional remedy, type of drug used – trypanocide/non-trypanocide and service provider – AHA/Farmer). In situations where individual farmers' responses to any of these five dependent variables under investigation yielded a 1:1 ratio from the two possible responses, the response of interest was then assigned to that farmer for that variable. Thus, farmers who had a 1:1 response ratio for treatment of disease episodes (Yes/No) were assigned as having a 'Yes' response to the question "did the sick animal receive treatment"; 1:1 Early/Late treatment timing responses was assigned 'Early' for that farmer; 1:1 Modern/Traditional treatments responses was assigned 'Modern'; 1:1 Trypanocide/Non-trypanocide responses was assigned 'Trypanocide'; and 1:1 AHA/Farmer response was assigned 'AHA'.

4.3 Results from key informants and focus group meetings

Key informant interviews were conducted in the study sites of Busia and Kwale Districts following a semi-structured interview (SSI) format. Local livestock keepers, school teachers, community leaders, veterinarians, animal health assistants and Agrovet traders were interviewed as key informants. Six-to-twelve farmers participated in each of five separate focus group discussion (FGD) meetings; each group had 1-6 female participants. The livestock disease perception discussions were used as a means of introducing the subject on contents of proposed trypanosomiasis extension messages with the target farmers described in Chapter VII. The outcomes of these discussions contributed towards confirming and supplementing the findings from the individual key informant and structured household interviews. The individual key informant interviews lasted approximately 30-60 minutes, whereas the FGD meetings lasted between 80 and 100 minutes each.

4.3.1 Constraints to livestock production

The key informants stated that the main objectives of livestock rearing were to have a good source of income and security. Livestock rearing was also said to provide owners with the ability to raise money for school fees from hiring out their bulls to a neighbour for traction, and animals are also kept for dowry and milk. The main farming system is mixed crop-livestock production. However, livestock production is also known to be fraught with problems, with the major constraints considered to be mostly from diseases, animal feed and water, and thus, prevents most farmers from keeping livestock. Apparently, only a few farmers own cattle within the study areas as a result of these constraints. They face problems of inadequate space for their animals to graze. Increased population has led to boundaries being drawn, thus leaving people with approximately a hectare of land, from which they cannot spare enough to let their animals graze on. Financial problems also make it difficult for them because they cannot afford to pay the animal health bills in most cases – this usually leads them to seek help from the elders who are considered to know the traditional medicines. Money also limits them in the choice of crops to grow; they generally grow subsistence crops because they need fewer inputs as compared to cash crops – also the land available is limited. Because they do not get enough money from their small farms, they cannot educate their children; and few animals owned means less manure produced for the fertilisation of their crops.

4.3.2 Commonly perceived diseases

In ruminant animals, the major diseases were said to be the presence of tsetse flies and trypanosomiasis, East Coast fever (ECF) and other tick-borne diseases (TBD), whereas in the case of poultry, the main obstacle to rearing them were said to be Newcastle disease (NCD), coccidiosis and typhoid. However, poultry were considered to be relatively easy to rear because the turnover is high as the farmers are able to sell them when they are six months old. Disease knowledge was another problem faced by farmers as they claimed not to have much knowledge about livestock diseases.

The commonly seen clinical signs were inappetence and staring coats. Farmers who do not own cattle would like to have them but are discouraged by the perceived high production (and maintenance) costs, lack of knowledge about disease diagnosis and management.

4.3.2.1 Tsetse flies and trypanosomiasis

In Kwale District, farmers commonly associate trypanosomiasis with eating soil. According to the Kwale DVO, trypanosomiasis is considered to be the most prevalent disease, and is thought to account for up to 80% of the reported disease conditions. They have observed trypanosomiasis to occur as mixed infections with anaplasmosis and East Coast fever (ECF). The divisional veterinary offices are supplied with microscopic glass slides from which AHAs are requested to make blood films which they then send to the Veterinary Investigation Laboratories. However screening of blood films is not always possible as the supply of staining reagents is infrequent.

The clinical signs that farmers associate with trypanosomiasis include dizziness, animal not being comfortable, recumbent for a long time, very weak. A lot of animals are seen with standing hair and poor looking coats. Some informants associated signs such as stringy and frothy saliva, black (bloody) and hard cow dung, difficulty in breathing, inappetence (including lack of water intake) with trypanosomiasis.

Some informants thought that these signs are usually seen during the dry season with fewer cases in the rainy season, but it is not very clear to them. Other farmers said they mainly saw these signs at the onset of the long rains around February. The local terms used to describe trypanosomiasis in Busia and Kwale Districts are presented in Table 4.1.

Table 4.1: Trypanosomiasis-related disease terms used by farmers in Busia and Kwale Districts

District	Name used	Meaning	Language
Busia	Lutako	Enlarged spleen	Luhya
	Mabuko	Tsetse flies	Luhya
	Achuya	Thinness/wasting condition	Luhya
	Malale	Sleeping sickness	Swahili
	Trypanosomiasis	Trypanosomiasis	English
Kwale	Mbung'o	Tsetse flies	Swahili
	Malale	Sleeping sickness	Swahili
	Kula m'changa	Eating soil	Swahili
	Trypanosomiasis	Trypanosomiasis	English

In Busia District, tsetse flies (*mabuko*) are seen near the rivers and in the hills. Informants in Kwale District said tsetse were mostly found near the forests and the Simba National Park.

Farmers described several other diseases that they face in their livestock. These included ECF, anaplasmosis, babesiosis, helminthiasis, conditions affecting limbs and skin. The local terms used to describe these are presented in Appendix VIII.

4.3.3 Disease importance indicators

A pair-wise ranking exercise conducted during FGD meetings in Funyula Division of Busia District indicated the diseases that concern farmers the most, their perceived causes and control practices adopted by the farmers. The pair-wise ranking exercise also provided some of the reasons why farmers have these attitudes of importance towards different livestock diseases. Opinions on the most important animal health problems were similar among the five FGD meetings. Various reasons were given for these perceptions. Four groups thought that *mabuko* (tsetse flies) was the biggest problem in their area. The reasons they gave included presence of too many tsetse flies due to lack of spraying and trapping of thickets. They also felt that the disease spread by *mabuko* is very debilitating for the animals and is difficult to treat; the animals usually die from this disease. There is constant presence of *mabuko*, which "are hard to get rid of, only government has means of control by using pour-on medicines"; *engwa* (ticks) on the other hand can be "controlled by available drugs". One group of farmers, however, felt that *mabuko* and *engwa* had equal importance because they both 'suck' the animal's blood, irritate the animals and cause disease resulting in death. This group also felt that *engwa* were equally important because the drugs used to treat the disease they cause are very expensive. Most of the groups, however, felt that ticks were not as big a problem compared to tsetse flies because one could see them on the animal's body and 'pluck' them off, unlike flies which just "fly around and cannot be controlled by local farmers unless the government intervenes". One group ranked *lutako* (enlarged spleen – associated with trypanosomiasis) as the most important because it "is difficult to tell when an animal is suffering from it, and it has no cure". The other groups did not consider *lutako* as a separate disease because they associate it with the disease caused by *mabuko*.

Table 4.2: Major disease and parasites concerns of cattle-keeping farmers discussed during focus group meetings in selected villages of Funyula Division, Busia District, Kenya

Village	Magogongo / Sigulu	Sijowa	Siwongo (Cattle keepers)	Bolori / Gulumoyo	Siwongo (Sheep/Goats keepers)
Diseases conditions and parasites*	1. Trypanosomiasis 2. Liver flukes 3. Tsetse flies 4. Ticks	1. Tsetse flies 2. Ticks	1. Tsetse flies 2. Ticks 3. Lutako 4. Sloughing of skin	1. Tsetse flies 2. Gall bladder disease 3. Liver flukes 4. Wasting syndrome 4. Ticks	1. Tsetse flies 2. Worms 3. Ticks

*Diseases listed in order of perceived importance from pair-wise ranking exercise

4.3.4 Availability of veterinary services and products

Discussions with the DVOs and other veterinary staff in the study sites revealed that all the members of staff are involved in clinical and extension work. The extension topics include heat detection in breeding cows, artificial insemination (AI) and disease recognition. The veterinary staff offer advice to the farming community mainly on tsetse- and tick-borne (anaplasmosis and ECF) diseases. When operational funds are available the extension meetings are organised every month, and are known as Farm Field Day (FFD). The constraints faced by the DVO include transport (most vehicles are broken down and have not been running for years), few veterinary personnel leading to very early morning starts for meat inspection in abattoirs in order to meet other veterinary commitments. Drug companies are sometimes invited to FFD to benefit the farmers by giving out information on available drugs and stockists for control of various diseases.

Agro-veterinary products can be purchased in the market centres located near the study sites in Busia District (Figure 3.2). Stockists of veterinary products include general shops (Plate 4.1), chemists and Agrovet shops trading exclusively in veterinary and horticultural inputs managed by individuals and some by community based extension projects (Plate 4.2). The major veterinary products sold are trypanocides, antibiotics, anthelmintics and acaricides; however, acaricides are said not to sell as much as anthelmintics and trypanocides.

Unlike Busia District, Kwale District has very few Agrovet shops within the communities of the farmers in the study sites (Figure 3.3). When AHAs are consulted by farmers on disease management, they recommend drugs to them; the farmers generally go to Mombasa to purchase these drugs as there are only one or two Agrovets within the market centres nearest to them. However, during market day, some of the traders sell veterinary products. Kinango and Samburu Divisions have ranch farmers who form groups of approximately 20 farmers who manage their cattle together; these ranchers mainly purchase their drugs from Mombasa. Msambweni Division is considered to be a high potential cattle production area and has lots of market centres where veterinary products can be found.

Plate 4.1: A multi-purpose shop at Bumala market centre, Busia District, trading in veterinary products and general household goods

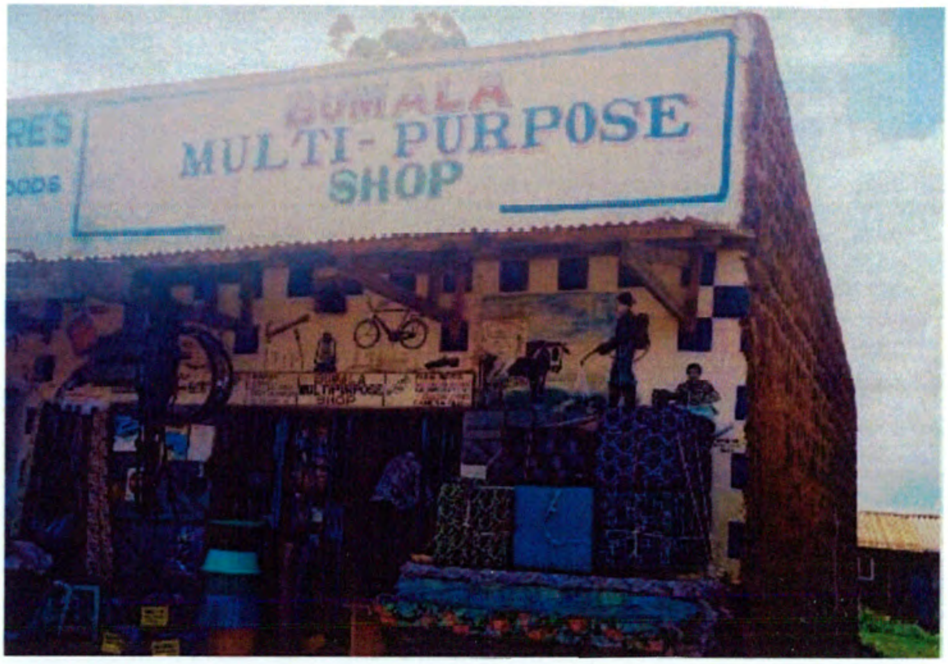

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Plate 4.2: An agro-veterinary shop managed by a community-based NGO, Bumala market, Busia District

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Knowledge of allopathic (conventional) veterinary drugs was varied amongst the informants. Most farmers do not know the drugs that are given to their animals because they call in veterinary personnel who choose and administer the drugs in cases where a farmer can afford to pay for them. The drugs provided by the veterinary personnel are seen not to always work and animals are seen to die despite receiving treatment. Most farmers do not give their animals any medical attention because the drugs and services are too costly for them. The general practice in animal health was said to be traditional in Busia District.

Farmers rely on advice from animal health workers whom they perceive to have more knowledge of diseases and also on elders who are seen to have considerable knowledge of traditional treatments. Neighbouring farmers are also seen to have a wealth of veterinary information.

4.4 Questionnaire results

4.4.1 Household sample demographics

The size and composition of the households in the study sites are shown in Table 4.3, and the socio-economic characteristics of the households are presented in Table 4.4a and Table 4.4b. Busia District had more female-headed households (23.7%) than Kwale District (6.0%), the difference being highly significant ($\chi^2 = 15.2, p < 0.001$); this difference was observed again during the follow-up survey ($\chi^2 = 6.604; p = 0.010$).

Table 4.3: Sample household size and composition, Busia and Kwale Districts, baseline survey

	Busia (n=138 HH*)					Kwale (n=117 HH*)				
	Males	Females	Children	All	Herders	Males	Females	Children	All	Herders
Mean	2.5	2.8	3.9	9.2	0.2	2.9	2.9	4.8	10.6	0.6
Median	2	2.5	3	8	0	3	2	4	9	0
Std. Dev.	1.61	2.32	3.40	5.27	0.43	1.86	2.10	4.05	6.42	0.81
Range	1-8	0-22	0-20	1-31	0-2	0-9	1-11	0-30	2-48	0-3
Total	351	389	536	1276	23	341	342	563	1246	67

*HH = total number of households

The average length of experience in cattle rearing was 13.4 years (range = 0.3-60 years) in Busia and 15.6 years (range = 0.5-68 years) in Kwale. Overall, nearly half of the sample households (47.8%, 122/255) fell within the 'moderate resources' category (Figure 4.1). However, there were more farmers within the 'resource-poor' category in Busia District (36.0%, 50/139) than was the case for Kwale District (3.4%, 4/117). Conversely, far fewer households fell within the 'resource-rich' category in Busia District (8.6%, 12/139) compared to more than half in Kwale District (58.1%, 61/117). More female- (27.5%, 11/40) than male-headed (19.9%, 43/216) households fell within the 'resource-poor' category.

Figure 4.1: Proportions of farmers in three household resources categories in Busia and Kwale Districts (n households = 256), baseline survey 1999

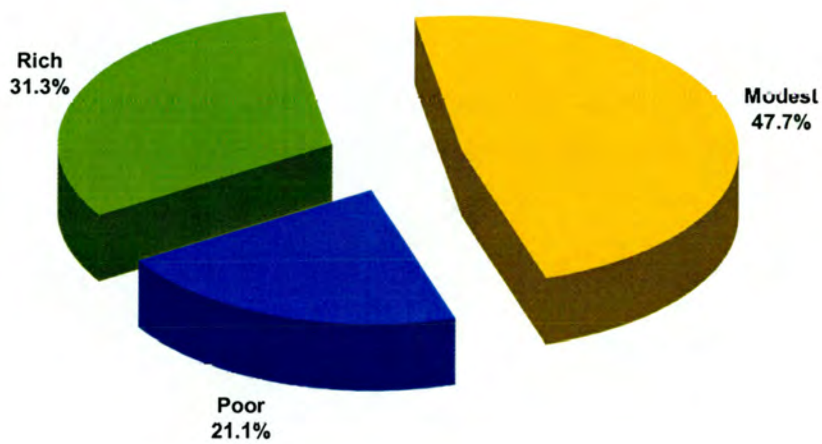


Table 4.4: Socio-demographic and socio-economic characteristics of the study households in Busia and Kwale Districts, Kenya

a) Baseline survey, 1999

Variable	Busia (n = 139)		Kwale (n = 117)		Total (n = 256)	
	n	%	n	%	n	%
Respondent's gender						
Female	68	48.9	41	35.0	109	42.7
Male	71	51.1	76	65.0	147	57.6
Household head's gender						
Female	33	23.7	7	6.0	40	15.7
Male	106	76.3	110	94.0	216	84.7
Cattle herd size						
Small (<=5 TLU*)	127	91.4	43	36.8	170	66.7
Medium (>5-10 TLU*)	12	8.6	41	35.0	53	20.8
Large (>10 TLU*)	0	0.0	33	28.2	33	12.9
Land holding size						
Small (<=5 Acres)	92	66.2	20	17.1	112	43.9
Medium (>5-10 Acres)	36	25.9	62	53.0	98	38.4
Large (>10 Acres)	11	7.9	35	29.9	46	18.0
Grows cash crops						
Yes	70	50.4	99	84.6	169	66.3
No	69	49.6	18	15.4	87	34.1
Cattle-keeping experience						
Less experienced (<3 years)	14	10.1	16	13.7	30	11.8
More experienced (3-10 years)	71	51.1	42	35.9	113	44.3
Very experienced (>10 years)	54	38.8	59	50.4	113	44.3
Main cash source						
Crop produce	119	85.6	37	31.6	156	61.2
Livestock produce	20	14.4	80	68.4	100	39.2
Main livelihood activity						
On-farm	111	79.9	96	82.1	207	81.2
Combination	17	12.2	20	17.1	37	14.5
Off-farm	11	7.9	1	0.9	12	4.7

TLU[2] (Tropical Livestock Unit)

[2] TLU (Ghirotti, 1993) was used for the purpose of comparison between the study sites. The conversion factors used were: bulls = 1, cows = 0.7, weaners = 0.5 and pre-weaners = 0.2.

b) Follow-up survey, 2002

Variable	Category	Busia (n=158)		Kwale (n=109)		Total (n=267)	
		n	%	n	%	n	%
Household head characteristics							
Gender	Female	27	17.1	7	6.4	34	12.7
	Male	131	82.9	102	93.6	233	87.3
Age-group	≤35 years	11	7	13	11.9	24	9
	36-55 years	60	38	62	56.9	122	45.7
	>55 years	65	41.1	28	25.7	93	34.8
	No response	22	13.9	6	5.5	28	10.5
Education level	None	56	35.4	57	52.3	113	42.3
	Primary	68	43	33	30.3	101	37.8
	Secondary	29	18.4	12	11	41	15.4
	College	5	3.2	7	6.4	12	4.5
Length of rearing cattle	≤2 years	20	12.7	8	7.3	28	10.5
	>2-10 years	85	53.8	44	40.4	129	48.3
	>10 years	53	33.5	57	52.3	110	41.2
Main economic activity	Businessman	12	7.6	4	3.7	16	6
	Formally employed	12	7.6	5	4.6	17	6.4
	Farm management	124	78.5	97	89	221	82.8
	Retiree	7	4.4	2	1.8	9	3.4
	Other[a]	3	1.9	1	0.9	4	1.5
Main source of livelihood	On-farm	58	36.7	96	88.1	154	57.7
	On-farm/Off-farm	39	24.7	38	34.9	77	28.8
	Off-farm	23	14.6	13	11.9	36	13.5
Respondent characteristics							
Gender	Female	81	51.3	38	34.9	119	44.6
	Male	77	48.7	71	65.1	148	55.4
Age-group	≤35 years	61	38.6	41	37.6	102	38.2
	36-55 years	53	33.5	49	45	102	38.2
	>55 years	44	27.8	19	17.4	63	23.6
Relationship to household head	Self	74	46.8	53	48.6	127	47.6
	Wife	53	33.5	27	24.8	80	30
	Relative	31	19.6	29	26.6	60	22.5
Involved in caring for cattle	Yes	130	82.3	101	92.7	231	86.5
	No	28	17.7	8	7.3	36	13.5
Livestock care							
Looks after livestock	Children	19	12	13	11.9	32	12
	Herdsman	19	12	38	34.9	57	21.3
	Husband	68	43	46	42.2	114	42.7
	Other	1	0.6	3	2.8	4	1.5
	Wife	50	31.6	9	8.3	59	22.1
	No response	1	0.6	0	0	1	0.4
Looks after sick cattle	Children	7	4.4	6	5.5	13	4.9
	Herdsman	6	3.8	2	1.8	8	3
	Husband	92	58.2	80	73.4	172	64.4

Other	2	1.3	8	7.3	10	3.7
Wife	46	29.1	10	9.2	56	21
No response	5	3.2	3	2.8	8	3

[a]Other: one church leader and three community leaders

4.4.2 Farming characteristics

The system of farming in both study areas is a combination of horticulture and animal husbandry. It is characterised by cultivation of maize, which is the main staple food in Kenya, and by other crops (Appendix IX – Table I). The average size of land holdings in Busia District was 2.3 ha (range: 0.2-21.0 ha), whereas that for Kwale District was significantly larger ($t = 6.35$, $p < 0.001$) at 5.1 ha (range: 1.2-24.3 ha). The average value for Kwale District did not include the 80.9 ha land holding that belonged to one household to avoid having a skewed result. Figure 4.2 shows the herd composition in both districts from the two surveys. The herds of cattle owned by the farmers sampled in Busia and Kwale Districts largely comprised local breeds, except for two (1.4%) farmers in Busia District who owned exotic cattle. The average cattle herd sizes were compared following conversion to Tropical Livestock Unit (TLU). Average herd size was lower for Busia District (2.1 TLU, range: 0-8.8 TLU during the baseline survey; 2.2 TLU, range: 0-11.9 TLU during the follow-up survey), than for Kwale District (11.2 TLU, range: 1.4-120 TLU during the baseline survey; 11.4 TLU, range: 0-125.5 TLU during the follow-up survey); these differences were highly significant for both surveys ($t = 6.386$, $p < 0.001$ for the baseline survey; $t = 7.648$, $p < 0.001$ for the follow-up survey). There was no significant difference in the mean herd sizes from the two surveys, with the herd profiles being very similar between the two surveys ($t = 0.375$, $p = 0.708$ for Busia District and $t = 0.119$, $p = 0.905$ for Kwale District; Figure 4.2)

Figure 4.2: Cattle herd composition for Busia and Kwale Districts (baseline survey 1999: n cattle = 431 in Busia and n cattle = 2108 in Kwale; follow-up survey 2002: n cattle = 543 in Busia and n cattle = 2010 in Kwale)

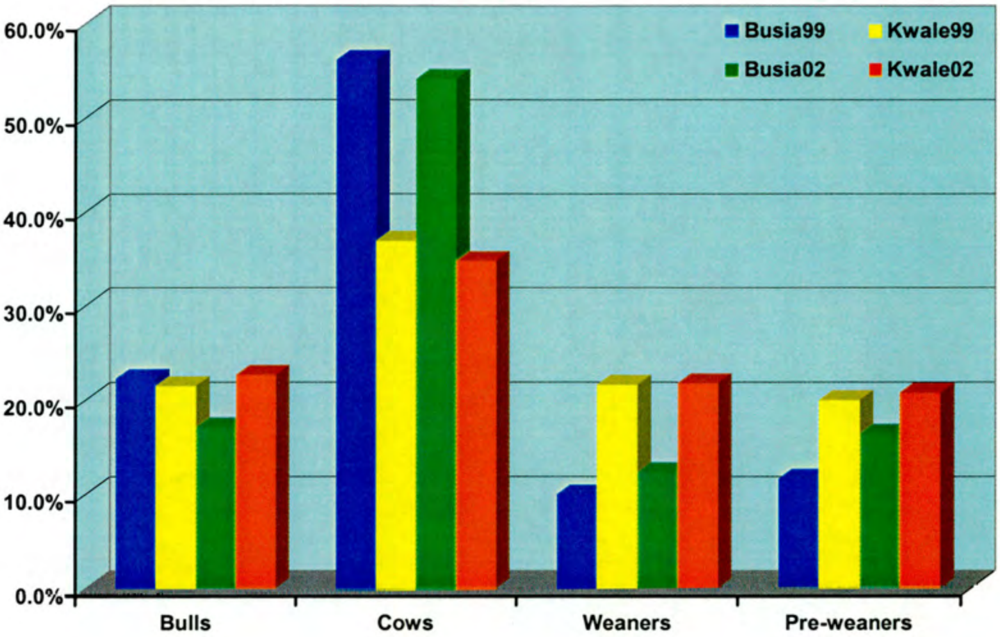
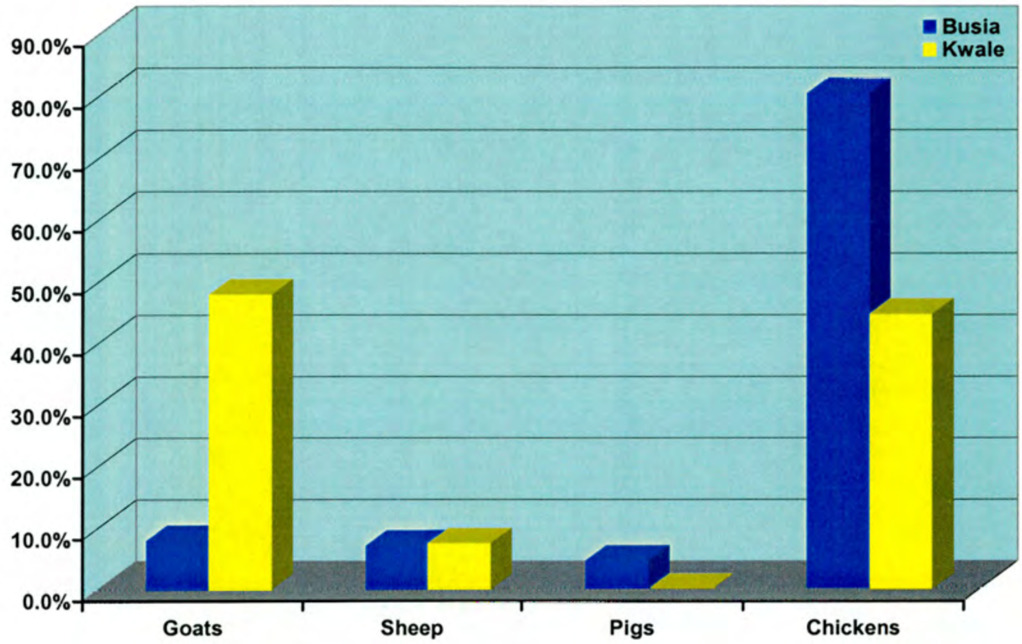


Figure 4.3 shows the proportion of the other livestock species kept on smallholdings by the farmers in the study. Sixty nine percent of the households keep sheep and/or goats, 90.3% keep poultry and 15.0% keep pigs (only in Busia District).

Figure 4.3: Profile of the other livestock species kept by small-scale farmers in the study sites of Busia and Kwale Districts, follow-up survey 2002



Forty-seven percent of the farmers in Busia District used manual labour to plough their fields, and 46.0% stated that they hired bulls for draught power and a further 2.2% owned their own working bulls (Plate 4.3). Ninety-three percent of the farmers, 67.0% of who owned their own bulls and the other 33.0% who hired from fellow farmers, practiced the use of draught power in Kwale. Almost all the farmers (95.7%) use manure in Busia and the corresponding number in Kwale is 82.9%. Average daily milk production was 1.0l/cow/day from 239 cows owned by the producers in the study in Busia, and 0.8l/cow/day from 778 cows in Kwale.

Plate 4.3: Use of Draught power in mixed crop-livestock production farming systems, Busia District, Kenya

© Dave Elsworth

Plate 4.4: Smallholder farmer watering and grazing his Cattle at the river in Funyula Division, Busia District

© Mark Eisler

4.4.3 Cattle management systems

The main system of grazing practiced by the farmers in Busia District (60.4%) in the survey was restricted grazing by tethering (Table 4.5). The other patterns of feeding were free range grazing, and a combination of fetching feed for the cattle and free-range grazing. On the other hand, almost all households (96.6%) in Kwale District left their cattle to graze free range, and the remaining farmers tethered their cattle.

Table 4.5 also shows the different sources that the farmers used to water their cattle. Seventy-one percent of the farmers in Busia District took them to the river (Plate 4.4), compared to 62.4% in Kwale District.

Table 4.5: Feeding and watering systems in Busia (n households = 139) and Kwale (n households = 117) Districts

	Busia		Kwale			Busia		Kwale	
Grazing	**n**	**%**	**n**	**%**	**Water**	**n**	**%**	**n**	**%**
Free-range	39	28.1	113	96.6	River	99	71.2	73	62.4
Tethered	84	60.4	3	2.6	Borehole	17	12.2	0	0.0
Combination	13	9.4	0	0.0	Well	15	10.8	35	29.9
No information	3	2.2	1	0.9	Fetch	4	2.9	0	0.0
					Other	4	2.9	9	7.7

Herding of cattle was mostly conducted by husbands (30.9% of the households), followed by the wives, children, herdsmen and other relatives. In Kwale, herdsmen formed the main group of cattle herders (31.6%), followed by the husbands, children, wives and other relatives (Table 4.6).

Table 4.6: Proportion of household members herding cattle, Busia (n households = 139) and Kwale (n households = 117) Districts, baseline survey 1999

	Busia		Kwale	
Herder	**n**	**%**	**n**	**%**
Husband	43	30.9	32	27.4
Wife	32	23.0	10	8.5
Children	21	15.1	20	17.1
Herdsman	19	13.7	37	31.6
Other	2	1.4	7	6.0
No information	22	15.8	11	9.4

At night, most of the farmers in Busia (79.9%) kept their cattle in an animal house, and the other farmers kept them in a cattle *boma*[3] or an open field. This practice was significantly different from the farmers in Kwale who mainly rested their cattle in *bomas* (89.7%) at night, and the rest in the open field, and only one farmer cited animal house as a resting place for his cattle.

For breeding, all the farmers in the survey in both districts exclusively used bulls and not artificial insemination for impregnating cows.

4.4.4 Sick cattle

During the baseline survey conducted in 1999, 133 farmers in Busia District described a total of 269 cattle disease episodes while those in Kwale District (116) described 268 (Figure 4.5). Meanwhile, during the 2002 follow-up survey, the number of sick cattle described by 145 farmers in Busia District and 108 in Kwale District was 373 and 310, respectively. The average number of sick cattle per household was 2.1 (median: 2, range: 0-6) during the baseline survey; the corresponding figures observed during the follow-up survey were similar, with the average being 2.6 (median: 3 and range: 0-6). Figure 4.4 shows the frequency of disease episodes reported by the farmers during the two surveys.

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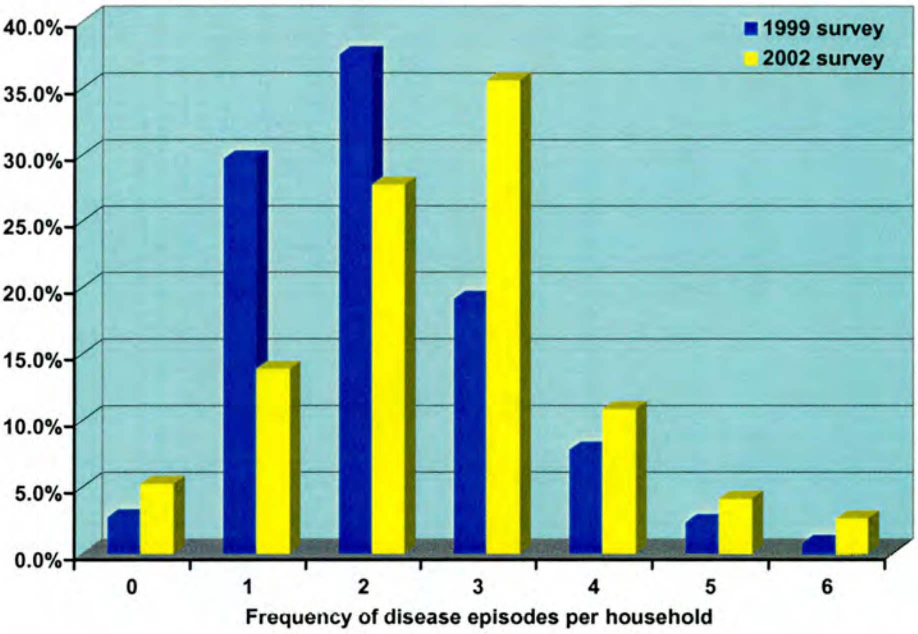
[3] *Boma* is a commonly used term in Kenya meaning 'livestock enclosure'.

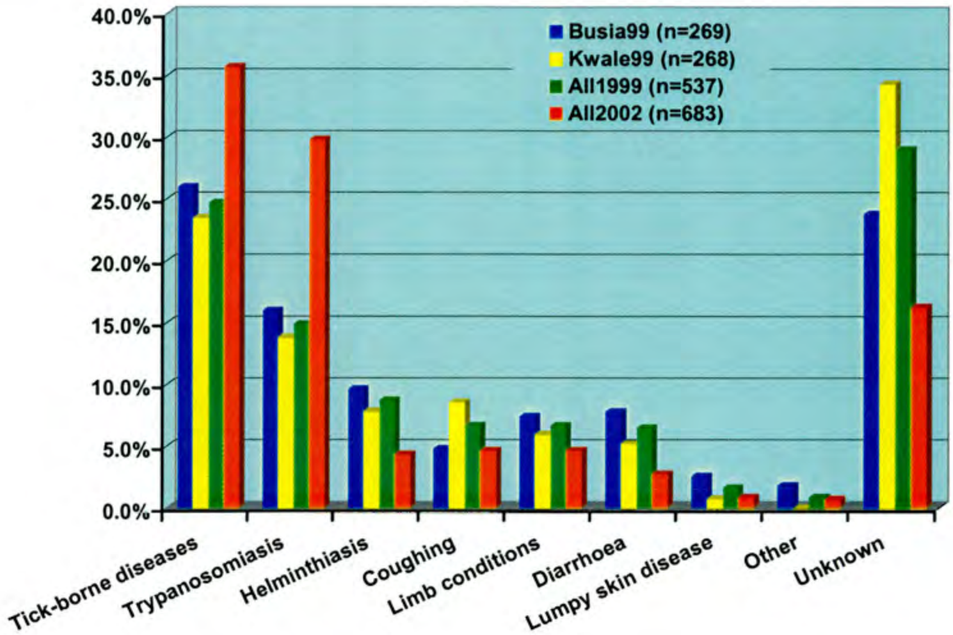
Figure 4.4: Proportions of farmers reporting different frequencies of disease episodes occurring over a one year period prior to the baseline (1999) and follow-up (2002) household interviews, Busia and Kwale Districts



4.4.5 Disease conditions perceived in cattle

All diseases described in local terms were assigned to the equivalent English/scientific disease group. The diseases most commonly described during the baseline survey were tick-borne diseases (25.7% [69/269] in Busia District and 23.1% [62/268] in Kwale District) (Figure 4.5). Of these, some were descriptions of tick-burdens without clinical illness (17/69 in Busia District and 3/62 in Kwale District). The next most commonly described disease was trypanosomiasis (43 [16.0%] in Busia District and 37 [13.8%] in Kwale District). This observed pattern of decreasing order in frequency of reported disease episodes occurring on small-scale farms in these study areas was similar in the follow-up survey during which farmers described a total of 683 disease conditions that occurred in their cattle within the one-year period prior to the interviews (Figure 4.5). Tick-borne diseases (TBD) formed the largest group (35.7%) of disease conditions mentioned, followed by trypanosomiasis (29.9%).

Figure 4.5: Bovine disease episodes observed by owners in Busia and Kwale Districts, Kenya during the baseline (1999) and follow-up (2002) household surveys



4.4.5.1 Farmers' attitudes towards trypanosomiasis

In both districts, animal diseases were ranked above other constraints associated with cattle production faced by farmers. This was followed by stock theft and animal feed in Busia Districts, and water and animal health services in Kwale District. Tick-borne diseases were reported as the most important disease by 37 (26.6%) respondents in Busia District and 19 (16.2%) respondents in Kwale District, followed by trypanosomiasis (20 [14.4%] and 10 [8.5%] respondents in Busia and Kwale Districts, respectively). Thirty-three (23.7%) and 57 (48.7%) individuals, in the two districts, respectively, did not offer an opinion on the most important disease constraint.

During the follow-up survey, farmers in the study area who were interviewed attached varying degrees of importance to trypanosomiasis. Most of them (48.3%, 129/267) considered it to be the most important and severe disease, with significantly more farmers from Busia District (58.2%, 92/158) than Kwale District (33.9%, 37/109) holding this view, $\chi^2 = 18.626, p < 0.001$. Meanwhile, 14.6% (39/267) of them felt that other diseases were a bigger problem although trypanosomiasis was a recognised problem; the proportions of respondents holding this view were similar in this instance (13.9% in Busia District and 15.6% in Kwale District). Nineteen percent (50/267) of the farmers regarded trypanosomiasis as not being a problem despite its occurrence, with two times more farmers holding this view in Kwale District (28.4%) than in Busia District (12.0%); whereas 18.3% (49/267) said that it is not present in their area (again, more farmers in Kwale District [22.0%] than in Busia District [15.8%] held this opinion).

When trypanosomiasis was ranked relative to other endemic diseases, it was the second most frequently mentioned disease (25.5%, 68/267) of importance in livestock next to TBD (44.2%, 118/267). There were no major differences in these views between the two districts in that similar proportions of farmers expressed these opinions for both trypanosomiasis (24.7% in Busia District and 26.6% in Kwale District) and TBD (47.5% in Busia District and 39.4% in Kwale District). Other diseases mentioned by a few farmers included foot lesions (9.7%, 26/267) and diarrhoea (9.4%, 25/267). Trypanosomiasis was mentioned by 17.2% (1/267) of respondents as being the first most important disease, while another 7.1% (1/267) respondents considered it to be the second most important livestock disease in their area.

4.4.6 Cattle health problems observed by farmers

Farmers in Busia District identified 60.7% (155/252) clinical disease episodes by disease names, while the remaining 39.3% (99/252) were either not named (but described only by their clinical signs) or named by clinical signs such as coughing or diarrhoea as presented in Figure 4.5. Kwale farmers identified 53.6% (142/265) clinical disease episodes by name and 46.4% (123/265) by their clinical signs only. Of those disease episodes named by farmers, 72.9% in Busia District, and 51.8% in Kwale District were characterised by clinical signs largely consistent with standard veterinary texts, and were therefore possibly correct diagnoses. The remaining 27.1% named disease episodes in Busia District, and 48.2% in Kwale District were characterised by clinical signs largely inconsistent with standard veterinary texts and were therefore unlikely to be correct diagnoses. Hence in Busia District 56.2% of all clinical disease episodes were either not identified, or probably identified incorrectly;

the corresponding figure for Kwale District was 72.5%. Overall in both districts, only 35.6% of the clinical disease episodes were possibly identified correctly by farmers, while 64.4% were either not identified or identified probably incorrectly. The clinical signs observed for all the diseases episodes described are presented in Appendix IX – Table II.

With particular reference to trypanosomiasis, there were differences between the two districts in the most commonly reported clinical signs that farmers observed in cattle they perceived to have had trypanosomiasis (Table 4.7a). Overall comparison of clinical signs related to trypanosomiasis described by respondents in the two surveys showed some similarities in the most frequently reported signs (e.g. staring coat, inappetence, weight loss and weakness) (Table 4.7b).

Fifty-four percent (23/43) of the trypanosomiasis cases reported by farmers in Busia District and 62.2% (23/37) in Kwale District were said to have resulted in death. The post mortem signs that were observed by these farmers (21 in Busia and 23 in Kwale Districts) in these carcases included splenomegaly (33.3% of farmers), enlarged bile ducts (19.0% of farmers) and hepatomegaly (14.3% of farmers) in Busia District, and soil in the stomach (21.7% of farmers) and abnormal lungs and livers (13.0% of farmers each) in Kwale District.

Table 4.7: Clinical signs most frequently observed by farmers for diseases they perceived to be trypanosomiasis in Busia and Kwale Districts, Kenya

a) Baseline survey (1999), comparison between respondents in Busia and Kwale Districts

Busia (n = 35 farmers)			Kwale (n = 30 farmers)		
Clinical Sign	**n**	**% of farmers**	**Clinical Sign**	**n**	**% of farmers**
Staring coat	20	57.1	Staring coat	9	30.0
Inappetence	18	51.4	Eating soil	8	26.7
Weight loss	12	34.3	Inappetence	7	23.3
Nasal discharge	8	22.9	Coughing	6	20.0
Weakness	7	20.0	Weakness	6	20.0
Dullness	4	11.4	Constipation	5	16.7
Lameness	4	11.4	Salivation	5	16.7
Constipation	3	8.6	Weight loss	3	10.0
Diarrhoea	3	8.6	Swollen lymph nodes	2	6.7
Eating soil	3	8.6	Teeth grinding	2	6.7
Reluctant to drink	3	8.6	Other[b]	1	3.3
Salivation	3	8.6			
Coughing	2	5.7			
Other[a]	1	2.9			

[a]Other = Aggression, Alopecia, Anaemia, Drooping ears, Fever, Lacrimation, Low milk production, Lumps on skin, Muscle twitching, Recumbent, Sloughing of skin, Swollen abdomen, Swollen lymph nodes, Tachypnoea, Tail alopecia (each stated by 1 farmer)

[b]Other = Aggression, Bleeding from ears, Bloody diarrhoea, Dyspnoea, Flatulence, Lacrimation, Lameness, Low milk production, Muscle twitching, Oral ulcerations, Photophobia, Sneezing, Swelling around eyes (each stated by 1 farmer)

b) Comparison between respondents during baseline (1999) and follow-up surveys (2002)

	Baseline survey 1999 (n = 65 farmers)			Follow-up survey 2002 (n = 149 farmers)	
Clinical Sign	**n**	**% of farmers**	**Clinical Sign**	**n**	**% of farmers**
Staring coat	29	44.6	Staring coat	97	65.1
Inappetence	26	40.0	Inappetence	92	61.7
Respiratory conditions	14	21.5	Demeanour	63	42.3
Weight loss	13	20.0	Weight loss	51	34.2
Eating soil	11	16.9	Discharges	48	32.2
Weakness	11	16.9	Weakness	47	31.5
Discharges	8	12.3	Respiratory conditions	25	16.8
Constipation	6	9.2	Oedema	20	13.4
Skin lesions	5	7.7	Constipation	19	12.8
Diarrhoea	4	6.2	Limb conditions	12	8.1
Other[a]	≤ 3	≤ 4.6	Eating soil	11	7.4
			Other[b]	≤ 6	≤ 4.0

[a]Other = Demeanour, Limb conditions, Nervous signs, Low milk yield, Oedema, Swollen lymph nodes, Muscle twitching, Anaemia, Bleeding from orifices, Fever, Flatulence, Photophobia

[b]Other = Diarrhoea, Nervous signs, Skin lesions, Reproductive conditions, Fever, Anaemia, Bleeding from orifices, Low milk yield, Swollen lymph nodes

4.4.7 Knowledge of bovine trypanosomiasis

Few farmers in Kwale District (23.1%, 27/117) were aware of the causal association between tsetse flies and trypanosomiasis, while much more of them (61.9%, 86/139) in Busia District were aware of it (Table 4.8). Some farmers associated trypanosomiasis with other organisms, feeding and watering at rivers or climatic factors (Table 4.8).

Table 4.8: Farmers' beliefs about the cause of bovine trypanosomiasis in Busia and Kwale Districts

	Believed cause	Busia		Kwale	
		n	%	n	%
Organisms	Tsetse fly bite	86	61.9	27	23.1
	Biting flies	11	7.9	1	0.9
	Tick bites	1	0.7	2	1.7
	Worms	0	0.0	1	0.9
Feeding and drinking	Watering animals at river	16	11.5	0	0.0
	Feeding on grass by the river	2	1.4	0	0.0
	Drinking water from stagnant pools	0	0.0	2	1.7
	Ingestion of soil or foreign bodies	0	0.0	4	3.4
Climate	Rainy season	4	2.9	0	0.0
	Cold weather	0	0.0	1	0.9
Not known		41	29.5	87	74.4

Disease causes mentioned by the farmers for the rest of the disease episodes are presented in Appendix IX – Table III. Twenty six percent (66/256) of the respondents mentioned at least one clinical sign that was consistent with trypanosomiasis, and more than half (55.5%, 142/256) of them mentioned at least one trypanocidal drug. The trypanosomiasis knowledge scores attained by the respondents are indicated in Table 4.9.

For the overall assessment of trypanosomiasis knowledge, the average score obtained by the respondents was 2.6 (range: 0-11); the average score for knowledge of trypanosomiasis aetiology and associated factors was significantly higher in Busia District than in Kwale District (Table 4.9). Meanwhile, average score for knowledge of trypanocidal drugs was significantly lower for female respondents compared to that attained by their male counterparts (Table 4.9). In accordance with the knowledge criteria described in the materials and methods in section 4.2.4 above, the proportion of respondents within the 'Has knowledge' group came to 45.3%

(116/256), thus only three new respondents (all male and all from Kwale District) who did not mention tsetse flies joined the group of respondents that initially mentioned them (Table 4.8). The remaining respondents who did not meet these criteria were assigned to the 'Lacks knowledge' group.

Table 4.9: Trypanosomiasis knowledge scores obtained by respondents in Busia and Kwale Districts

	Busia (n=139)	Kwale (n=117)	Female (n=109)	Male (n=147)
Tsetse knowledge score				
Mean	1.7	0.6	1.2	1.2
Median	2	0	2	1
Sample Variance	1.57	0.91	1.33	1.79
Range	0-4	0-3	0-4	0-4
Mean rank	153.6	98.7	131.5	126.3
Mann-Whitney U	4644.0		7689.0	
p-value	<0.001		0.255	
Clinical signs knowledge score				
Mean	0.5	0.4	0.4	0.5
Median	0	0	0	0
Sample Variance	0.87	0.78	0.58	1.00
Range	0-4	0-4	0-3	0-4
Mean rank	132.4	123.8	122.3	133.1
Mann-Whitney U	7586.0		7335.5	
p-value	0.115		0.066	
Treatment knowledge score				
Mean	0.4	1.5	0.7	1.1
Median	0	2	0	1
Sample Variance	0.52	1.06	0.74	1.22
Range	0-4	0-4	0-4	0-4
Mean rank	127.4	129.8	124.5	131.5
Mann-Whitney U	7982.5		7570.0	
p-value	0.289		0.026	

4.4.7.1 Factors influencing bovine trypanosomiasis knowledge

In order to account for the influence experience of trypanosomiasis might have on the respondents' knowledge, those who mentioned having had trypanosomiasis (25.4%, 65/256) in their cattle in the year prior to the interview were assessed separately from those that did not (74.6%, 191/256). This was a justified decision as there was a marked difference in knowledge between the two groups; more than twice as many respondents who had trypanosomiasis in their herds also 'had knowledge' (83.1%, 54/65) compared to those that had no trypanosomiasis in the previous year (32.5%, 62/191), $\chi^2 = 50.14, p < 0.001$.

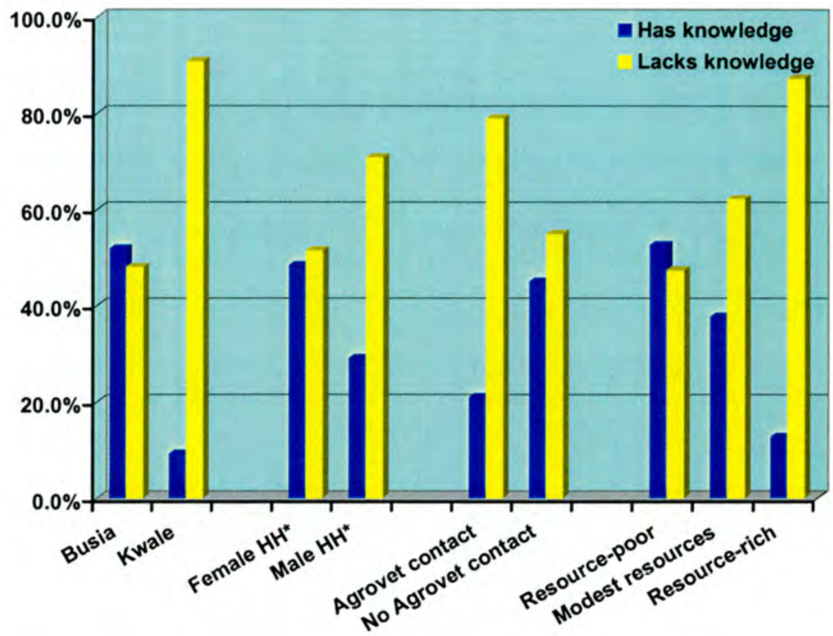
Respondents without bovine trypanosomiasis in the previous year

The factors that were significantly associated with trypanosomiasis knowledge in this group of respondents included location ($\chi^2 = 39.45, p < 0.001$), gender of the household head ($\chi^2 = 4.67, p = 0.031$), household resources ($\chi^2 = 19.44, p < 0.001$) and contact with Agrovet traders for trypanosomiasis information ($\chi^2 = 12.58, p <$ 0.001) (Figure 4.6). Respondents in Busia District were significantly more likely to have trypanosomiasis knowledge than those in Kwale District (OR: 6.58, 95% CI: 2.46-17.65). On the other hand, those in contact with Agrovet traders were the least likely to have knowledge than those without (OR: 0.61, CI: 0.29-1.27), however, this was not statistically significant in its predictive value. When it came to household resources, respondents from poorer households were more likely to have knowledge than those from richer ones (OR: 1.96, 95% CI: 0.61-6.32); similarly, respondents from moderately resourced households were more likely to have knowledge than those from richer ones (OR: 1.49, 95% CI: 0.54-4.13). Finally, respondents from female headed households had a higher likelihood of having trypanosomiasis knowledge than their male counterparts (OR: 1.23, 95% CI: 0.53-2.89).

Respondents with bovine trypanosomiasis in the previous year

None of the social variables were significantly associated with trypanosomiasis knowledge in the group of respondents who had experienced bovine trypanosomiasis on their farms (although two variables, location and contact with fellow farmers for trypanosomiasis information, were both borderline, with $p = 0.052$ and 0.057, respectively).

Figure 4.6: Factors significantly associated with trypanosomiasis knowledge of the respondents who had not experienced bovine trypanosomiasis in the previous year in their cattle, Busia (n respondents = 104) and Kwale (n respondents = 87) Districts

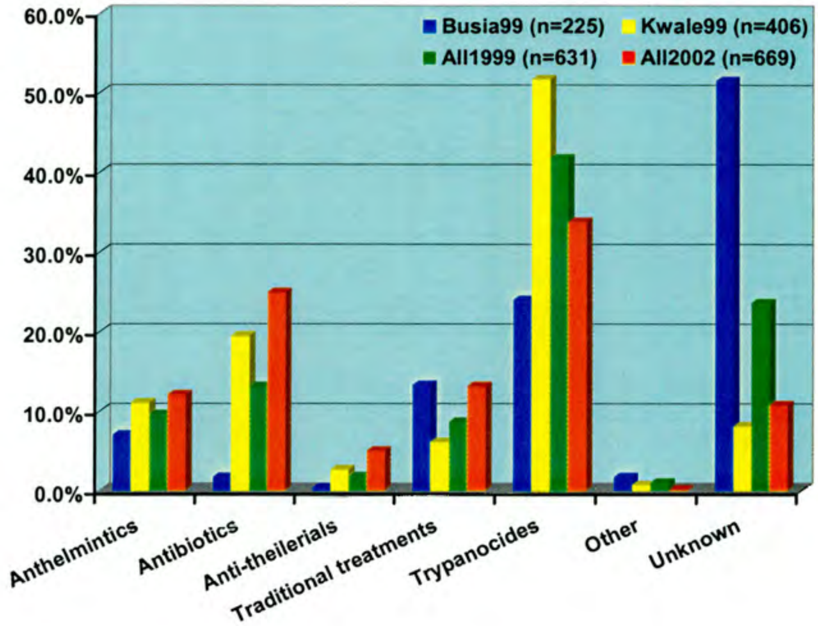


*HH: household head

4.4.8 Animal health management practices of farmers

The baseline household survey showed that trypanocides were the most commonly administered drug in response to perceived illnesses in cattle in Busia (17.9%, 54/302) and Kwale Districts (48.1%, 204/424) (Figure 4.7). Busia District had a high proportion of 'unknown' drugs, 81.6% of these were administered by animal health assistants (AHAs). The follow-up household survey showed that trypanocides, again, formed the largest proportion (33.8%) of the drugs administered to cattle (Figure 4.7).

Figure 4.7: Proportions of medications used against bovine diseases described by respondents during the baseline survey (1999) and follow-up household surveys (2002) in Busia and Kwale Districts, Kenya



4.4.8.1 Indications for use of trypanocides

Table 4.10 shows the indications for use of trypanocidal drugs by farmers. Overall in the two districts, 53.5% (76/142) of trypanocidal drug treatments were administered inappropriately, i.e. to conditions they perceived to be diseases other than trypanosomiasis. There was no significant difference ($\chi^2 = 5.80, p = 0.016$) in this respect between Busia and Kwale Districts.

Table 4.10: Indications for use of trypanocides in cattle by farmers in Busia and Kwale Districts, baseline survey 1999

		Trypanosomiasis		Non-trypanosomiasis		Total
		n	%	*n*	%	*n*
Trypanocides	Busia	24	63.2	14	36.8	38
	Kwale	42	40.4	62	59.6	104
	Both	66	46.5	76	53.5	142
Non-trypanocides	Busia	5	7.6	61	92.4	66
	Kwale	17	15.7	91	84.3	108
	Both	22	12.6	152	87.4	174
Total	Busia	29	27.9	75	72.1	104
	Kwale	59	27.8	153	72.2	212
	Both	88	27.8	228	72.2	316

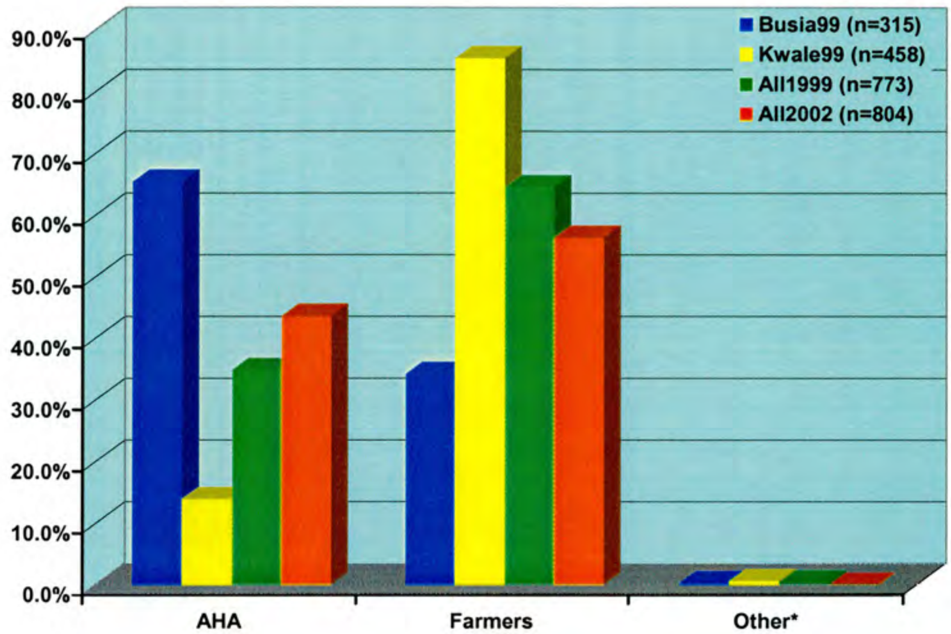
With respect to choice of drug for the treatment of conditions perceived by farmers to be trypanosomiasis, three quarters (66/88) of these conditions were appropriately treated with trypanocides, the remainder having been treated with non-trypanocidal drugs. There was no significant difference ($\chi^2 = 1.39, p = 0.239$) in this respect between Busia and Kwale Districts. However, one third (76/228) of conditions perceived by farmers to be non-trypanosomiasis were inappropriately treated with trypanocides. There was a significant difference ($\chi^2 = 10.8, p = 0.001$) in this respect between Busia and Kwale Districts.

In Busia District, ecto-parasiticides were the most commonly used ecto-parasite treatment (112/131 [85.5%]); the remainder of the treatments consisted of traditional methods (i.e. hand-washing with kerosene or hand-picking of ticks from cattle). The corresponding figures for Kwale District were 90/96 (93.7%) for ecto-parasiticides with the remainder consisting of traditional methods.

4.4.8.2 Provision of animal healthcare

The proportions of individuals who administered drugs to cattle are shown in Figure 4.8. In Busia District, cattle owners and fellow farmers administered 108/315 (34.3%) drug treatments; of these, 74 were administered without any professional (i.e. AHAs and local agro-veterinary [Agrovet] traders) advice. The corresponding figure for Kwale District was much higher at 391/458 (85.4%), 220 of which were administered without any professional advice. The follow-up survey showed no marked differences in overall proportions of people administering drugs and applying ecto-parasiticides to cattle (Figure 4.8), $\chi^2 = 1.695, p = 0.193$.

Figure 4.8: Proportions of animal healthcare providers who administered medications and ecto-parasiticides to cattle in Busia and Kwale Districts, Kenya



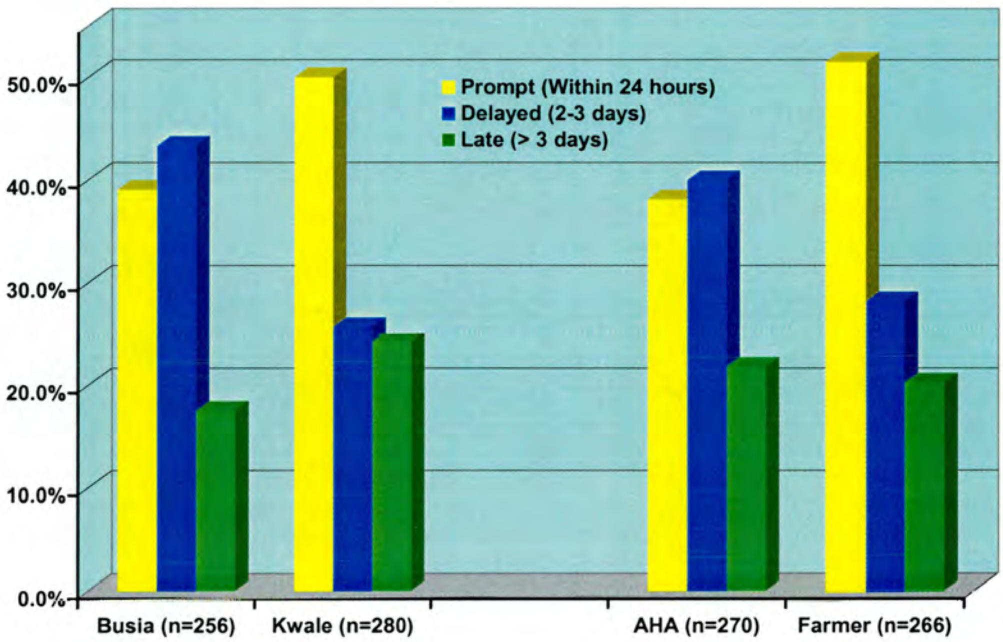
Other* = Agrovet shop-keepers and extension workers

The supply of drugs for the farmers came mainly from AHAs (50.6% in Busia District and 30.1% in Kwale District) and Agrovets (22.8% in Busia District and 52.0% in Kwale District). In Busia District, advice and information on cattle disease management was sought from AHAs (46.3%), cattle owners and fellow farmers (39.9%) and Agrovets (11.8%). In Kwale District, cattle owners relied on themselves and fellow farmers (44.1%) for advice and information on animal health issues, and also on AHAs (30.6%), and Agrovets (20.0%).

4.4.8.3 Time taken to treat sick cattle

Farmers' responses to the question 'how soon did the animal receive treatment after you noticed it was ill' showed that less than half of the sick cattle that received therapeutic treatments were attended to promptly (Figure 4.9). A 'prompt' treatment response was defined as therapeutic treatment (and not ecto-parasite control) given to an animal within 24 hours of becoming aware of abnormal signs indicative of disease. A treatment response was considered to be 'delayed' when administered 2-3 days after first becoming aware of onset of disease, and 'late' when treatment occurred more than three days later. An assessment of factors associated with timing of treatment of sick cattle showed that prompt treatments were administered largely by the cattle owners and fellow farmers ($\chi^2 = 10.959, p = 0.004$); whereas with respect to location, more disease episodes in Kwale District than in Busia District received prompt treatment ($\chi^2 = 18.622, p < 0.001$).

Figure 4.9: Time taken for sick cattle to receive therapeutic interventions in Busia and Kwale Districts, Kenya, follow-up survey 2002



4.4.8.4 Multiple trypanocidal treatments

Twenty-two percent (118/536) of the animals that received therapeutic treatments were given multiple treatments of drugs, while the remainder received single treatments only. Table 4.11 shows four patterns of multiple drug treatments that were identified. The common multiple treatment practice was giving different drugs to sick cattle simultaneously (44.9%, 53/118). Twenty-nine percent (34/118) of the multiple treatments involved administration of two-to-three trypanocides to treat individual disease episodes in cattle (Table 4.11).

Table 4.11: Number of therapeutic treatments for single disease episodes between July 2001 and July 2002, Busia and Kwale Districts

Treatment occasion	Drug types	Busia (n = 23)		Kwale (n = 95)		Total (n = 118)	
		n	%	n	%	n	%
Same	Trypanocides[a]	5	21.7	23	24.2	28	23.7
Different	Trypanocides[a]	0	0.0	6	6.3	6	5.1
Same	Other drugs[b]	8	34.8	45	47.4	53	44.9
Different	Other drugs[b]	10	43.5	21	22.1	31	26.3

[a]Two or three trypanocides

[b]Other drugs with or without one trypanocide

4.4.8.5 Relationship between use of cattle products and farmers' animal health input levels

Animal health input levels towards the disease conditions described by farmers in the study sites, and determined according to the criteria described in Chapter III, were mostly of 'high' (45.7%, 242/530) and 'low' (39.8%, 211/530) input levels, whereas the remaining disease conditions had 'no inputs' (14.5%, 77/530) because they were either not treated or only ecto-parasiticides were used. These input levels varied significantly between the two districts ($\chi^2 = 32.81, p < 0.001$) in that more farmers in Busia District (22.5%, 60/267) had 'no inputs' towards disease management than those in Kwale District (6.5%, 17/263), and also fewer disease episodes received low inputs in Busia District (31.5%, 84/267) than in Kwale District (48.3%, 127/263), but the proportion of those that received high inputs were similar in both districts. With respect to ownership of draught cattle, fewer of the disease episodes that occurred in households that owned them were left untreated (6.8%, 12/176) compared to those that occurred in households that did not own them (18.4%, 65/354), $\chi^2 = 13.39$, p = 0.001. A household's use of other cattle products such as sale of milk and use of cattle dung as manure in crop fields had no significant association with input levels towards disease management. The level of household resources also had a significant association with level of animal health inputs in that twice as many resource-poor farmers (25.0%, 26/104) had no inputs towards disease management compared to either resource-rich (11.0%, 21/191) or moderately resourced (12.8%, 30/235) farmers ($\chi^2 = 12.90, p = 0.012$). However, the proportions of disease episodes that received high inputs were similar across all the three household resource level groups (45.5% disease episodes in the resource-rich group, 46.4% in the moderate resources and 44.2% in the resource-poor groups).

4.4.9 Predictive factors of animal health management practices

4.4.9.1 Treatment of disease conditions vs. non-treatment

The social variables that were significantly associated with whether or not cattle diseases were treated include district, education level of household head, duration of cattle-keeping, household resources status and their attitude towards trypanosomiasis (whether or not they considered trypanosomiasis to be a severe disease constraint to livestock production in their respective areas) (Table 4.12a). The significant biological variables include inappetence, demeanour, respiratory signs, lacrymation/salivation, diarrhoea, disease cause and total number of clinical signs observed (Table 4.12b). These variables were fitted into two separate logistic regression models to determine the factors that significantly influenced the decision to treat a sick animal. The results indicate that sick cattle in Busia District were less likely to receive treatment than those in Kwale District. Sick cattle owned by non-formally educated household heads and those with a primary education had very reduced likelihood of being treated. The belief that trypanosomiasis was not a severe disease constraint in the area also decreased the likelihood of sick animals receiving treatment. Presence of inappetence and lacrymation/salivation highly increased the likelihood of an animal being treated; whereas absence of clinical signs such as dullness and respiratory signs greatly reduced the likelihood of receiving treatment. Disease conditions that farmers perceived to have been caused by ticks were eight times less likely to receive treatment than those perceived to have been caused by tsetse flies.

Table 4.12: Predictive factors towards treatment of bovine disease episodes (n = 683) in Busia and Kwale Districts

(a) Social factors

Variable	Treatment given			Wald	*p*-value	OR[a]	95% CI[b] for OR[a]	
	Frequency	Yes (%)	No (%)				Lower	Upper
District								
Busia	145	78.6	21.4	8.673	0.003	0.169	0.052	0.552
Kwale	108	95.4	4.6					
Household head education level								
Secondary	51	98.0	2.0	5.663	0.059			
None	107	84.1	15.9	5.449	0.020	0.083	0.010	0.671
Primary	95	81.1	19.9	5.412	0.020	0.084	0.010	0.677
Cattle-keeping duration								
3-10 years	123	85.4	14.6	3.504	0.173			
>10 years	105	90.5	9.5	0.010	0.920	1.048	0.418	2.629
≤2 years	25	68.0	32.0	3.023	0.082	0.371	0.121	1.135
Resources status								
Rich	70	95.7	4.3	1.781	0.410			
Poor	41	68.3	31.7	1.551	0.213	0.367	0.076	1.778
Moderate	142	85.9	14.1	0.536	0.464	0.588	0.142	2.433
Trypanosomiasis attitude								
Not severe	127	81.9	18.1	6.020	0.014	0.349	0.151	0.809
Severe	126	89.7	10.3					
Constant	24.577				<0.001	693.759		

[a]OR: Odds ratio

[b]CI: Confidence interval

(b) Biophysical factors

Parameter	Treatment given			Wald	*p*-value	OR[a]	95% CI[b] for OR[a]	
	Frequency	Yes (%)	No (%)				Lower	Upper
Inappetence								
Yes	237	91.1	8.9	9.191	0.002	2.513	1.385	4.560
No	446	71.7	28.3					
Dullness								
No	531	74.4	25.6	5.493	0.019	0.399	0.185	0.861
Yes	152	92.8	7.2					
Respiratory signs								
No	563	75.7	24.3	5.059	0.024	0.427	0.203	0.896
Yes	120	91.7	8.3					
Lacrymation/salivation								
Yes	113	93.8	6.2	4.161	0.041	2.514	1.037	6.098
No	570	75.4	24.6					
Diarrhoea								
Yes	67	91.0	9.0	0.913	0.339	1.603	0.609	4.223
No	616	77.1	22.9					
Perceived disease cause								
Other/Unknown	226	89.4	10.6	68.263	0.000			
Ticks	236	54.2	45.8	36.900	0.000	0.181	0.105	0.315
Tsetse flies	221	93.2	6.8	1.337	0.248	1.526	0.745	3.125
No. clinical signs observed								
1	166	56.5	43.5	3.215	0.200			
2	239	79.9	20.1	3.081	0.079	1.591	0.947	2.674
≥3	278	90.3	9.7	1.434	0.231	1.549	0.757	3.170
Constant				24.002	0.000	17.333		

[a]OR: Odds ratio

[b]CI: Confidence interval

4.4.9.2 Early vs. late treatment response towards bovine diseases

The social variables that were significantly associated with time taken by farmers to respond to bovine diseases by administering treatment, included farmers' education level ($\chi^2 = 6.72, p = 0.035$) and their attitude towards trypanosomiasis ($\chi^2 = 3.38, p = 0.048$). As for the biological nature of the disease conditions, the significant variables associated with timing of response to illness were clinical signs including inappetence ($\chi^2 = 4.17, p = 0.027$), staring coat ($\chi^2 = 13.63, p < 0.001$) and limb lesions ($\chi^2 = 7.87, p = 0.002$) and perceived cause of the disease ($\chi^2 = 8.66, p = 0.011$). These variables were fitted into two separate logistic regression models to determine their usefulness in predicting farmers' behaviour in this aspect of animal health management. A treatment response was considered to be 'early' when administered either 'promptly' within 24 hours or when 'delayed' by 2-3 days after first becoming aware of the illness, whereas any treatment administered more than three days later was considered to be 'late'.

Social factors

When 'late' treatment response was assessed in relation to 'early' treatment response, the regression analysis indicated that cattle producers with no formal education (OR: 0.876, 95% CI: 0.393-1.954) had reduced odds of responding early to bovine illnesses with reference to those with a secondary school education; however, this finding was not statistically significant as a predictive factor ($p = 0.746$). Similarly, those with a primary school education (OR: 0.334, 95% CI: 0.126-0.884) had even more reduced odds (and statistically significant, $p = 0.027$) of responding early to cattle illnesses. Farmers who considered trypanosomiasis not to be severe in their areas were more likely to offer late treatments to their sick cattle than those who felt otherwise (OR: 1.780, 95% CI: 0.890-3.559); however this was not statistically significant ($p = 0.103$).

Biophysical factors

Cases that did not exhibit clinical signs such as a staring coat (OR: 0.466, 95% CI: 0.278-0.780) and limb lesions (OR: 0.222, 95% CI: 0.077-0.637) were significantly ($p = 0.004$ and 0.005, respectively) less likely to be given early treatment than those that did. Meanwhile, cattle that were inappetent (OR: 0.717, 95% CI: 0.463-1.110), also had decreased likelihood of receiving an early treatment intervention, but this finding was not significant ($p = 0.136$). Beliefs that ticks were the causative agents of bovine disease did not make any difference (OR: 1.096, 95% CI: 0.645-1.862) as to whether or not a farmer would respond early to the perceived illness, whereas beliefs that tsetse flies were the causative agents strongly (and significantly – $p = 0.005$) raised the likelihood (OR: 2.106, 95% CI: 1.248-3.553) of sick cattle being offered medications early.

4.4.9.3 Use of traditional treatments vs. allopathic

When patterns of use of allopathic (or modern) veterinary drugs were compared to use of traditional remedies, the only social variable that was significantly associated with this was the farmer's education level. The biological variables associated with this included perceived disease cause, staring coat and limb lesions. Only 443 disease conditions that received treatment were included in this analysis as the other 93 treatments were neither named nor described by the respondents.

Social factors

With reference to having a secondary school education, sick cattle from households where the owner has no formal education were less likely to receive modern treatments (OR: 0.091, 95% CI: 0.012-0.711, $p = 0.022$), as were those from households where the owner had a primary school education (OR: 0.464, 95% CI: 0.047-4.602), although this was not significant ($p = 0.512$).

Biophysical factors

When disease cause was considered to be tsetse-borne (with reference to diseases thought to be caused by other known and unknown pathogens) by the cattle owners, the likelihood of using traditional remedies decreased significantly (OR: 0.358, 95% CI: 0.176-0.728, $p = 0.005$). Similarly, when ticks were thought to be the cause of the illness, traditional remedies were less likely to be used (OR: 0.646, 95% CI: 0.320-1.303); however, this was not statistically significant ($p = 0.222$). Traditional remedies were significantly less likely to be used on cattle without limb lesions (OR: 0.346, 95% CI: 0.169-0.707, $p = 0.004$), whereas those not exhibiting signs of a staring coat were more likely to be treated with traditional remedies (OR: 2.328, 95% CI: 1.167-4.646, $p = 0.017$).

4.4.9.4 Use of trypanocides vs. non-trypanocidal drugs

Occasions of using trypanocides or non-trypanocides were not significantly associated with any particular household social characteristics including the farmers' attitudes towards trypanosomiasis; therefore no logistic regression model was fitted to the social variables. However, some aspects of the biological nature of the diseases were significantly associated with whether trypanocides or non-trypanocides were used for treatment, which were all fitted into a logistic regression model (Table 4.13). A total of 437 disease episodes data was used for this analysis where an animal received treatment as the medications used in 99 cases were not known.

Table 4.13: Biological factors predicting the use of trypanocidal drugs to treat bovine disease conditions (n = 434) in Busia and Kwale Districts

Variable	Trypanocide used			Wald	*p*-value	OR[a]	95% CI[b] for OR[a]	
	Frequency	Yes (%)	No (%)				Lower	Upper
Inappetence								
Yes	183	52.5	47.5	6.145	0.013	1.883	1.142	3.106
No	251	36.6	63.4					
Staring coat								
No	286	54.3	45.7	3.347	0.067	0.627	0.38	1.034
Yes	148	37.4	62.6					
Dullness								
No	325	34.8	65.2	13.191	0.000	0.368	0.215	0.631
Yes	109	67.9	32.1					
Respiratory signs								
No	341	40.8	59.2	1.351	0.245	0.730	0.429	1.241
Yes	93	52.1	47.9					
Diarrhoea								
Yes	48	18.8	81.2	7.411	0.006	0.311	0.134	0.721
No	386	46.3	53.7					
Animal affected								
Calf	58	27.6	72.4	2.706	0.258			
Cow	271	45.8	54.2	2.181	0.140	1.694	0.842	3.409
Bull	105	43.8	56.2	2.556	0.110	1.874	0.818	4.047
Perceived disease cause								
Other/Unknown	172	36.0	64.0	20.972	0.000			
Ticks	89	25.8	74.2	5.963	0.015	0.462	0.249	0.859
Tsetse	173	59.5	40.5	6.414	0.011	1.872	1.152	3.041
No. clinical signs observed								
1	68	30.9	69.1	2.669	0.263			
2	164	34.8	65.2	0.965	0.326	0.710	0.359	1.405
≥3	202	54.1	45.9	0.022	0.882	1.061	0.489	2.300
Constant				0.300	0.584	1.414		

[a]OR: Odds ratio

[b]CI: Confidence interval

Overuse of trypanocidal drugs

Conditions during which trypanocides were overused (i.e. use of two or three trypanocides for one disease episode) were examined and compared to those when only one trypanocide was used. Overall, 44.2% (118/267) of the farmers used trypanocidal drugs on at least one occasion to treat their sick cattle, and 16.9% (20/118) of these farmers used 2-3 trypanocidal drugs to treat one disease episode. The cross-tabulation of these data indicated that this practice was significantly associated with socio-economic variables such as district ($\chi^2 = 5.659, p = 0.015$), household head age ($\chi^2 = 6.740, p = 0.047$), education level ($\chi^2 = 6.713, p = 0.028$), and farmer's household resources status ($\chi^2 = 9.253$, $p = 0.004$). Meanwhile, the biophysical variables that were significantly associated with overuse of trypanocides included respiratory signs ($\chi^2 = 4.598$, $p = 0.032$) and appearance of a dull demeanour ($\chi^2 = 4.235$, $p = 0.040$).

Fewer sick animals owned by farmers in Busia District (7.7%, 4/52) compared to those in Kwale District (24.2%, 16/66) received two or three trypanocides. More cattle owned by young (38.5%, 5/13) and old (21.1%, 8/38) household heads received more than one trypanocides than those owned by middle-aged household heads (10.4%, 7/67). With respect to education, overuse of trypanocides occurred mostly in households where farmers had a primary (27.3%, 12/44) or a secondary (17.2%, 5/29) school education unlike in households where the farmers had no formal education (6.7%, 3/45). Having poor household resources ensured no overuse of trypanocides (0/15) unlike the evidence observed for moderately (12.5%, 8/64) and richly (30.8%, 12/39) resourced households.

More animals showing a dull demeanour (25.0%, 19/76) received more than one trypanocide than those that did not (13.3%, 15/113), meanwhile, the converse was true with respect to respiratory signs in that fewer animals that exhibited this sign received more than one trypanocide (8.0%, 4/50) unlike those that did (21.6%, 30/139). Although perceived disease cause was not significantly associated with overuse of trypanocides ($\chi^2 = 4.408$, $p = 0.110$), there was, nonetheless, more animals believed to be suffering from tsetse-borne disease (22.3%, 23/103) that received more than one trypanocide compared to those believed to be suffering from TBD (4.3%, 1/23) or other known and unknown causes (15.9%, 10/63).

4.4.9.5 Use of trained animal health workers vs. farmer treatments

Seeking animal health care services from an AHA was significantly associated with location ($\chi^2 = 65.105$, $p \leq 0.001$), farmers main occupational activity ($\chi^2 = 5.876$, $p = 0.011$), household resources status ($\chi^2 = 14.356$, $p = 0.001$) and attitude towards trypanosomiasis ($\chi^2 = 14.625$, $p \leq 0.001$). The biophysical variables significantly associated with choice of AHA for drug administration included signs of a staring coat ($\chi^2 = 7.69$, $p = 0.01$), weight loss ($\chi^2 = 13.85$, $p < 0.001$), number of clinical signs observed ($\chi^2 = 7.24$, $p = 0.03$), believed cause of disease ($\chi^2 = 16.84$, $p < 0.001$)

and type of drug given ($\chi^2 = 61.96, p < 0.001$). However, the only significantly important factor in predicting choice of AHA for disease treatment was living in Busia District which greatly raised the probability of this event happening (OR: 12.656, 95% CI: 5.337-30.008). Weight loss was the most important clinical sign in predicting choice of animal health care provider, with the results indicating that its absence significantly decreased the chances of choosing an AHA to treat the animal (OR: 0.479, 95% CI: 0.295-0.779). Not surprisingly, AHAs were very unlikely to be chosen to administer traditional remedies to sick cattle (OR: 0.073, 95% CI: 0.025-0.209); meanwhile, administration of antibiotics to sick cattle, with reference to trypanocides, was more likely to be conducted by AHAs (OR: 1.560, 95% CI: 1.020-2.403).

4.5 Discussion

The cattle production and healthcare systems of Busia and Kwale Districts were investigated to understand the cattle producers' perceptions of trypanosomiasis and its control. This study provided baseline data intended for use in formulating extension messages to improve the targeting and usage of drugs for the control of African bovine trypanosomiasis within the context of primary animal healthcare. This study focused on trypanosomiasis and use of trypanocidal drugs because of observed indications of their overuse and misuse by farmers in the study sites from a previous cross-sectional survey of trypanocidal drug resistance (Murilla *et al.*, 1998, Mdachi, 1999). Furthermore, the follow-up survey (whose main purpose was to evaluate the impact of communication material on trypanosomiasis knowledge in the study communities described in Chapter VII) offered an opportunity to triangulate the baseline survey findings, as well as to assess the predictive factors that may influence farmers veterinary care-seeking behaviour (section 4.4.9 above).

The studies showed that many of these farmers have been rearing cattle for a relatively short time and had, therefore, little knowledge of animal health. Some livestock keepers had some understanding of their animals' diseases and ways of classifying, recognising and treating them. This lack of knowledge can be attributed to short length of time in cattle ownership and the fact that they had previously relied on the government veterinary services, and have only recently had to deal with these problems for themselves. It is also worth noting that these farmers are unlike pastoralists whose main occupation is stock-raising, and therefore, have a better indigenous knowledge of animal diseases (Sollod and Stem, 1991).

Trypanosomiasis was considered to be an important cattle disease problem by only a minority of farmers in the study (11.3%); this may be an underestimate, as it does not include the 35.2% who did not proffer an opinion as they considered all diseases to be important. Furthermore, they often considered diseases that had occurred in their own cattle to be 'the most important disease' without considering which ones were the most prevalent diseases in their area. A better reflection of farmers' attitudes towards trypanosomiasis was obtained during the follow-up survey when they were asked to state how important they considered trypanosomiasis to be in their respective areas relative to other endemic diseases, and also on a scale from 'not present' to 'severe'. It was, thus, possible to avoid having respondents only mention those diseases that had occurred on their farms as the most important diseases. Trypanosomiasis also accounted for 14.9% of the diseases that farmers had perceived in their cattle; this figure increased to 29.9% during the follow-up study. The use of pair-wise ranking as a participatory discussion tool during focus group meetings was effective in drawing out the matters that worry farmers in the various livestock diseases, and in turn why they consider some livestock diseases to be more important than others. An understanding of these matters is important when considering disease control measures such as extension programmes. Such information helps researchers and animal health and extension workers to predict impact of information dissemination on smallholder livestock-keeping (Mitchell and Branigan, 2000).

Although 44.1% of farmers in the study said tsetse flies were the cause of trypanosomiasis, they were not considered to be the sole aetiological factor. Sixteen percent of farmers, including those who cited tsetse flies, in Busia District also considered watering and grazing animals by the river and the rainy season to be associated with trypanosomiasis. This is consistent with the presence of riverine tsetse flies in western Kenya (Ford and Katondo, 1977). Fifty-four percent of farmers in the study either did not know the cause or reported causes that do not conform to the accepted scientific aetiology of trypanosomiasis.

Farmers also did not appear to be good at recognising diseases from the clinical signs they observed. Almost two thirds of clinical disease episodes were either not identified or identified probably incorrectly since the majority of clinical signs observed were inconsistent with accepted veterinary knowledge of the supposed condition. The remaining one third of disease episodes that were classified as (possibly) identified correctly by farmers may be an overestimate of the true correct proportion, in that the criteria used for a correct diagnosis were not particularly stringent. This evidence for widespread inability of farmers to make correct diagnoses suggests that veterinary extension targeting this area will be essential to improve farm-level disease control.

A general problem reported by many livestock keepers during interviews was their limited knowledge of use and specificity of modern drugs. This is supported by evidence from the baseline study that trypanocidal drugs are used more frequently (Figure 4.7) than the frequency of trypanosomiasis reported by farmers. This practice is further illustrated by the fact that 53.5% of trypanocides were inappropriately used to treat cases perceived by farmers not to be trypanosomiasis (Table 4.10). During FGD, farmers made it clear that there are rarely any discussions of the presenting problems held with animal health workers when they are called upon to attend to sick animals and therefore remained without any knowledge of the drugs that the AHAs give to their animals. The improper drug practice would be another key matter for veterinary extension, as it could lead to build up of drug resistance and can be harmful (Stevenson *et al.*, 1993, Eisler *et al.*, 1997a; Geerts & Holmes, 1998). To investigate further the activities surrounding bovine disease management, a subset of farmers from this study were interviewed, and physical examination of their cattle was also conducted with their participation as described in Chapter V.

Overall, farmers and their neighbours were the main administrators of drugs to cattle in Busia and Kwale Districts (Figure 4.8). Livestock owners relied on modern veterinary products although they were not always knowledgeable about their application (Table 4.10). However, the results from the study also showed that some of these livestock owners did obtain information about modern drugs and their posology from AHAs and Agrovets. Further details of sources of knowledge about agriculture and veterinary products in particular are discussed in Chapter VI.

Further work will be required to develop diagnostic methodologies that are more 'user-friendly' for farmers in order to improve their basis for treatment decisions. Use of the clinical appraisal of ocular mucous membranes has recently been applied in the treatment of sheep infected with the blood-sucking nematode *Haemonchus contortus* (van Wyk *et al.*, 1997). This has led to the development of Famacha©, a simple colour chart guide for farmers which can be used as a basis for anthelmintic treatment. A simplified version of the colour chart has also been incorporated in the DFID/KARI Technical Manual of Integrated Helminth Control for diagnosis of liver fluke and haemonchosis (Bain, 1999). Other methods of assessment of anaemia that may be suitable for use at the farmer level, after appropriate training, include the WHO Colour Scale for detecting anaemia (developed for analysing the impact of malaria in endemic areas [Lewis *et al.*, 1998]); such applications could be adapted for use in veterinary medicine.

In this study, the diseases that the farmers described (through recalling from experience) provided an insight into the way disease concepts are constructed locally. This also provided a comprehensive list of the veterinary problems of high concern to the cattle owners. The local and/or English terms provided for the diseases described arose from ethno-diagnoses, which relied mainly on visible clinical signs and on post mortem observations, and were occasionally based on the perceived cause of the disease. This was also observed by Delehanty (1996) in ethnoveterinary studies of sedentary cattle-owning *Mijikenda* farmers of coastal Kenya, and by Heffernan *et al.* (1996) with *Samburu* pastoralists of north-central Kenya.

Veterinary extension concerning livestock diseases and their management will be more successful, have better uptake, and be better retained if the messages build upon and incorporate owners' existing animal healthcare concepts and vocabulary. Education of farmers and field workers through veterinary extension would ultimately result in improved targeting and usage of drugs. However, it should not be forgotten that farmers are free to follow the advice of extension – or to ignore it.

Thus, extension will only achieve its goal if it meets also the interests of farmers (van den Ban and Hawkins, 1988).

Despite low proportions of use of trained animal health workers for clinical examination of sick cattle (41%) and drug and ecto-parasiticide administration (43%), a large proportion of the diseases described in the follow-up study received treatment (78%); however, of those that received treatment, 13% of the disease episodes were treated with traditional remedies only. These findings were largely similar to those from the baseline study, but the follow-up study was useful to conduct as it afforded collection of some extra information that was not obtained previously in relation to the disease episodes such as sex/age of animal affected, time taken to treat animals and whether or not sick animals received a physical examination prior to treatment, as well as personal parameters of the cattle owners such as age and education. These extra pieces of information were considered to be important factors in influencing farmers' veterinary-seeking behaviour, and it was necessary to have as wide a representation of indicators as was possible to collect during a questionnaire interview. It was not very important to have this many indicators in the baseline study as its main purpose was largely to understand farmers' knowledge, attitudes and frequency and range of animal health practices.

The findings from the analyses in the follow-up study indicated that household characteristics such as district, education level and wealth – measured as resources status – were significant in their importance at influencing farmers' animal healthcare practices, as were certain individual clinical signs (inappetence, staring coat, dullness, lacrymation/salivation and diarrhoea), perceived disease cause and total number of clinical signs observed per disease episode. The other notable animal health management practices included time taken by farmers to provide treatment to sick cattle; this appeared to be largely influenced by the person administering the drugs in that it took longer for most farmers to ask an AHA to treat their animals than when they decided to attend to the animals themselves (Figure 4.9).

Farmers are faced with many problems in their livestock from vector-borne diseases, and to respond to these requires various animal health management practices, some of which the farmers have no control over, thus resulting in uncertainty towards their action(s) taken. Providing smallholder farmers with relevant information on various options of vector-borne disease control strategies would help reduce the factors of uncertainty in their decision-making processes. Perceptions about the causes or predisposing factors of diseases were important as they had an influence on farmers' choice of medications. It was encouraging to note that disease conditions believed to be associated with tsetse flies inevitably received trypanocide treatments, but it was, at the same time, alarming in that this group of diseases also received repeated doses of trypanocidal drugs. Trypanocidal drugs have a very narrow therapeutic index (Eisler *et al.*, 1997a), and are known to be toxic to animals when given in excess of the recommended dosages which has been known to result in death (Eisler *et al.*, 1997a). It was also important to assess the influence of total number of clinical signs observed in a disease episode as a proxy measure of disease severity as that also had some bearing on how a farmer responded to a bovine disease condition; in this case it was positively related to sick animals receiving treatment when at least two abnormal signs were seen.

The differences observed in farmers' animal health management practices between the two study locations (Busia and Kwale Districts) were, in some ways, really an indirect reflection of the influence of social capital (or institutional factors) in that the study households in Busia District have relatively more animal health amenities in terms of both distance (shorter as opposed to further in the case of the study households in Kwale District) and availability through more choice from the numerous Agrovet shops in the nearby trading centres (Chapter III – Figure 3.2 and Figure 3.3). Factors such as level of household resources were also important indicators in the process of farmers' decision-making as it was observed that the larger the resources possessed, the more likely a farmer was to consider making appropriate decisions such as providing treatment for a sick animal, although the negative aspect of this with respect to the richer farmers was that they were also more likely to overuse trypanocidal drugs. The observation that richer farmers were more likely to have their cattle treated is in line with the theory of economies of scale which assume that small-scale farmers with larger herds of livestock (in this case contributing towards being in the moderate resources or resource-rich wealth levels) have a higher likelihood of experiencing diseases and are likely to afford veterinary inputs to alleviate disease because the cost per unit is lower than that for a small-scale farmer with a smaller herd of livestock (de Haan and Umali, 1992; Schillhorn van Veen and de Haan, 1995).

Understanding farmers' behaviour in veterinary care is very important in this era of post-privatisation of public veterinary services as it has resulted in farmers having to increasingly make decisions on animal health management matters (Tambi *et al.*, 1999; Heffernan and Mistureli, 2000; Bett, 2001; present studies, Chapters III, IV and V). This has, in turn, meant that successful disease control for improved livestock productivity (at both a public and private level) largely relies on farmers' adoption of sound animal health practices and strategies. Most of the research on animal health management has been directed at decision support tools for implementers or mangers of disease control programmes at a larger scale (Ellis and James, 1979; Putt *et al.*, 1987; Dijkhuizen *et al.*, 1995; Rushton *et al.*, 1999), and towards decision support tools for individual vets or para-vets in public and private practice (Chamberlain, 1998; Cockcroft, 1999). As a result, there were not many animal health management studies focussing on farmers' personal characteristics available in the literature to draw parallels or differences from apart from a few including Tambi *et al.* (1999) and the conceptual framework of analysis suggested by Chilonda and Van Huylenbroeck (2001). There are, however, several adoption studies in agricultural extension which have also pointed out the importance of farmers' personal characteristics, farmers' interaction with extension workers (Wadsworth, 1995), as well as the characteristics of the technologies or strategies under recommendation (Adesina and Zinnah, 1993; Adesina and Baidu-Forson, 1995; Rogers, 1995, Jabbar *et al.*, 1998) in influencing their decisions on their farming activities. Examples from human medicine also exist that indicate the importance of personal and disease characteristics on health-seeking behaviours (Mwenesi *et al.*, 1995; Develay *et al.*, 1996; Tanner and Vlassoff, 1998; Goldman and Heuveline, 2000), and some of the arguments in those cases can be applied to farmers and their veterinary care-seeking behaviours.

The findings in the follow-up study re-enforce the arguments for trypanosomiasis control through community education. Apart from knowledge of diseases (as discussed for the baseline study above), other areas to be targeted within the dynamic processes of animal health provision is improving the frequency of early diagnosis and treatment to ensure a reduction in duration of morbidity in the animals, and in turn minimise further livestock production loss through death.

5 Chapter V: Clinical examination of cattle: observations conducted together with owners and by trained animal health workers

5.1 Introduction

Farmers are faced with different endemic vector-borne diseases in their cattle including trypanosomiasis, East Coast fever (ECF) and fascioliasis. These vector-borne diseases are characterised by several clinical signs, some of which are similar. Distinguishing these diseases normally requires confirmation at the laboratory level during parasitological examinations of blood and faecal samples. These laboratory tools are not available to farmers, and in most cases not to the frontline staff in the district veterinary offices. Thus, the para-vets (and to some extent the livestock owners) in these production systems have to rely on the syndrome or pattern recognition technique, whereas the more seasoned and senior para-vets and fully qualified vets may also make use of key abnormality signs or the hypothetico-deductive reasoning techniques of arriving at a diagnosis (Sackett *et al.*, 1991; Radostits *et al.*, 2000a and 2000b).

Useful indicators of disease in areas with endemic vector-borne diseases include body condition scoring and examination of visible mucous membranes for signs of anaemia. Body condition scoring is a useful technique for determining whether livestock are in a satisfactory condition for breeding and production, and also whether they are sick and losing condition.

History-taking is considered to be the most important part of a clinical examination. Animal health workers (AHW) are encouraged to avoid using technical expressions when asking questions as the livestock producer may be confused. They must be able to separate the owner's observations from her/his interpretations. Ideally, for completeness and accuracy in history-taking, the AHW should conform to a set routine. Patient data, disease history and management history must be recorded. It is generally best to take the patient data first as the owner will be psychologically keen to get down to the problem at hand (Radostits *et al.*, 2000a). In herd health, any disease states should be treated as a herd problem. Examination of other animals in a herd often yields animals in the early stages of the disease. In order to determine the present disease, an attempt should be made to elicit the owner's observations of the sequence of clinical signs occurrence. Physiological function variations from normal such as food intake, milk production, growth, respiration, defecation, urination, sweating, activity, gait, posture, voice and odour should be noted in all cases.

Making a diagnosis is one of two major facets of practising clinical veterinary medicine, with the second one being the provision of treatment and control measures. A diagnosis is the identification of the disease affecting the patient, and a complete diagnosis includes the specific cause and the abnormality of structure or function produced by the causative agent which is inimical (i.e. injurious or harmful) to normal body processes, and the clinical manifestation of that abnormality produced by the causative agent.

General signs of illness are the most apparent feature of disease in a farmer's animals, rather than whether it is infectious or vector-borne. In most cases in rural and peri-urban areas, it is indeed necessary to attempt a diagnosis in order to take immediate action pending a visit of a trained animal health worker, or when one is unavailable altogether. Farmers can use clinical signs as a guide to identify type of disease affecting an animal. In any disease, sick animals show certain abnormalities that the farmers notice. Some of the most important diseases do not cause dramatic clinical signs or kill a lot of animals, but affect the animals' general condition and reduce their productivity. This loss in production affects farmers' livelihoods and are economically damaging because their non-dramatic nature results in failure by farmers to take any steps to control them.

Trypanosomiasis is characterised by intermittent fever, progressive anaemia, loss of condition, staring lustreless coat, dullness, loss of weight – easily exhausted, lagging behind herd, abortion, inappetence, enlarged and prominent superficial lymph nodes, photophobia, excessive lachrymation, increasing weakness, debility, emaciation, recumbence and high mortality if left untreated. Other vector-borne diseases can present similar clinical signs to trypanosomiasis and thus make the process of disease diagnosis complicated. A summary of the clinical characteristics of the major endemic diseases in the study areas of Busia and Kwale Districts are shown in Figure 5.1 (local names shown in parentheses). This highlights the complexity of distinguishing one from the other if knowledge of the presenting signs for each disease is not certain.

Figure 5.1: Clinical signs of the endemic diseases that occur in Busia and Kwale Districts

Trypanosomiasis (*Achuya, Dorobo, Malale*)	**East Coast fever** (*Ngai, Kupe, Kuva*)	**Liver flukes/Fascioliasis** (*Ntharambaa*)
• Enlarged lymph nodes • Pallor of visible mucous membranes • Fever • Raised coat hair • Progressive wasting • Low milk yield • Abortion • No coughing • No nasal discharges • No diarrhoea • Medium mortality	• Inappetence • Enlarged parotid and pre-scapular lymph nodes • Fever • Dyspnoea • Coughing • Nasal discharges • Diarrhoea • Blood spots or mucus in faeces • Normal urine • High mortality • Mostly calves affected	• Sub-mandibular oedema • Pallor of visible mucous membranes • Chronic diarrhoea • Wasting with large abdomen • No enlarged lymph nodes • Low mortality • Faeces contain some blood • Coughing at night

Apart from being useful towards making an aetiological diagnosis, clinical reasoning also serves the purpose of designing a management plan to solve the patient or client's problem (Morley, 1991). Management of these diseases usually involve prevention and/or treatment. The allopathic drugs currently used to prevent and cure trypanosomiasis are isometamidium chloride and, to some extent, homidium chloride/bromide; the curative drug for trypanosomiasis is diminazene aceturate. Tsetse flies can be chemically controlled by applying synthetic pyrethroids on cattle, as well as by the use of some acaricides with insecticidal properties. Theileriosis (East Coast fever) is usually treated by use of the naphthoquinone derived drugs (buparvaquone and parvaquone) and halofuginone lactate. Tetracyclines have some efficacy on clinical *Theileria parva* infections when used early-on during the onset of the disease (Brown *et al.*, 1977); it is also useful for secondary therapeutic support when inter-current bacterial infections occur. Other supportive drugs are corticosteroids; they are useful in suppressing the effects of pulmonary oedema (Norval *et al.*, 1992; Thaiyah *et al.*, 1993; Matovelo *et al.*, 2000) that cause respiratory distress as ECF progresses. Treatment of anaplasmosis relies on use of tetracycline and imidocarb. Babesiosis is treated using imidocarb and diminazene aceturate; supportive treatment with vitamin E and high doses of corticosteroids maybe helpful in acute cases of bovine babesiosis and also when treatment is delayed. Treatment for heartwater disease (cowdriosis) currently relies on use of tetracyclines early on in the course of the disease. Control of these tick-borne diseases can be achieved through vaccination and use of acaricides to control the tick vectors.

A disease management decision to use any of the above chemotherapeutic and chemoprophylactic drugs, or combinations thereof, depends on the clinical history and findings from physical examination of the affected animal.

The present study aimed to:

1. Investigate the body parts or systems that farmers examine as diagnostic indicators of the health status of their cattle in Busia and Kwale Districts.
2. Investigate the ability of farmers to distinguish diagnostic indicators for trypanosomiasis, ECF and fascioliasis.
3. Compile a list of animal health messages needed to address the findings of the previous and present study in readiness for field testing and validation before conducting a communication intervention trial.
4. Compile a list of frequently observed clinical signs in sick cattle from clinical records generated by animal health workers (AHW) during their routine farm visits in a specified period of time. The AHW clinical data was also aimed at providing a further insight into farmers' timeliness in responding to cattle illnesses by seeking diagnosis and treatment.

5.2 Materials and methods

5.2.1 Clinical examinations

Two actively generated clinical datasets were obtained from physical examinations of cattle owned by some smallholder farmers in the two study areas described in Chapters II and III. The first dataset came from clinical examinations conducted by the research veterinarians in conjunction with the cattle owners. The second dataset came from clinical examinations conducted by trained animal health workers (one vet and six para-vets [i.e. animal health assistants]) covering the two study sites. The clinical data collected by the AHWs were generated during their routine farm call-outs in their respective areas of operation.

5.2.1.1 Participatory clinical examination

This exercise was conducted with a subset of the cattle-keeping farmers identified in the baseline survey. The main purpose was to ascertain farmers' perception of health status of their animals compared to the perceptions of the veterinarian researchers. Diagnostic indicators considered for comparison largely comprised those discernible by careful observation and examination of livestock, and not involving technology to which most farmers have little or no access. They included the following clinical signs: body condition score, skin/coat condition, demeanour, as well as opinion of the general health status of the animal at the time of visit. However, parameters for temperature and anaemia, in the cattle under examination, were measured by use of a digital thermometer and haemoglobinometer (HaemoCue®), respectively, but were not used to compare farmers' perceptions against veterinarian researchers' perceptions of animal health status. Farmers were also asked to state the main body systems that they normally 'check or consider' in animals perceived to be unwell. The clinical examination forms (Appendix VI) consisted of seven sections including interview and farmer details, cattle inventory; animal details such as breed, sex, age, number of calvings, milk yield; and clinical examination including body condition score (three-scale for farmers – lean/medium/fat, nine-scale for researcher observations as described by Nicholson and Butterworth [1986] – L-/L/L+/M-/M/M+/F-/F/F+; this takes into account the extent to which fat is stored or how much the muscles have become reduced), temperature, respiration, haemoglobin (Hb) concentration (measured in g/dl), mucous membrane status (normal/pale/jaundiced/bloodshot), lymph nodes, coat/skin condition, presence or absence of ticks and tick speciation, discharges, faeces, joints, appetite, navel, demeanour (alertness), locomotion (recumbency/reluctance to stand/lameness), and general health status at time of visit. There was a separate section used to assess farmers' ability to differentiate three endemic diseases namely trypanosomiasis, ECF and fascioliasis, in a pair-wise ranking exercise. This ranking exercise was also used for disease importance indicators of the three endemic diseases. Three pairs of comparisons were thus conducted, and the diseases were paired as follows: (i) trypanosomiasis vs. ECF, (ii) trypanosomiasis vs. fascioliasis and (iii) ECF vs. fascioliasis.

5.2.1.2 Trained animal health worker clinical examinations

A protocol for the examination of cattle was devised for this purpose so as to have a standardised format of all the data collected by the different AHW in the two study sites (Appendix VII). Besides the farmer and farm details, the clinical examination protocol had a list of parameters to be collected from each sick animal examined by the AHW. These included the details of the sick animal (sex, age and reproduction history), clinical history/signs of sick animal, clinical parameters measured by AHW (body condition score [3-scale: lean/medium/fat], temperature using a digital thermometer, presence/absence of ticks, general state of animal's health), duration of illness at time of AHW visit, any drugs given by farmer before AHW's visit and drugs and/or advice given to farmer by AHW.

5.2.2 Data storage and analyses

Data was stored and managed as described in Chapter II. Where appropriate, chi-square (χ^2) tests were performed on data using software described in Chapter II. Cohen's kappa coefficient ([Observed agreement-Chance agreement] / [Maximum agreement-Chance agreement]) was used to assess the degree of agreement between farmers' and research veterinarians' observations of the four clinical parameters described above. Interpretation of the kappa values followed the approach described by Petrie and Watson (1999):

- 'Poor' if κ =< 0.20
- 'Fair' if κ = 0.21-0.40
- 'Moderate' if κ = 0.41-0.60
- 'Substantial' if κ = 0.61-0.80
- 'Good' if κ > 0.80.

Animals that exhibited a temperature above 39.9°C were considered to have a fever; and those with Hb concentrations below 8g/dl were considered to be anaemic, as were the ones with pallor of visible mucous membranes.

5.3 Results

5.3.1 Participatory clinical examination

5.3.1.1 Farmers' characteristics

Forty two farmers were included in this exercise within the study areas of Busia (26) and Kwale (16) Districts. They were mostly made up of men, with only 23.8% of them being women. The average age was 51.1 years (range: 25-80 years). Half the farmers in this sample had attended primary school; while over a third of them (35.7%) had no formal education, and the remaining 14.3% had a secondary education. The major economic activity was farming, except for 3 respondents who said they were formally employed as teachers. Their cattle-keeping experience averaged at 26.3 years (range: 1-60 years).

Cattle herd structure for the farmers in this study was composed of 48.1% cows, 17.6% bulls and 34.4% calves less than two years old in Busia District, while that for Kwale District was 29.5% cows, 25.9% bulls and 44.6% calves. The average Tropical Livestock Units (TLU) of cattle per farm in Busia District (mean: 3.2 TLU, range: 0.5-16.6 TLU) was much lower than that for Kwale District (mean: 17.3 TLU, range: 4.7-38.4 TLU), $z = 5.291$, $p < 0.001$. With respect to farm size (measured in hectares), the average size for Busia District was lower (mean: 3.0ha, range: 0.2-14.6ha) than that for Kwale District (mean: 15.3ha, range: 2.0-40.5ha), $z = 4.45$, $p < 0.001$.

5.3.1.2 Characteristics of cattle examined

In total, 77 cattle were examined on the 42 farms described above in Busia (54 cattle) and Kwale (23 cattle) Districts. Sixty eight percent of these cattle were cows with mean age 3.6 years, ranging from 0.1-11 years; the remainder were bulls (mean age: 2.1 years, range: 0.2-6 years). Almost all the cattle examined were local East African zebu, except for 3 crossbred (grade) cattle. There were 21 lactating zebu cows with an average daily milk yield of 2.5 litres (range: 1-6 litres); there was only 1 lactating grade cow, and it gave a daily milk yield of 12 litres. There were 21 breeding cows examined in this study whose calving history ranged from 1-6 calves each (mean calves: 2.6); 4 of the cows were in-calf at the time of the visit.

Plate 5.1: Farmer in Kwale District describing veterinary medicines used in cattle and the diseases against which they are used

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Plate 5.2: Examination of buccal mucous membranes; animal in Busia District, Kenya, showing pale mucous membranes indicative of low haemoglobin levels

5.3.1.3 Clinical parameters measured in the examined cattle

The body condition scores for the cattle examined ranged from thin to fat, with most of them (74.3%) clustered around 'medium' (23 M-, 20 M and 9 M+); the remainder included 14.3% lean (2 L-, 3 L, 5 L+) and 11.4% fat (1 F-, 5 F, 2 F+) cattle. Rectal temperatures were mostly within the normal range (38.0-39.9°C) except for 17.7% (11/62) that had febrile temperatures above 39.9°C. The respiratory system appeared normal in most of the cattle upon examination apart from 4.9% (3/61) which had dyspnoea; however, 19.7% (12/61) were said to have been coughing within the past week prior to the visit. Very few cattle had any unhealthy discharges from natural orifices; the only ones seen (from 71 cattle examined) included ocular (7.0%), nasal (2.8%) and oral (2.8%) discharges. None of the calves examined had any navel discharges either.

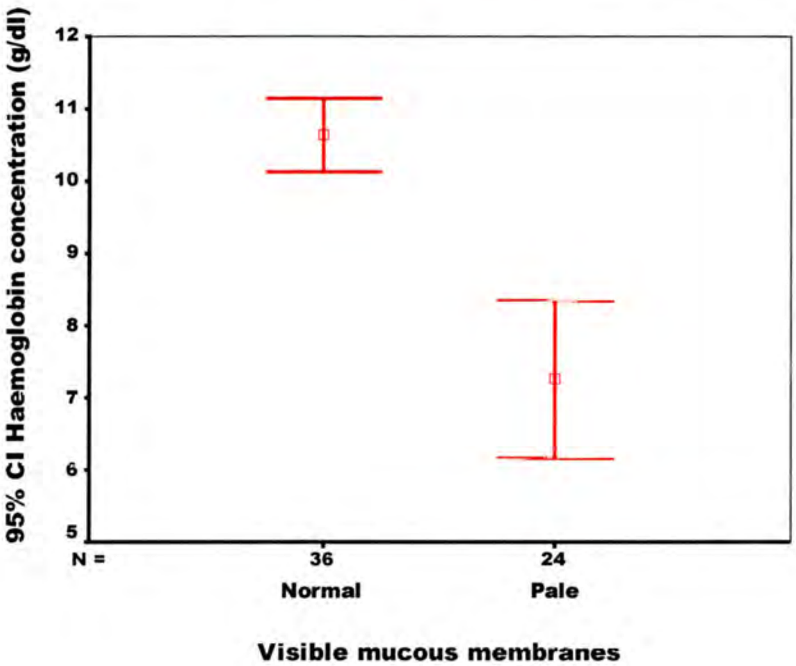
There was pallor of visible mucous membranes (Plate 5.2) in 34.3% (23/67) of the cattle that were examined; 3.0% (2/67) of them showed signs of congestion, while the remainder had healthy pink visible mucous membranes. Haemoglobin (Hb) level readings had a mean of 9.3 g/dl from 60 cattle (range: 2.4-13.4 g/dl); 25.0% of the cattle had lower than 8 g/dl levels of Hb which is indicative of anaemia. Of the 68 cattle that were examined, only three of them (4.4%) had enlarged parotid lymph nodes while the rest of them were normal except for 7.4% that had been cauterised by the owners at some stage. On the other hand, the proportion of examined cattle with enlarged pre-scapular lymph nodes was much larger at 37.7% (26/69), and again, there were a small proportion of cattle (5.8%) that had these lymph nodes cauterised at some stage previously. Nearly a quarter (24.6%, 16/65) of the cattle had enlarged pre-crural lymph nodes while the rest of them had normal ones. Overall, 49.3% (34/69) of all the cattle examined had some swollen lymph nodes. Not all of the 65 cattle examined had shiny and healthy looking coats as most of them appeared to have rough staring coats (38.5%) and the rest of them exhibited lumps on the skin (18.5%). All the cattle's joints were normal upon examination. Farmers reported that normal dung was produced by cattle examined within the last two days prior to the visit for 79.0% of the 62 cattle, while the remainder were said to have produced loose stools indicative of diarrhoea. Cattle's appetite was also said to be generally normal in 77.0% of the cattle, whereas 8.2% of them showed abnormal feeding behaviour such as eating soil (pica) while 14.8% are said to have had a decreased appetite. The general demeanour of the cattle under examination was seen to be quite active and alert (81.5%), with only 18.5% appearing dull. Locomotion status of the animals was also very good in that nearly all of the animals appeared able to move reasonably well with only 2/77 of them having been reported to be weak and lagging behind the rest of the herd or showing reluctance to stand when recumbent.

With respect to tick infestation on 66 cattle examined, 48.5% had a few ticks (less than 20 ticks) and a further 34.8% had heavier tick-burdens (more than 20 ticks), while the remaining few cattle were clean with no obvious ticks on them. The predominant ticks seen (from 47 cattle) were from the genus *Rhipicephalus* (89.4%); this was followed, equally, by *Amblyoma* and *Boophilus* ticks (15.9% each). All 3 types of ticks were seen on 8.5% (4/47) of cattle with tick infestation. The overall health status of cattle examined at the time of visit was good for 73.2% (52/71) of them, while it was judged to be poor for the remaining 26.8%.

5.3.1.4 Comparison of haemoglobin (Hb) values against pallor of visible mucous membranes

There was a good correlation ($R^2 = 0.650$) between levels of Hb and pallor of visible mucous membranes (Figure 5.2). Cattle that had normal and healthy looking visible mucous membranes upon examination had a higher mean Hb value of 10.6g/dl (range: 6.2-13.4g/dl) than that observed for cattle with pale mucous membranes (mean: 7.2g/dl, range: 2.4-10.5g/dl), $z = 5.55$, $p < 0.001$.

Figure 5.2: Correlation between haemoglobinometer readings and pallor of visible mucous membranes in cattle in Busia and Kwale Districts



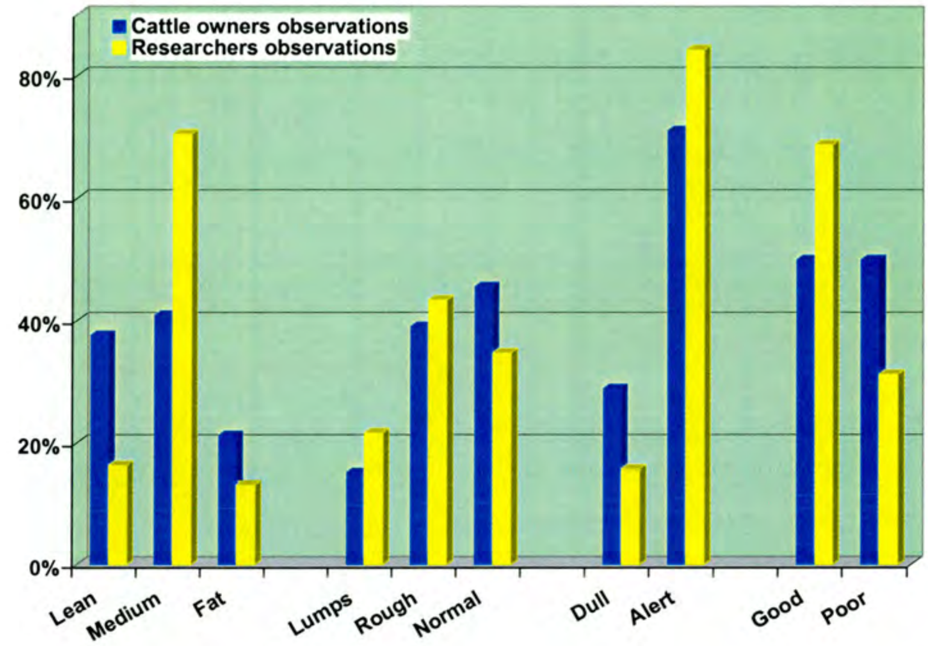
5.3.1.5 Indicators normally used by farmers to assess the health status of their cattle

Farmers mentioned various cattle body systems as being useful indicators of an animal's health status. They included appetite (76.2%), coat/skin condition (71.4%), animal's demeanour (50.4%), faeces (50.0%), general body condition (23.8%) and discharges (21.4%). None of the farmers perceived mucous membranes as being useful health indicators in livestock, even when prompted, and only a few of them (16.7%) considered respiratory signs to be useful health indicators.

5.3.1.6 Comparison of farmers' and researchers' clinical observations of cattle

Farmers' observations of clinical parameters that can be easily assessed (body condition score, skin/coat condition, demeanour and overall health status at time of visit) in cattle were compared to that of the research veterinarians' observations of the same parameters on the same animals. Cohen's kappa coefficient indicated a 'fair' observer agreement ($\kappa = 0.367$) between cattle owners and researchers with respect to body condition scores of cattle (Figure 5.3). When it came to observations of the condition of the coat/skin and demeanour, the agreement between the observers was 'substantial' (κ = 0.625and κ = 0.630, respectively); meanwhile, the agreement for opinion of overall health status of the cattle was 'moderate' between farmers and researchers (κ = 0.438).

Figure 5.3: Observation agreement of clinical parameters between cattle owners and research veterinarians in Busia and Kwale Districts



5.3.1.7 Farmers' importance and difference indicators for endemic vector-borne diseases

Results from the pair-wise comparison exercise indicated that farmers considered trypanosomiasis to be more important than ECF and fascioliasis. Figure 5.4 shows the overall scores obtained for each disease. A lot of the farmers were, however, unable to say why they considered one disease to be more important than the other because they were ignorant of one or both of the diseases being compared; the proportions of farmers who 'did not know' when comparing trypanosomiasis vs. ECF were 32.4% (11/34). There were more than twice as many who 'did not know' for comparisons between trypanosomiasis and fascioliasis (70.6%, 24/34) and ECF and fascioliasis (85.3%, 29/34). The reasons cited for certain diseases being more important than others are presented in Table 5.1.

Figure 5.4: Pair-wise ranking of important endemic vector-borne diseases in Busia and Kwale Districts, Kenya (n = 34 responses)

	Less important			
More important	**Trypanosomiasis**	**East Coast fever**	**Fascioliasis**	**Total**
Trypanosomiasis		16	8	24
East Coast fever	7		2	9
Fascioliasis	2	3		5
Total	9	19	10	

Table 5.1: Reasons for disease importance cited by farmers in Busia and Kwale Districts

More important disease	Reason	n
Trypanosomiasis > East Coast fever	High mortality	7
	Hard to cure	5
	High morbidity	4
	Soil intake (pica)	1
	Proximity to river and bushy areas	1
	Too many tsetse flies	1
Trypanosomiasis > Fascioliasis	High mortality	6
	High morbidity	1
	Hard to cure	1
	Too many tsetse flies	1
East Coast fever > Trypanosomiasis	High mortality	3
	Expensive to treat	1
	Too many ticks	2
East Coast fever > Fascioliasis	Animals become very thin	1
	High mortality	1
Fascioliasis > Trypanosomiasis	High morbidity	1
	High mortality	1
Fascioliasis > East Coast fever	Ill for very long	1
	High mortality	1

The farmers' had difficulty in distinguishing among trypanosomiasis, ECF and fascioliasis. Accordingly, not all of them were able to supply distinguishing indicators between the pairs of diseases for the same reasons as above of not being aware (or 'lacking knowledge') of one or both of the diseases being compared. The proportion of farmers who were unable to supply any answers to the question of differentiating indicators for trypanosomiasis and ECF was quite high at 64.7% (22/34); there were even more who 'did not know' with respect to trypanosomiasis and fascioliasis (82.4%, 28/34) and ECF and fascioliasis (91.2%, 31/34). Where a response to this question was given, the following reasons were proffered for the differences:

1. Trypanosomiasis vs. ECF/fascioliasis – this was believed to cause a more prolonged illness than the other two diseases and resulted in more deaths from sick animals. The other signs largely associated with trypanosomiasis were pica (mentioned by a farmer in Kwale District), staring coat, weight loss, fever, no ulcers seen on the skin, large swellings on the skin and bloody diarrhoea.
2. ECF vs. trypanosomiasis/fascioliasis – farmers associated swollen lymph nodes more with ECF than the other two diseases. Signs such as ulcers on the skin, foaming (or frothy) at the mouth, coughing, no pica, dullness and especially tick burden with bleeding from bites on the skin were considered to be more indicative of ECF than the other two diseases.
3. Fascioliasis vs. trypanosomiasis/ECF – although farmers associated weakness with all disease conditions, a few of them felt that it was more pronounced in fascioliasis than the other two diseases. Wasting (more pronounced than in other conditions) together with anorexia and presence of marshy areas were considered to be indicative of fascioliasis.

5.3.2 Clinical conditions examined by trained animal health workers

The animal health workers (AHW) involved in this study included a fully qualified vet and three para-vets (two certificate holders and one diploma holder) in Busia District and three para-vets (two certificate holders and one diploma holder) in Kwale District. The study was conducted over a three month period – 8th June to 14th August 2002 in Busia District and 20th June to 25th September 2002 in Kwale District. One AHW in Kwale District was unable to make any farm visits during this short study due to illness, which resulted in a smaller set of clinical data collected from Kwale District (31 cases) compared to that collected in Busia District (65 cases).

5.3.2.1 Farmers and their farming enterprises

The six animal health workers (AHW) visited 77 farms in Busia (76.6%) and Kwale (23.4%) Districts. The farmers visited were mostly male (83.1%) aged between 22-76 years (mean: 49.7 years); the average age of the females was 51.6 years (range: 32-76 years). The herd structure of cattle owned by these farmers was composed of 53.6% cows, 19.2% bulls and 27.2% calves less than two years old (35.8% of them still suckling) in Busia District, while the herd composition for Kwale District was 34.6% cows, 15.9% bulls and 49.5% calves (35.6% of them still suckling). The average TLU owned by farmers visited in Busia District (mean: 5.3 TLU, range 0.7-20.3 TLU) was slightly lower than that for farmers visited in Kwale District (mean: 6.4 TLU, range 0.5-15.7 TLU). The reported mortality rates (deaths that occurred within the year prior to the visit) on these farms were higher in Busia District (mean: 12% per year, range 0-80% per year) than in Kwale District (mean: 4% per year, range 0-30% per year).

5.3.2.2 Sick cattle and case details

Table 5.2 presents the details of the sick cattle that were examined in Busia (67.7%, 65/96) and Kwale (32.3%, 31/96) Districts. Twenty nine percent of these cattle received veterinary care within three days of having been seen to be unwell; meanwhile, 28.2% of them received veterinary care later on during the week of being ill (30.2%) and the rest much later still (9.4% more than a week later and 3.1% more than a month later). The time it took for sick cattle to receive veterinary care was not recorded for 28.1% (27/96) of the cases.

Table 5.2: Characteristics of sick cattle examined by trained animal health workers in Busia and Kwale Districts

Parameter	Category	All	Busia	Kwale
Total patients examined		96	67.7%	32.3%
Breed	Local zebu	79	60.8%	39.2%
	Exotic cross	17	100.0%	0.0%
Sex	Bulls	40	60.0%	40.0%
	Cows	56	73.2%	26.8%
Age (years)	Mean	2.8	3.3	2.0
	Range	0.3-7	0.3-7	0.8-5
Number of calving	0	33	63.6%	36.4%
	1	5	100.0%	0.0%
	2-3	10	80.0%	20.0%
	≥4	2	100.0%	0.0%
	In-calf	6	83.3%	16.7%

5.3.2.3 Clinical history of sick animals

Farmers reported inappetence in 60.4% (58/96) of the sick cattle in this study. This was followed by staring coat (32.3%) and weakness (31.3%). Some clinical signs such as dull demeanour and bleeding from natural orifices were only observed by farmers in Busia District (41.5% and 9.2%, respectively) and not those in Kwale District; whereas, eating soil was largely observed by farmers in Kwale District (22.6%, 7/31) and by only one farmer in Busia District. A further difference between the two districts was that a larger proportion of animals were said to be emaciated in Kwale District (32.3%) than was the case for Busia District (16.9%). Swollen lymph nodes were mentioned in 12.3% of the cases in Busia District and 6.5% of those in Kwale District.

Most of the animals (75.0%, 72/96) had not received any medication prior to the AHW's visit in this study; there was no significant difference in this respect between the two districts (70.8% in Busia and 83.9% in Kwale). Of the 24 cattle that received medications prior to the AHW's study visit, one of them was given three medications, four of them were given two medications each and the remainder were given one medication each. The medications given to the cattle included trypanocides (43.3%, 13/30), antibiotics (30.0%, 9/30), anthelmintics (10.0%, 3/30) and one each of milking salve, multivitamins and cauterised lymph nodes. These drugs were mostly administered by farmers, except for 20.8% (5/24) that were administered by animal health assistants.

5.3.2.4 Clinical examination of sick animals

More than half of the animals examined by the AHW were described as having a 'medium' body condition score (53.8%), while the remainder were observed to be mostly 'lean' (28.6%) and some fat (17.6%). A large proportion of these cattle (41.0%, 32/78) had febrile rectal temperatures above 39.9°C, with the highest recorded being 41.5°C; the remainder had temperatures within the normal range (38.0-39.9°C) except for 5.1% (4/78) that had sub-normal temperatures. (There were no temperature readings for 18.8% [18/96] of the cattle as the AHWs that examined them did not possess thermometers.) The respiratory system was found to be normal in more than half of the cattle (54.2%, 52/96); whereas, the rest of them were coughing (17.7%) and/or exhibiting signs of dyspnoea (17.7%) or hyperpnoea

(16.7%). Most of the cattle examined were reported to have had some unhealthy discharges from their natural orifices, except for 34.4% (33/96) which had none. The most commonly reported discharges included ocular (51.0%) and nasal (22.9%) discharges as well as a few reports of oral (4.2%) discharges and one cow that was said to have a 'brownish' mammary excretion. There were slightly more cattle with pale (39.6%, 38/96) than with normal (37.5%) visible mucous membranes; the remainder are reported to have had signs of congestion (15.6%), jaundice (4.2%) and ulcers in the mouth (3.1%).

Of the 94 sick cattle that were examined, 22.3% of them had enlarged parotid lymph nodes while they were normal for the rest of them. On the other hand, the proportion of cattle with enlarged pre-scapular lymph nodes was much larger at 58.5% (55/94). Over a third (35.1%, 33/94) of the cattle had enlarged pre-crural lymph nodes, and another one of them showed evidence of cauterised pre-crural lymph nodes, while the remainder had normal ones. The overall proportion of examined cattle that exhibited some swollen lymph nodes was 61.7% (58/94). More than half the cattle had a rough staring coat (63.5%); other abnormal coat/skin conditions noted by the AHW in 5.2% of the cattle included lumps on the skin, sloughing of the skin, wounds and ulcers on the udder. The remaining 31.3% of the cattle exhibited normal shiny coats. Abnormal faecal production was reported in cattle, mainly due to diarrhoea (22.9%), constipation (13.5%) and dysentery (4.2%); the rest of the cattle had normal stools. Fifty five percent (53/96) of the cattle were said to be inappetent and 6.3% showed abnormal feeding behaviour by eating soil (pica); meanwhile, the remaining 38.5% had a normal appetite. The general demeanour in 57.3% of the cattle was seen to be dull, with the rest of them appearing quite active and alert (42.7%). Locomotion status of the animals was very good in that a large proportion of the animals appeared able to stand and move normally with only 19.8% of them having been reported to be weak and lagging behind the rest of the herd or showing reluctance to stand when recumbent; one animal had ulcers on the hooves.

With respect to tick infestation on the 96 sick cattle examined by AHW, 45.8% had a few ticks (less than 20) and a further 19.8% had heavier tick-burdens (more than 20 ticks), while the remaining third of the cattle were clean with no obvious ticks on them.

5.3.2.5 *Animal health workers' tentative diagnoses and case management*

Tentative diagnoses were made by the AHW on 58.3% (56/96) of the cases that were presented to them by the farmers (Table 5.3). These consisted mostly of diseases they considered to be trypanosomiasis (37.5%, 21/56) and tick-borne diseases including ECF, anaplasmosis and babesiosis (28.6%, 16/56). A second tentative diagnosis was made on 12 of the cases, with the main one being trypanosomiasis (66.7%, 8/12), followed by anaplasmosis (25.0%) and fascioliasis (8.3%).

Table 5.3: Tentative bovine disease diagnoses made by animal health workers in Busia and Kwale Districts

Busia			Kwale		
Tentative diagnosis 1	*n*	%	*Tentative diagnosis 1*	*n*	%
No diagnosis made	28	43.1	No diagnosis made	12	38.7
Trypanosomiasis	11	16.9	Trypanosomiasis	10	32.3
East coast fever	10	15.4	East coast fever	2	6.5
Foot and mouth disease	3	4.6	Anaplasmosis	2	6.5
Heliminthiasis	2	3.1	Enteritis	2	6.5
Photosensitisation	2	3.1	Other[b]	1	3.2
Other[a]	1	1.5			
Tentative diagnosis 2			*Tentative diagnosis 2*		
Trypanosomiasis	4	6.2	Trypanosomiasis	4	12.9
Fascioliasis	1	1.5	Anaplasmosis	3	9.7

[a]Other = Actinobacillosis, Anaplasmosis, Crushed penis, Difficult calving, Lumpy skin disease, Mastitis, Poor management, Respiratory disease, Ulcerative mammilitis (each diagnosis made for one disease episode)

[b]Other = Babesiosis, Helminthiasis, Respiratory disease (each diagnosis made for one disease episode)

Antibiotics and trypanocides formed the largest group of drugs given to the animals by the AHW in response to the disease conditions described above. Busia District had antibiotics (70.8%, 46/65) followed by trypanocides (53.8%, 35/65) as the top two drugs administered, whereas this was reversed in the case for Kwale District where trypanocides (80.6%, 25/31) were administered more often than antibiotics (67.7%, 21/31). There was a higher use of multivitamins and anti-theilerial drugs in Busia District (24.6% and 16.9%, respectively) than in Kwale District (6.5% for both types of drugs). A higher frequency of anthelmintics and drugs to alleviate digestive problems (e.g. castor oil and Epsom salts) were used in Kwale District (22.6% and 16.1%, respectively) than in Busia District (12.3% and 7.7%, respectively). There were further differences in drug use between the two districts in that corticosteroids

(20.0%), disinfectants (7.7%) and acaricides (3.1%) were exclusively used in Busia District only and not in Kwale District. All the corticosteroids were administered by the fully qualified vet. Only two sick cattle out of the 96 presented in this study were left untreated; both these animals were in Busia District, and the farmers were asked to purchase drugs for these animals by the attending AHW.

The animal health workers did not proffer any advice to farmers for 67.7% (65/96) of the cases. When they did give some advice, it was largely targeted at tick and/or tsetse control, and this was similar in both districts (53.8% [14/26] in Busia and 58.3% [7/12] in Kwale). In Busia District (none in Kwale District), farmers were advised to use homidium chloride (Novidium®) as prophylaxis against trypanosomiasis in 11.5% (3/26) of the cases; whereas in 41.7% (5/12) of the cases in Kwale District (none in Busia District), farmers were advised to buy anti-theilerial drugs (Parvexon®) or tetracycline and diminazene aceturate (Veriben®) to treat diseases. Other pieces of advice proffered to farmers in 34.6% (9/26) of the cases in Busia District only included avoiding grazing of *Lantana camara* shrubs and staying in the shade for the animal suspected of suffering from photosensitisation, for the cases of suspected foot and mouth disease, the farmers involved were advised to wash the cattle's mouths and feet with *Magadi* soda. Slaughter was recommended for the bull with the 'crushed' penis.

Animal health workers made follow-up calls on 25.0% (24/96) of the cases; most of these are said to have recovered, except for 8.3% (2/24) which died and 12.5% (3/24) which were still unwell.

5.4 Discussion

Participatory clinical examinations of cattle were conducted with smallholder farmers to understand what body systems or organs they use to decide the health status of their cattle, and also to assess their ability to distinguish between a collection of useful predictors of disease syndromes including trypanosomiasis, ECF and fascioliasis. The clinical data collected by the researchers and AHW was useful in providing a more comprehensive picture of the predominant disease indicators in the study sites.

A number of useful clinical parameters are never observed which may lead to less than optimal disease management and a limited knowledge of the disease's prognosis. Furthermore, the organs or systems that at least half of the farmers involved in the participatory clinical examinations mentioned as being their key indicators of ill health (appetite, skin/coat condition, demeanour and faeces) offer limited information on their own without knowing whether or not other signs such as fever, enlarged lymph nodes, nasal discharges or coughing are present to enable the individual managing the disease condition draw out a short differential diagnosis list. It was clear from this study that farmers' omission of mentioning some clinical parameters does not necessarily mean that those signs are absent, but probably that they were not investigated. It is obviously too much to expect a farmer to approach a sick animal the same way a qualified and experienced clinician or para-vet would who are trained to be thorough in their clinical investigations. Moreover, small-scale farmers in mixed crop-livestock production systems have been used to having all their livestock health matters managed by for them by public veterinary workers; they are unlike pastoralist farmers who have had a long history of livestock keeping and whose livelihoods depend entirely on their livestock and have had generations to learn to cope with bovine diseases (Sollod and Stem, 1991). Hence, given that trained AHW get to see less than half of the cases (Chapter IV) means that a lot of the livestock in these rural communities receive poor quality veterinary care. This study provided evidence of probable under-reporting of many clinical signs considering the fact that unannounced farm visits by the researchers produced the observation that nearly half of the cattle examined had swollen lymph nodes; by contrast the proportion of reported swollen lymph nodes by farmers during the baseline study was much lower at 7%, and for the follow-up survey described in only 2% of the disease episodes are said to have exhibited swollen lymph nodes (Chapter IV). To add to this, the observations made by the AHW in this study also had a high report of swollen lymph nodes (62%) compared to 10% from the clinical history reports of the farmers for the same cases; this finding strongly supports evidence of farmers' lack of diagnostic skills and limited awareness of disease conditions.

There were more clinical parameters indicating abnormalities in the group of cattle examined by AHWs than in those examined by the researchers. This is most likely due to the fact that all the cases the AHWs attended to coincided with their farm visits made in response to routine call-outs by farmers who were experiencing disease in their cattle, whereas the cattle examined by the researchers were a result of unannounced farm visits made for research purposes described in section 5.1 above. It was, therefore, not surprising that not all the farms visited had sick cattle at the time the visits were made.

The farmers' had great difficulty in distinguishing amongst trypanosomiasis, ECF and fascioliasis. The indicators of disease importance were similar to those expressed during the focus group discussions (Chapter IV) and consisted of reasons based on mortality, morbidity, perceived ease and cost of treatment of diseases (see section 5.3.1.7 above). Farmers' attitude towards the health status of their cattle may influence their veterinary care-seeking patterns given their somewhat poor judgement of health parameters which may lead to them not considering the illness to be serious enough to require veterinary attention. As most of the farmers in the study sites are unlikely to have access to simple laboratory diagnostic tests to provide para-clinical information, obtaining a comprehensive clinical history and conducting a thorough physical examination becomes the most important means of disease management. There is a need to convey the importance of early diagnosis and treatment to small-scale farmers and highlighting the merits of this through reduced morbidity and mortality, and ultimately increasing their livestock's productivity.

The areas needed to be addressed by animal health messages for farmers based on the findings from the baseline study in Chapter IV and the present one include the following:

- Increase level of awareness of trypanosomiasis transmission by tsetse flies
- Increase level of awareness of drug specificity, e.g. trypanocides are indicated for use against diseases transmitted by tsetse flies
- Increase awareness of other organs/systems of animals that can be examined to ascertain their health status and predict most likely condition affecting animal
- Increase level of awareness of similarities and differences of endemic vector-borne diseases, i.e. there are other diseases that can be mistaken for

trypanosomiasis, e.g. tick-borne diseases and helminthiasis (especially liver fluke disease in adult cattle)

- Increase level of initiative by farmers to actively seek information about trypanosomiasis and other endemic diseases and their correct treatment from government or private animal health practitioners.

In order to investigate the possibility of improving farmers' basis for use of trypanocides, a controlled communication intervention trial was conducted in the study sites that incorporated the messages described above (see Chapter VII). This intervention study was preceded by an analysis of the existing agricultural knowledge and information networks in these study sites to guide the implementation of the communication intervention (see Chapter VI).

6 Chapter VI: Farmers' agricultural knowledge and information networks: Implications for dissemination of animal health messages

6.1 Introduction

Agriculture is the major engine of growth for rural development and remains the key to meeting global challenges of poverty reduction, economic growth, food security and environment conservation (Alex *et al.*, 2002). Successful achievement of increased livestock productivity is dependent on provision of information and services covering a range of subjects including animal health, nutrition, breeding and marketing to the rural and peri-urban poor (Subedi and Garforth, 1996). Extension is the means by which increased livestock production can be achieved. Extension is broadly defined as the rural knowledge and innovation system (Alex *et al.*, 2002). The word 'extension' originally refers to extending scientific education beyond the walls of school or university (Van den Ban and Hawkins, 1988, 1996). Agricultural extension has been described by Purcell and Anderson (1997) as "the process of introducing farmers to information and technologies that can improve their production, income and welfare". Extension, as a science, is based on the theories of communication, perception, psychology and development philosophy (Röling, 1988 and Bolliger *et al.*, 1998). Agricultural knowledge and information systems (AKIS), within which extension and farmers are enmeshed, was conceptualised by Röling (1986). It is described as being "a system of people and institutions that generates, transfers, and utilizes agricultural knowledge and information" (FAO and World Bank, 2000). The key sub-systems are agricultural research, agricultural extension, and agricultural education. Their importance is increasingly being realised in alleviation of rural poverty and promotion of sustainable agriculture. Within this context, farmers are treated as partners and not merely recipients. Smallholder farmers are met with daily challenges on their farms on which decisions have to be made. A lot of them have indigenous knowledge of how to meet challenges, but in some cases this knowledge is inadequate for overcoming some of them.

The agricultural knowledge and information networks of Kenya's smallholder farmers are diverse and complex and vary with agricultural enterprises and agro-ecology (Rees *et al.*, 1999, 2000). Many different organisations and actors are involved in developing and disseminating agricultural knowledge and skills, leading to a broad range of opportunities and needs for information transfer (Rees *et al.*, 1999, 2000).

Understanding farmers' agricultural knowledge and information networks is useful when selecting actors to be in partnerships with for adequate information dissemination. It offers an assessment of significant and relevant actors and organisations in local communities, as well as the important uptake/dissemination pathways for said communications. Improvement of communication can be achieved by knowing the pitfalls and opportunities offered by different actors, local groups and formal organisations in development and dissemination of information.

Delivery of information has many formats including mass media (print, audio and video) and traditional formats such as local community meetings (known as Chief's *Baraza* in Kenya), folklore, music and drama. These formats can be used individually or in various combinations, the choice of which is largely dictated to by available resources (social, human and financial capitals) and to audience characteristics, abilities and requirements. The channels of agricultural knowledge and information include government agricultural ministries and departments, universities, National Agricultural Research Systems (NARS), agri-business companies and non-governmental organisations (NGOs).

This study was conducted in order to assess smallholder farmers' animal health knowledge and information networks. The data generated from this study was intended to inform the next stage of the project which includes extension message design and dissemination (Chapter VII). The objectives of the present study were to:

1. Identify and assess the significance of various actors, associations, organisations and media as uptake/dissemination pathways for agricultural information to smallholder farmers
2. Assess the influence of information networks on smallholder farmers' current animal health knowledge

6.2 Materials and methods

A cross sectional household survey of animal health knowledge and information networks was conducted in 324 households in Busia (57.4%) and Kwale (42.6%)

Districts using a structured questionnaire (Appendix III). Farmers in the survey were selected from the same villages described in Chapter III. However, non-cattle rearing farmers were also included in this survey as it was important to compare information sources of all types of farmers resident in these tsetse and trypanosomiasis endemic areas. The decision to include non-cattle rearing farmers in the sample also stemmed from the fact that farmers move in and out of the 'cattle-rearing group' as a result of various socio-cultural (dowry, funeral rites), socio-economic (sale), and bio-physical (disease and death) activities (own observations; Thuranira, Ph.D. thesis in preparation).

The questionnaire was divided into different sections that addressed the various types of data that was required for this study. Data was collected on household demographics, livestock inventories, use of animal health services, community-based organisation (CBO) membership, interpersonal communication, decision-making within the family, media habits, animal health knowledge and information needs with regards to livestock production.

6.2.1 Data analysis

Farmers' descriptive variables including household head gender (Female, Male), age group (Young, <36, Middle-ages, >35-55, Old, >55 years) and educational level (none, primary and secondary school), respondent gender (Female, Male) and age group (Young, <36, Middle-ages, >35-55, old, >55 years), district (Busia, Kwale), livestock ownership (Cattle +/- Sheep and/or Goats, Sheep and/or Goats only, No ruminants) and level of household resources (Resource-rich, Moderate resources, Resource-poor; determined as indicated in Chapter III) were subjected to chi-square statistics to determine their influence on farmers' information sources, media habits and knowledge of disease transmission and drug specificity.

Smallholder farmers' information sources were classified into four categories namely veterinary services, community-based organisations (CBO), inter-personal communication (IPC) and media. Farmers were then categorised into three levels of extension contact (high, medium, low) by degree of exposure to these different sources of information. These sources of information were all given an equal score of one, and zero where a farmer did not use a service or seek information. The knowledge scores were then divided into three levels of knowledge starting with the lowest to the highest score.

Farmers' perceptions of veterinary services provided by trained animal health workers were assessed in terms of good or poor services with respect to clinical costs, information provision and trustworthiness.

Respondents' answers to 'True' or 'False' statements on indications for use of drugs including trypanocides and trypanosomiasis transmission were given an equal score of one when correct and zero when incorrect or when the response was 'Don't know'. The maximum score possible for each individual respondent was eight and the minimum was zero. Respondents who gave a score of three and above were assigned to the 'Has knowledge' group and those who scored two or less were assigned to the 'Lacks knowledge' group. The communication contact levels described above, as well as the socio-demographic variables were used to assess their impact on farmers' knowledge of disease transmission and drug specificity.

6.3 Results

6.3.1 Key informant and focus group interviews findings

Discussions about CBOs were largely conducted in April 2001 alongside the farmers' information networks questionnaire survey described below. They provided some in-depth insights into how some of the local organisations function.

Interviews with primary school teachers in Funyula Division, Busia District, revealed that Farmer Field Schools (FFS) are one of the main CBOs and are well distributed within the division. They are used for farmer education on new developments on crop and livestock production. FFS are organised by the FAO, but local farmers are in charge of them. The agriculture teacher at the school is the secretary of the local FFS. The local FFS in Funyula Division was established two years ago and has a membership of 30 farmers covering most of Sigulu Sublocation. The major activities are gardening and some poultry projects. Member farmers benefit from this FFS by gaining knowledge in modern farming practices such as land improvement (terracing), improved crop production resulting in increased sales of beans, maize and Soya beans. One farm was being used as a demonstration plot at the time of the interview. Initial inputs were received from FAO to set up the school; they consisted of seeds and poultry feed. The plans for the year 2001 included setting up a Billy goat scheme for breeding for the member farmers. They have had information from the FFS on control of NCD, which is achieved mainly through vaccination. The vaccines are obtained from Agrovet shops in Busia Township. One hundred vials for 100 birds cost KSh200 (~ £2), and most farmers willingly pay this price to protect their birds. The member farmers administer the vaccinations to the birds themselves, and they always ensure that non-expired vaccines are used.

The format for receiving information in the FFS is through workshops. The member farmers had an external facilitator and were 'in school' for 30 weeks, after which a certificate of qualification was issued to the participants. They are then encouraged (and expected) to 'go out' and teach others about what they learnt in the FFS. With respect to information channels, farmers consider information obtained through school children to be more valid if it originated from an external source, and not only from their children's teachers. Interest in FFS has been shown by non-member farmers who would like to enjoy similar benefits from the new farming methods observed from the farmers who belong to the FFS. However, most farmers are not members of FFS because of perceived prohibitive membership fees of KSh500 (~ £5). This group of farmers rely on meetings organised by the agriculture department which were said to be held every month.

A dairy co-operative exists in Funyula Division, Busia District and is known as Funyula Milk Collection Centre (FMCC). It has 178 members, most of whom own local zebu cattle with the exception of three members who own grade cattle. The milk collection centre buys milk from the farmers at KSh25 (~ £0.25) per litre; this milk is then sold on to Busia Dairy Co-operative (under which this collection centre is run) at KSh30 per litre. The FMCC provides its members with information on cattle feeding for increased milk production. They recommend feed such as napier grass, as well as cross-breeding indigenous cows with exotic dairy cattle. No monetary credit or loans were offered to the member farmers; instead cows were loaned to them and they were asked to sell their milk to the FMCC in return. The farmers are paid for their milk every seven days.

In Butula Division of Busia District, members of Burinda Self-help Group jointly own local cattle. Individually owned cattle range from 1-2 per household, while most people own none. The meetings of this group are rotated within the community and it has members from almost all the men within Ikonzo Sub-location. This group owned a grade bull that was intended for cross breeding with their local cows in order to upgrade their local zebu cattle. It, however, died from suspected TBD in June 1998. The bull was very thin at time of death and reddish "insect-like things" were observed on post-mortem in the fore-stomach, the liver was hard with black, stone-like things. The disease that killed this bull is believed by most people to result from animals grazing where people urinate. Other CBOs found in the Busia District study sites include a development committee that is involved in various activities. The activities include carpentry, animal rearing and vegetable gardens. The participants are people from the community. Each individual is paid for working in the garden and keeps their money. Namwitsula village in Butula Division has a dip-tank that requires repairing a leak before it can become functional again. The dip-tank chairman said that the tank was put up by the government who also supplied the initial acaricide, but now have to buy the acaricide themselves which they do after collection of money from farmers who bring animals for dipping – it works as a revolving fund. A retired AHA offers animal health services and advice to his neighbouring farmers including those in nearby villages.

Currently active non-governmental organisations (NGO) in Kwale District that collaborate with the DVO are the Heifer Project International based in Malindi Township and the Kwale Rural Support Programme based in Mariakani Township. They train community animal health workers (CAHW) in conjunction with the Kwale DVO. The trainees are usually unemployed school-leavers. Training consists of de-worming, dipping and general livestock management. However, they are officially not allowed to inject animals, although the veterinary officials are aware that they do inject animals as do the cattle-owners themselves.

There is a large women's group known as Matuga zero-grazing Group and has wide membership covering Matuga and Msambweni Divisions. Community-based organisations normally register with the government's department of social services. Kinango Division has about 15 group ranches. Farmers' group dealing with dairy and poultry farming tend to go hand-in-hand. Communal dips in Kwale District consist of four in Matuga Division (two are non-funtional), eight in Kubo and Kinango Divisions each, six in Samburu Division with only two of them functional and, lastly 12 in Msambweni Division with four of them functional. Farmers pay KSh10 (~ £0.10) per animal to have it dipped. The official price used to be KSh15 but farmers found this to be too expensive; some of them pay KSh5 only.

6.3.2 Household socio-demographic characteristics

The household demographics characteristics are shown in Table 6.1. A total of 324 household questionnaire interviews were conducted, 57.4% of them from Busia District and the remainder from Kwale District. Sixty percent of the households included in this survey were in the original baseline survey sample described in Chapter IV. The household heads were made up of 83.3% males and 16.7% females. There was no significant difference ($\chi^2 = 0.11$, $p = 0.735$) between these household head gender proportions and those described in the baseline household sample used in Chapter IV. The average age of the female household heads was 53.0 years old (range: 30-80 years old) and that of their male counterparts was 51.5 years old (range: 25-89 years old).

The gender proportions of the respondents were 49.1% females and 50.9% males. Respondents were made up of different members of the family; 47.5% of them were household heads, 25.3% were wives and the remainder included grown up sons, daughters and other relatives. The average age of the female respondents was 39.0 years (range: 14-80 years) and that of their male counterparts was 42.8 years (range: 13-85 years).

Table 6.1: Demographic characteristics of sample households in Busia and Kwale Districts

Variable	Busia		Kwale		Total		Chi-sq	*p*-value
	n	%	n	%	n	%		
Household head gender								
Female	41	22.0	13	9.4	54	16.7	9.088	0.003
Male	145	78.0	125	90.6	270	83.3		
Household head age-group								
Young (≤35 years)	16	8.6	26	18.8	42	13.0	12.122	0.002
Middle (36-55 years)	93	50.0	76	55.1	169	52.2		
Old (>55 years)	77	41.4	36	26.1	113	34.9		
Education level								
None	66	35.5	78	56.5	144	44.4	15.509	0.000
Primary	92	49.5	41	29.7	133	41.0		
Secondary	28	15.1	19	13.8	47	14.5		
Number of family members								
Small (≤7 people)	85	45.7	74	53.6	159	49.1	1.991	0.158
Large (>7 people)	101	54.3	64	46.4	165	50.9		
Number of school going children								
None	36	19.4	14	10.1	50	15.4	9.341	0.009
Few (1-4)	94	50.5	92	66.7	186	57.4		
Many (≥5)	56	30.1	32	23.2	88	27.2		
Main source of livelihood								
Livestock/crop production	50	26.9	106	76.8	156	48.1	79.109	0.000
Crop production	136	73.1	32	23.2	168	51.9		
Cattle rearing experience (years)								
None	74	39.8	54	39.1	128	39.5	26.354	0.000
Less experienced (<3)	29	15.6	14	10.1	43	13.3		
More experienced (3-10)	79	42.5	45	32.6	124	38.3		
Very experienced (>10)	4	2.2	25	18.1	29	9.0		
Livestock herd size owned (TLU)								
Negligible (<0.7)	72	38.7	12	8.7	84	25.9	83.460	0.000
Small (0.7-5)	104	55.9	65	47.1	169	52.2		
Medium (>5-10)	8	4.3	42	30.4	50	15.4		
Large (>10)	2	1.1	19	13.8	21	6.5		
Size land owned (acres)								
Small (≤5)	138	74.2	43	31.2	181	55.9	64.171	0.000
Medium (>5-10)	37	19.9	55	39.9	92	28.4		
Large (>10)	11	5.9	40	29.0	51	15.7		
Respondent gender								
Female	106	57.0	53	38.4	159	49.1	10.947	0.001
Male	80	43.0	85	61.6	165	50.9		
Respondent age-group								
Young (≤35 years)	71	38.2	67	48.6	138	42.6	7.081	0.029
Middle (36-55 years)	70	37.6	53	38.4	123	38.0		
Old (>55 years)	45	24.2	18	13.0	63	19.4		
Respondent's relationship to HHH								
Self	84	45.2	70	50.7	154	47.5	4.293	0.368
Wife	55	29.6	27	19.6	82	25.3		
Daughter	10	5.4	8	5.8	18	5.6		
Son	22	11.8	19	13.8	41	12.7		
Relative	15	8.1	14	10.1	29	9.0		

Over half of the farmers in the survey (51.8%) depended on crop production as their main source of income, whereas 45.7% of them mentioned both crop and livestock production as their main source of income. The remaining farmers mentioned other businesses as their source of income. The educational level of these farmers was low in that almost half of them (43.8%) had no formal education, 41.0% only had a primary school education and the remaining few had a secondary school education. Fifty seven percent of the respondents claimed they were able to read. The average number of school-going children per household was 3.1 (median: 3, range: 0-15) from an average household size of 8.9 people (median: 8, range: 1-27). The pattern of significantly smaller land ownership ($z = 7.071, p < 0.001$) and smaller herds of livestock owned ($z = 8.071, p < 0.001$) by farmers from Busia District compared to those in Kwale District has continued to be observed in this study as has been the case in the previous chapters. Land owned by the target audience ranged from 0.2-32.4ha, with an average of 1.8ha in Busia District (range: 0.2-9.3ha) and an average of 4.2ha in Kwale District (range: 0.8-32.4ha). The Tropical Livestock Units (TLU[4]) owned by these same people ranged from 0.0-38.3 with an average of 1.7 in Busia District (range: 0.0-11.0) and an average of 6.0 in Kwale District (range: 0.1-38.3). An inventory of the livestock species owned by the farmers in this study is presented in Table 6.2. There were some notable household head gender related differences between the households such as education ($\chi^2 = 36.538, p < 0.001$), livestock herd size owned compared using TLU herd levels as indicated in Chapter II ($\chi^2 = 14.863$, $p = 0.002$) and land size owned ($\chi^2 = 9.512, p = 0.009$).

Table 6.2: Livestock species inventory owned by target audience in Busia and Kwale Districts

	Busia		Kwale		Female HH*		Male HH*		Total	
	n	%	n	%	n	%	n	%	n	%
Bulls	79	2.3	229	3.4	25	2.4	283	3.1	308	3.0
Cows	205	5.9	313	4.6	48	4.6	470	5.1	518	5.1
Calves	74	2.1	152	2.3	13	1.2	213	2.3	226	2.2
Goats	189	5.4	2556	38.0	159	15.2	2586	28.2	2745	26.9
Sheep	159	4.6	337	5.0	53	5.1	443	4.8	496	4.9
Pigs	60	1.7	0	0.0	10	1.0	50	0.5	60	0.6
Chickens	2709	78.0	3145	46.7	740	70.6	5114	55.8	5854	57.4

*HH = Household head

[4] TLUs were calculated at a conversion rate of 1 for bulls, 0.7 for cows, 0.35 for calves, 0.2 for pigs, 0.1 for sheep and goats and 0.01 for chickens

There were significantly more women (81.5%, 44/54) who had no formal education compared to men (37.0%, 100/270); furthermore, nearly 10 times more men (17.0%, 46/270) than women (1.9%, 1/54) had secondary school education, and similarly, more men (45.9%, 124/270) than women (16.7%, 9/54) had primary school education. With respect to size of land owned, only one female headed household compared to 18.5% (50/270) male headed households fell within the 'large' land group of more than 10 acres. Forty two percent (23/54) of the female headed households owned less than 0.7 TLU of livestock compared to 22.6% (61/270) of the male headed household, and only 5.6% (3/54) female headed households owned more than 5 TLU, unlike 3% (7/270) in the case of male headed households.

6.3.3 Farmer information channels

6.3.3.1 Membership to community-based organisations

Membership to community-based organisations (CBO) was reasonably high as only 117 (36.1%) households had no family members that belonged to any of them (Table 6.3). Location (district), household head gender and age group and respondent's age group were significant variables of whether or not a family member belonged to any CBO. Farmers who live in Busia District were more likely to belong to a CBO than those residing in Kwale District. More female than male household heads belonged to a CBO. Fewer young household heads aged 35 years or less were affiliated to any CBO than householders aged between 35 and 55 years or older householders aged more than 55 years. A similar pattern of CBO membership was observed in the three corresponding age groups of the respondents, with membership increasing in the age groups from young respondents, middle-aged and older respondents.

Table 6.3: Factors associated with households' membership to community-based organisations in Busia and Kwale Districts (Shoats = sheep and goats)

Variable	Category	CBO Member			Chi-sq	*p*-value
		Total	Yes (%)	No (%)		
Total		324	63.9	36.1		
District	Busia	186	73.1	26.9	16.123	0.000
	Kwale	138	51.4	48.6		
Household head gender	Female	54	75.9	24.1	4.070	0.044
	Male	270	61.5	38.5		
Household head age-group	Young	32	43.8	56.3	6.250	0.044
	Middle-aged	179	65.9	34.1		
	Old	113	66.4	33.6		
Education level	None	144	59.7	40.3	3.400	0.183
	Primary	133	64.7	35.3		
	Secondary	47	74.5	25.5		
Respondent gender	Female	159	60.4	39.6	1.670	0.196
	Male	165	67.3	32.7		
Respondent age-group	Young	126	55.6	44.4	6.410	0.041
	Middle-aged	135	68.1	31.9		
	Old	63	71.4	28.6		
Livestock owned	Cattle +/- Shoats	196	64.8	35.2	0.815	0.665
	Shoats only	77	59.7	40.3		
	None	51	66.7	33.3		

Membership to a religious organisation accounted for the highest mentions of CBO by 43.5% (141/324) respondents. This was followed by women's (30.6%, 99/324) and farmers' self-help (30.2%, 98/324) groups. The significant determinants for type of CBO membership were geographical location ($\chi^2 = 23.72, p < 0.001$) and household head gender ($\chi^2 = 11.16, p = 0.048$). The most popular affiliations accounting for more than 80% membership were religious organisations (39.8%), Farmer Self-Help Groups (21.5%) and Women's Groups (19.0%) in Busia District. The corresponding figures for Kwale District were 22.9%, 29.0% and 35.1%, respectively. When it came to gender differences, two-times as many female headed households (5.3%) belonged to co-operatives as their male counterparts (2.7%), whereas male headed households (26.6%) had more than two-times as many members of Farmer Self-Help Groups as female headed homes (11.8%).

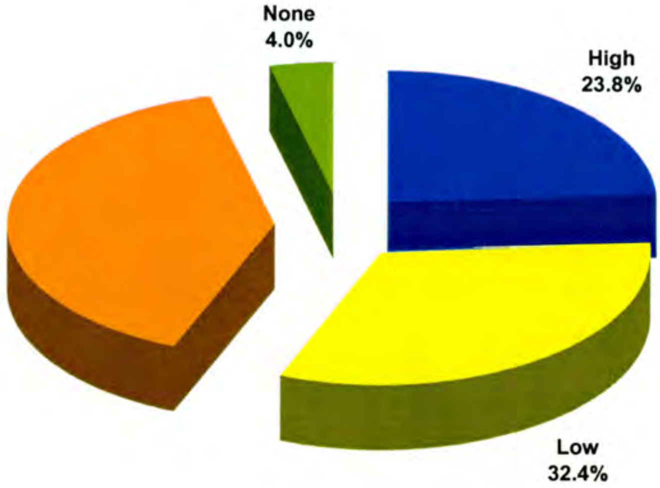
6.3.3.2 Use of veterinary services and other information channels

Respondents mentioned several commonly used sources of information and services in the one year prior to the interviews. Four types of contacts were identified; these included CBOs (local chief's meetings known as Chief's *Barazas*, Women's Groups, Farmer Self-help Groups, 4K Clubs or Youth Groups based in schools, religious organisations), inter-personal communications (spouse, family members and other relatives, farmer-to-farmer contact, traditional herbalists), media (radio, newspapers, posters or billboards, television) and veterinary services (government and privately employed animal health assistants [AHA], local agro-veterinary traders [Agrovets]). Local contacts from within the communities (i.e. through CBOs) were the most frequently mentioned sources by 84.9% (275/324) respondents. This was followed by inter-personal communications (54.3%, 176/324), veterinary services (45.4%, 147/324) and media forming the least (10.8%, 35/324) mentioned source. Farmers' use of veterinary services and sources was significantly different with respect to livestock ownership ($\chi^2 = 23.67, p = 0.001$). Respondents from cattle keeping households (24.7%) were the highest users of veterinary services and information compared to sheep and/or goat keepers (16.7%) and those that kept no ruminant animals (11.5%).

6.3.3.3 Extension contact levels of the farmers in the study households

Farmers and their households were assigned to four levels of extension contact groups according to the criteria described in section 6.2.1 above, and the proportions of the farmers in the various levels of contact are presented in Figure 6.1. The highest number of contacts was six and the least was zero. Therefore, households that had 5-6 contacts in the one year prior to the interviews were assigned to the 'high' contacts group; this was followed by those who mentioned 3-4 contacts, and were thus assigned to the 'medium' contact group. The 'low' contact group consisted of households whose farmers mentioned 1-2 contacts, and lastly, those who had no contacts with outside sources were assigned to the 'no' contacts group (Figure 6.1).

Figure 6.1: Extension contact levels of farmers in Busia and Kwale Districts



6.3.3.4 Important channels of information

Farmers spontaneously mentioned a range of channels as their most important sources of information (Table 6.4). The top three channels were radio (mentioned by 74.4% respondents), Chief's *Barazas* (53.7%) and school children (30.6%).

Table 6.4: Important channels of information for small-scale farmers in Busia and Kwale Districts

Information source	Busia (n = 186)		Kwale (n = 138)		Female HH (n = 54)		Male HH (n = 270)		Total (n = 324)	
	n	%	n	%	n	%	n	%	n	%
Radio	145	78.0	96	69.6	34	63.0	207	76.7	241	74.4
Chief's *Barazas*	78	41.9	96	69.6	28	51.9	146	54.1	174	53.7
School children	49	26.3	50	36.2	18	33.3	81	30.0	99	30.6
Newspapers	31	16.7	7	5.1	0	0.0	38	14.1	38	11.7
Agrovets	4	2.2	7	5.1	2	3.7	9	3.3	11	3.4
TV/Video	4	2.2	5	3.6	0	0.0	9	3.3	9	2.8
Herbalist	1	0.5	4	2.9	0	0.0	5	1.9	5	1.5
AHAs	4	2.2	0	0.0	0	0.0	4	1.5	4	1.2
Churches	4	2.2	0	0.0	2	3.7	2	0.7	4	1.2
Neighbours	2	1.1	0	0.0	2	3.7	0	0.0	2	0.6
CBOs	1	0.5	0	0.0	1	1.9	0	0.0	1	0.3
Community leaders	0	0.0	1	0.7	1	1.9	0	0.0	1	0.3
Co-operatives	1	0.5	0	0.0	0	0.0	1	0.4	1	0.3
Relatives	0	0.0	1	0.7	1	1.9	0	0.0	1	0.3

Sources of information that farmers perceived to be important varied significantly by location ($\chi^2 = 22.48, p = 0.001$), household head gender ($\chi^2 = 21.15, p = 0.002$) and education level ($\chi^2 = 60.72, p < 0.001$). Farmers in Busia District (78.0%) had the highest mentions of radio as their main channel followed by 41.9% mentions of Chief's *Barazas*; these had equal mention in Kwale District (69.6% each). With respect to newspapers, three times more respondents in Busia District (16.7%) than those in Kwale District (5.1%) mentioned them as their main information channel.

The main gender differences in important channels were newspapers which were exclusively mentioned by male household heads (14.1%) and other channels (religious organisations, local associations, traditional healers, neighbours/friends and relatives) which were mostly mentioned by 13.0% of female compared to 1.1% of male householders.

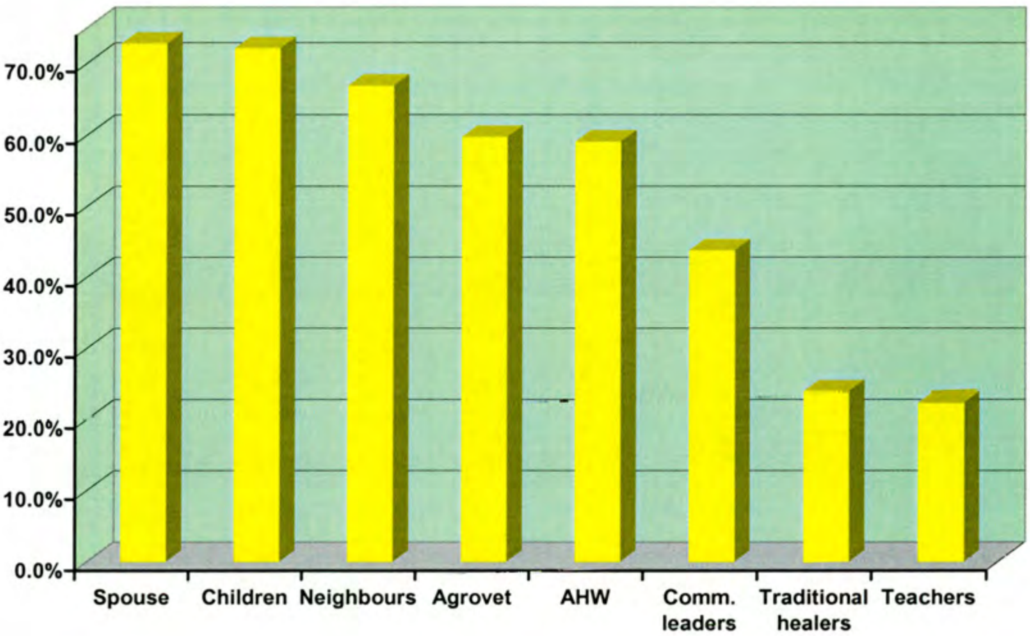
More farmers with no formal education (19.2%) depended on school children for information than did those with a primary (16.9%) or secondary (9.6%) education. Importance of radio increased with education level of the household head starting from no formal education (35.3%), primary education (44.2%) and secondary education (46.8%). With respect to the importance of Chief's Barazas, the reverse trend was observed in that it was mentioned by mostly by farmers with no formal education (38.4%) followed by those with a primary education (24.0%) and least by those with a secondary education (19.1%). Although livestock ownership was on the whole not statistically significant in predicting farmers' important sources of information, 13 out of 15 mentions of veterinary services were by respondents from cattle keeping households.

6.3.4 Interpersonal communications on animal health

Discussion of animal health matters was common within households and communities in the study areas (Figure 6.2). Respondents were asked to comment on whether or not the heads of households, i.e. the owners of livestock, discussed animal health matters with eight types of people within their community including spouses, their children, neighbours or friends, animal health workers (AHW), Agrovet shopkeepers, community leaders, teachers and traditional healers/herbalists. The highest prompted mention of interpersonal communication was between spouses

(72.7%) and their children (72.1%), and lowest was between owners and traditional healers (24.0%) and teachers (22.4%). Prompted mention of farmer consultation with animal health workers and Agrovet shopkeepers was reasonably high at 59.1% and 59.7%, respectively.

Figure 6.2: Interpersonal communications on animal health matters within households and local communities in Busia and Kwale District



There were some differences in the frequencies of responses on interpersonal communication within different socio-economics groups (Table 6.5). Location (district) and species of livestock owned were the main differentiating factors of farmers' interpersonal communication. Other less common differentiating factors included age-group and gender of the household head. Level of education had no significant influence on the frequency of mention of any type of interpersonal communication (Table 6.5).

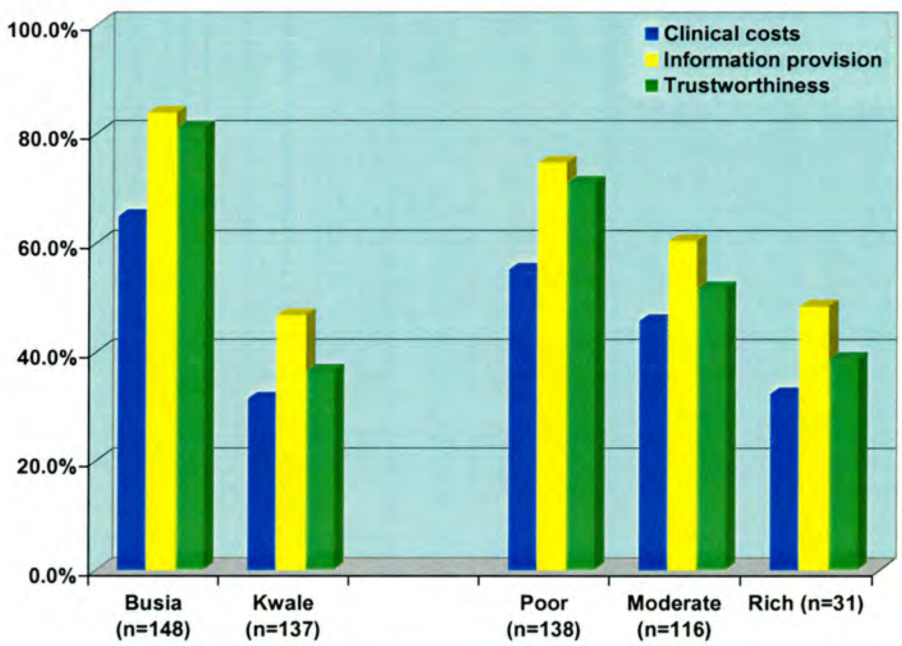
Table 6.5: Differences in interpersonal communication patterns on animal health matters within different socio-economics groups, Busia and Kwale Districts (Shoats = sheep and goats)

			Interpersonal communication held with (n = 308):							
Variable	Category	Frequency	Spouse	Children	Neighbours	AHW	Agrovet	Community leaders	Teachers	Herbalists
Total responses	Yes		223	222	206	182	184	135	69	74
	No		49	86	102	126	124	173	239	234
District	Busia	170	58.2%	67.6%	60.0%	71.2%	45.9%	54.7%	27.1%	33.5%
	Kwale	138	90.6%	77.5%	75.4%	44.2%	76.8%	30.4%	16.7%	12.3%
	Chi-square		40.174	3.701	8.116	22.925	30.295	18.225	4.732	18.733
	p-value		0.000	0.054	0.004	0.000	0.000	0.000	0.030	0.000
Household head gender	Female	50	24.0%	72.0%	74.0%	56.0%	38.0%	46.0%	16.0%	26.0%
	Male	258	82.2%	72.1%	65.5%	59.7%	64.0%	43.4%	23.6%	23.6%
	Chi-square		71.453	0.000	1.365	0.236	11.730	0.114	1.408	0.127
	p-value		0.000	0.989	0.243	0.627	0.001	0.736	0.235	0.721
Household head age-group	Young	30	73.3%	43.3%	63.3%	46.7%	70.0%	23.3%	6.7%	10.0%
	Middle	172	73.8%	75.0%	65.7%	61.0%	58.7%	43.6%	25.6%	27.9%
	Old	106	70.8%	75.5%	69.8%	59.4%	58.5%	50.0%	21.7%	21.7%
	Chi-square		0.320	13.653	0.690	2.193	1.456	6.762	5.303	4.967
	p-value		0.852	0.001	0.708	0.334	0.483	0.034	0.071	0.083
Education level	None	136	68.4%	75.0%	72.8%	54.4%	58.8%	41.9%	19.9%	24.3%
	Primary	126	76.2%	69.0%	63.5%	62.7%	59.5%	43.7%	23.8%	24.6%
	Secondary	46	76.1%	71.7%	58.7%	63.0%	63.0%	50.0%	26.1%	21.7%
	Chi-square		2.318	1.155	4.192	2.207	0.259	0.916	1.011	0.159
	p-value		0.314	0.561	0.123	0.332	0.879	0.632	0.603	0.924
Livestock owned	Cattle +/- Shoats	196	79.6%	75.5%	71.4%	68.4%	69.4%	48.5%	23.5%	24.5%
	Shoats only	71	74.6%	73.2%	64.8%	43.7%	53.5%	29.6%	16.9%	21.1%
	None	41	36.6%	53.7%	48.8%	41.5%	24.4%	46.3%	26.8%	26.8%
	Chi-square		31.790	8.107	8.035	19.239	30.029	7.677	1.826	0.527
	p-value		0.000	0.017	0.018	0.000	0.000	0.022	0.401	0.769

6.3.4.1 Farmers' perceptions of trained animal health workers

All three aspects of veterinary services (clinical costs, information provision and trustworthiness) that farmers were asked to assess with respect to trained animal health workers received a 'good' as opposed to a 'poor/expensive' rating by many farmers (43.5%, 124/285) in Busia and Kwale Districts. Twelve percent (39/324) of the farmers (one farmer in Kwale District and the rest in Busia District) in the study declined to offer an opinion on this because they never use veterinary services. The proportions of 'good' ratings for individual aspects of veterinary services was highest for information provision (66.0%, 188/285) followed by trustworthiness (59.6%, 170/285) and finally by clinical costs (48.8%, 139/285). The perceptions of veterinary service provision ratings by the farmers in different socio-economics groups are shown in Figure 6.3.

Figure 6.3: Proportion of farmers who considered veterinary services provided by trained animal health workers to be 'good' compared between districts and household resources

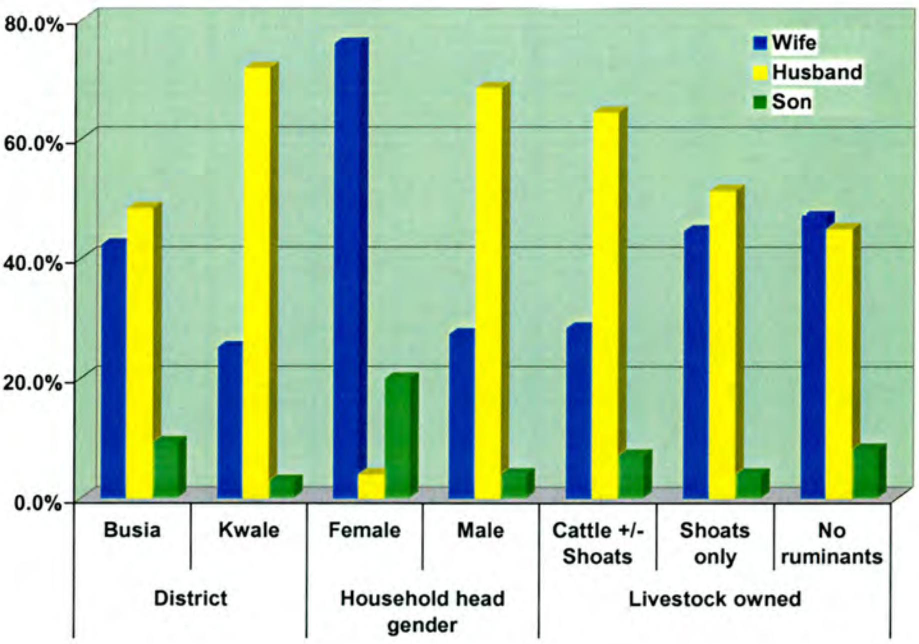


More farmers from Busia District regarded clinical costs ($\chi^2 = 31.914, p < 0.001$), information provision ($\chi^2 = 43.542, p < 0.001$) and trustworthiness of the AHAs ($\chi^2 = 58.756, p < 0.001$) to be good compared to those in Kwale District; similarly more farmers from poorly-resourced households considered the AHAs to be good in the three aspects of veterinary service provision ($\chi^2 = 6.017, p = 0.049, \chi^2 = 10.522, p = 0.005$ and $\chi^2 = 16.080, p < 0.001$, respectively).

6.3.5 Decision-making within the family

Individuals involved in making decisions about animal health care included wives, husbands and other family members especially sons (Figure 6.4). There were fewer wives making decisions about animal health matters in particular (32.8%) than household matters in general (39.1%). The opposite was true for husbands in that a higher number of them made decisions about animal health matters (61.5%) and a somewhat smaller number of them made general household decisions (56.2%). However, these decision-making patterns were not significantly different ($\chi^2 = 4.81$, $p = 0.569$). Almost all the decisions about animal health matters were made by the same individual (91.5%) except for a few households where different people made different decisions. When general household decision-making was taken into consideration the figures changed to 77.6% for 'same individual' with the remainder being from 'different individuals'.

Figure 6.4: Decision-makers within the household about animal health matters in Busia and Kwale Districts (Shoats = Sheep and Goats)



6.3.6 Farmers' use of media

6.3.6.1 Print material readership

Just over half (57.1%, 185/324) of the farmers in the sample are able to read, with approximately similar proportions in Busia (56.5%) and Kwale (58.0%) Districts. However, there were twice as many male household heads (62.2%) who could read as their female counterparts (31.5%), $\chi^2 = 17.36$, $p < 0.001$. With respect to respondent gender, more males (71.5%) came from households where the head could read compared to 42.1% of the female respondents ($\chi^2 = 28.53$, $p < 0.001$). There were fewer older (more than 55 years of age) householders (47.8%) who could read compared to younger householders less than 35 years (62.5%) and middle-aged farmers aged 35-55 years (62.0%). Proportions of respondents coming from households where the head could read decreased with increasing age-group starting from 71.4% young, 52.6% middle-aged down to 38.1% older respondents; this downward trend was highly significant ($\chi^2 = 20.97$, $p < 0.001$). Predictably, education level was a very good measure of household head's ability to read in that the higher the education level the more 'able to read' the individual was ($\chi^2 = 67.72$, $p < 0.001$). Almost all the farmers with a secondary education (93.6%) could read compared to those without any formal education (33.3%) and with a primary education (69.9%). The languages preferred for reading (as well as listening to the radio) were mostly consistent with the major ethnic groups of the 2 study areas. Swahili was the most frequently mentioned language in both Busia (87.1%) and Kwale (94.2%) Districts followed by *Luhya* which is the major language spoken in Busia District (79.6%) and *Mijikenda* which is widely spoken in Kwale District (71.7%). English was mentioned by a very small proportion of farmers, 9.7% in Busia and 4.3% in Kwale Districts.

There was wide readership of newspapers among the group of farmers who could read (166/185 or 89.7%) except for 19 (10.3%) who said they never read them. However, the frequency of readership was very low with most of the respondents (74.1%) saying they only read newspapers occasionally and only a minority of them (12.0%) read at least 4 days per week. Responses to the question 'did you read a newspaper yesterday or today' yielded only 12.6% 'Yes' answers from the 'newspaper-reading' group of literate farmers. The 'Daily Nation' and '*Taifa Leo*' were the most widely read newspapers in the study areas as indicated by 86/166 (51.8%) and 80/166 (48.8%) literate farmers respectively.

Readership of magazines was lower than newspapers in that only 78/185 (42.2%) of literate farmers claimed to read them, with the predominantly mentioned magazine being 'Parents' by 42.3% of those who read them. Almost a quarter of these farmers read a magazine at least once per month.

There were significant differences in proportions of farmer newspaper and/or magazines readership depending on household head's gender ($\chi^2 = 14.27$, $p < 0.001$), education level ($\chi^2 = 63.85$, $p < 0.001$), respondent's gender ($\chi^2 = 24.94$, $p < 0.001$) and respondent's age-group ($\chi^2 = 11.73$, $p = 0.003$).

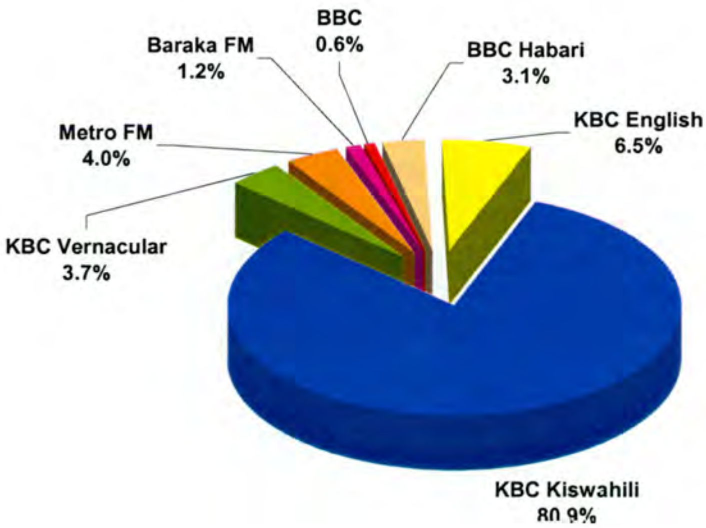
Reading and/or perusal of leaflets or pamphlets was more common among literate farmers (155/185 or 83.8%) than among non-literate ones (45/139 or 32.4%), $\chi^2 = 88.79$, $p < 0.001$. Similar proportions were observed with regard to posters and billboards in that more literate farmers (90.8%) paid attention to posters than non-literate farmers (41.7%), $\chi^2 = 90.63$, $p < 0.001$. These posters and/or billboards were mostly viewed in many public places (33.6%), followed by market places in particular (28.8%) and health centres (21.6%). There were low mentions of seeing posters at veterinary offices (7.9%) and Agrovet shops (8.1%).

6.3.6.2 Radio audience

Seventy eight percent (251/324) of the respondents came from households that own a radio. Batteries were the main source of power for the radios for almost all the households except for three respondents who came from homes that use solar power and one that uses electricity. Frequency of listening to the radio varied from 'daily' to 'never'. Sixty five percent (211/324) of the respondents listened to the radio daily, followed by 11.1% who 'rarely' listened, 4.3% listened a 'few days per week', 3.1% claimed they listen at 'weekends only' or 'once per week' and the remaining 16.4% never listen to the radio. Radio audience occurred mainly in own homes (87.4%, 249/285), neighbours/friends' homes (11.2%, 32/285) and other locations such as market centres (1.4%, 4/285).

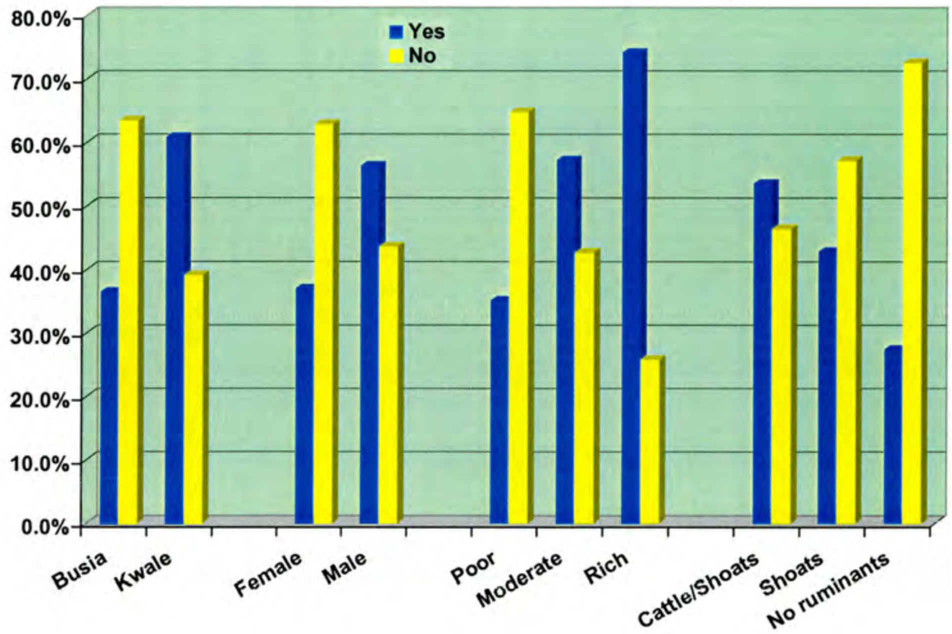
Thc most popular radio station that farmers listen to is KBC- (Kenya Broadcasting Corporation) Swahili which accounted for 80.9% mentions (Figure 6.5). The most popular listening times mentioned were early morning between 6.00 and 9.00 hrs (33.9%), evening between 17.00 and 20.00 hrs (23.0%) and all day (19.6%). There were some location and gender differences in favourite radio-listening times. The favourite time in Kwale District was during the evening (39.4%) whereas in Busia District it was early morning (31.3%). There were three times more female headed householders who listened to the radio in the afternoon compared to the male headed householders.

Figure 6.5: Favourite radio stations listened-to by farmers in the study sites of Busia and Kwale Districts



The popular programmes listened to by many farmers in the study included mentions of the news (73.8%, 239/324), agriculture (46.9%, 152/324), religion (43.5%, 141/324), music (25.0%, 81/324), greetings programmes known as *salaams* (18.8%, 61/324), lifcstyle (16.7%, 54/324), radio soap called *Tembea na Majira* (16.7%, 54/324), women's (14.8%, 48/324), children's (13.9%, 45/324), educational (9.3%, 30/324), health (8.6%, 28/324) and other programmes. Almost twice as many farmers resident in Kwale District (Figure 6.6) listened to agricultural programmes as did those resident in Busia District ($\chi^2 = 18.800$, $p < 0.001$). More male than female respondents mentioned listening to agricultural programmes ($\chi^2 = 12.056, p = 0.001$). The proportions of respondents who cited listening to agricultural programmes rose significantly as household resources levels increased ($\chi^2 = 23.948, p < 0.001$). Livestock species owned was significantly associated with listernership to agricultural programmes ($\chi^2 = 11.754, p = 0.003$) (Figure 6.6).

Figure 6.6: Listenership to agricultural radio programmes by farmers in Busia and Kwale Districts (Shoats = sheep and goats)



6.3.7 Knowledge of trypanosomiasis transmission and drug specificity

There was a low proportion of farmers (21.1%, 68/322) who gave a correct response to at least three out of eight 'True' or 'False' questions on trypanosomiasis transmission and drug specificity (Table 6.6). (Two respondents did not attempt to answer these questions.) There were more farmers with trypanosomiasis transmission knowledge (52.8%, 170/322) than with drug specificity knowledge (23.0%, 74/322). Overall knowledge significantly varied by location, household head and respondent genders, education level and level of household resources. More farmers gave at least three correct responses in Kwale District (27.7%) compared to 16.2% in Busia District. More than twice as many male household heads (23.5%) and respondents (30.5%) as their female counterparts (9.3% and

11.4%, respectively) gave at least 3/8 correct responses. There was an upwards trend in proportions of knowledgeable (those who scored at least 3/8) farmers with a rise in level of education such that there were fewer farmers with no formal education (16.0%) than those with a primary (22.1%) and secondary (34.0%) education. A similar pattern was observed with regard to household resources level in that knowledgeable respondents in the resource-poor category were fewer (14.9%) than those with moderate resources (27.6%) and resource-rich category (32.3%). Surprisingly, extension contact levels, characterised by contact with animal health workers, visiting Agrovet shops, membership to local farmers associations and listening to radio agricultural programmes, did not have a significant impact on farmers' knowledge. Although experience in rearing cattle, measured by number of years of involvement, did not have a significant difference on knowledge (χ^2 = 5.220, p = 0.074), nonetheless, most of the knowledgeable farmers had kept cattle for at least 10 years (29.7%) followed by those with less than 10 years experience (22.0%) and finally by those with no experience whatsoever (15.6%).

Table 6.6: Small-scale farmers' knowledge of trypanosomiasis transmission and drug specificity, Busia and Kwale Districts (Shoats = sheep and goats)

			Has knowledge			
Variable	**Category**	**Frequency**	**Yes (%)**	**No (%)**	**Chi-sq**	***p*-value**
Total responses		322	21.1	78.9		
District	Busia	185	16.2	83.8	6.272	0.012
	Kwale	137	27.7	72.3		
Household head gender	Female	54	9.3	90.7	5.477	0.019
	Male	268	23.5	76.5		
Respondent gender	Female	158	11.4	88.6	17.615	0.000
	Male	164	30.5	69.5		
Education level	None	144	16.0	84.0	7.084	0.029
	Primary	131	22.1	77.9		
	Secondary	47	34.0	66.0		
Livestock owned	Cattle/Shoats	196	24.5	75.5	1.356	0.161
	Shoats	51	13.7	86.3		
	None	75	17.3	82.7		
Household resources level	Poor	175	14.9	85.1	9.341	0.009
	Moderate	116	27.6	72.4		
	Rich	31	32.3	67.7		
Extension contact level	High	77	18.2	81.8	1.837	0.607
	Medium	129	21.7	78.3		
	Low	105	23.8	76.2		
	None	11	9.1	90.9		

6.3.8 Farmers' animal health information needs

Farmers mentioned various types of information needed including disease identification and control, with some specifically asking for prevention and/or treatment of diseases in general and trypanosomiasis and East Coast fever (ECF) in particular. A small group of farmers, 49/324 or 15.1%, claimed they did not require any information, mainly because they did not own any livestock, and one said that the information received in the past was not useful, while another farmer said he had a knowledgeable son. The most popular type of information requested was disease identification (174/275, 63.3%) followed by general animal husbandry (147/275, 53.5%). Other types of information mentioned (each by a minority of farmers, less than 10%) were poultry management, disease prevention, ECF and tick control, trypanosomiasis and tsetse control, drug use and improvement of cattle breeds. Farmers in Kwale District mainly wanted information on disease identification (55.9%), while those in Busia District mainly demanded information on general animal husbandry (44.0%). There were no gender or age-group differences in type of information required.

Farmers were asked if they would accept information that was transferred to them through school-children, and most of them (268/324, 82.7%) were agreeable to this suggestion. Those who did not like this suggestion gave reasons such as children giving out wrong information (44.1%), lack of livestock (23.5%), not having any children in school (20.6%), prefer information directly from animal health workers (5.9%), some children might not receive any information (2.9%) and having a knowledgeable son (2.9%).

6.4 Discussion

A survey of animal health knowledge and information networks of smallholder farmers was conducted in 324 households in Busia and Kwale Districts of Kenya. The study enabled an audience analysis of the smallholder farmers and provided an insight into their main channels of communication and the extent to which they are exposed to media. The level of literacy of these farmers was low with 44% of farmers having had no formal education and 41% with a primary school education; however, more than half of these farmers were able to read and those who cannot would benefit from their school-going children's explanations of any simple literature available given that 85% of the households had school-going children (Table 6.1).

Although not every household owned a radio, the radio audience was high as some of the respondents listened to it from neighbours' and friends' homes as well as in market centres. Farmers' use of print media was very high amongst literate farmers (over 80% newspaper, leaflets/pamphlets and poster/billboards readership) and lower amongst illiterate farmers (approximately 40% leaflets/pamphlets and poster/billboards readership). Despite some misgivings from a few respondents in the survey, school children were considered by most of the farming community to be reliable channels of communication on animal health issues. The key informant interviews and focus group discussions were effective in supplying more insights into farmers' perceptions of some channels of information within their communities (section 6.3.1).

The notable high use of Agrovet shops (Figure 6.2) for animal health information and veterinary products offers an opportunity for dissemination of animal health information. Farmers who receive this information are in turn likely to share it with their fellow farmers judging by the high mentions of local sources of information and interpersonal communication. The opportunities for information dissemination offered by farmers' associations and women's group is highlighted by the high membership amongst farmers. However, the perceived high costs of membership to these CBOs could potentially prevent members from sharing their information with non-members as this would be perceived as free-riding (Alex *et al.*, 2002).

Interpersonal communication was high at both the household and village levels (Figure 6.2). This is a good indication that there is social cohesion within the communities and is therefore an important indicator of the likelihood of high levels of information dissemination within a community. Social cohesion is critical for societies to prosper economically and for development to be sustainable (World Bank, 2002). Many studies on communication and extension have shown that informal farmer-to-farmer interactions are very important processes and are effective in information dissemination and diffusion of innovations (Rogers, 1983 and 1995;

Subedi and Garforth, 1996; Garforth, 2001). This becomes even more important in terms of collective action for activities such as tsetse control technologies like using pour-on insecticides or spray formulations, whose efficacy in an area is enhanced by widespread use (Hargrove *et al.*, 2000). Farmers' cited various actors and organisations as being important sources of information on agriculture, health and other matters (Table 6.4). The commonly reported ones were radio, Chief's *Baraza* (community meetings) and schools. Similar results were reported from AKIS studies conducted in four districts (Homa Bay, Trans Nzoia, West pokot and Kiambu) in Kenya (Rees *et al.*, 2000).

Women as decision-makers in animal health matters within the households was high which makes them important targets as beneficiaries of information when conducting animal health extension activities. Subedi and Garforth (1996) showed the importance of understanding female communication and patterns of interactions amongst crop growers in Nepal; they indicated that they were different from the male interactions which made them vulnerable to lack of access to agricultural information. There was a noticeable gender difference in main sources of information between male and female respondents; more women mentioned local sources than men, whereas newspapers were mentioned only by men (Table 6.4).

Extension contact did not appear to have any influence on farmers' trypanosomiasis knowledge (Table 6.6), but personal characteristics seemed to play an influential role in knowledge. Individual assessment of the various types of social contacts did not seem to have any special influence either in increasing farmers' knowledge. One of the reasons for this seeming lack of association between extension contact and knowledge is probably that most of the channels or associations discussed were not specifically for animal health activities. The key informant discussions highlighted the fact that most of the associations including the existing farmer field school in Busia District were mainly concerned with horticultural production.

Farmers especially wanted to be given information on correct dosages for different age groups and sizes of animals, and also wanted to know 'exactly' how they could decide that an animal had trypanosomiasis or another disease. These expressed information needs largely coincided with the author's views in that data from the earlier surveys (Chapters IV and V) showed the lack of knowledge in those areas, as did the present study (section 6.3.7).

The findings from the present chapter were useful in selecting the dissemination pathway and medium of the extension materials discussed in Chapter VII.

7 Chapter VII: Impact assessment of a communication intervention on smallholder cattle-owners' and school children's understanding of trypanosomiasis

7.1 Introduction

Animal health service provision by smallholder farmers has seen a sharp and important rise in recent years (Tambi *et al.*, 1999; studies presented in Chapter IV). This has largely been attributed to a decrease in supply of these services by the public sector. Farmers' use of trypanocidal drugs has been shown to be quite inappropriate in some instances (Chapter IV, this thesis; Van den Bossche and Doran, 2000). As there is increasing evidence of trypanocidal drug resistance (Eisler *et al.*, 1998; Geerts and Holmes, 1998; Murilla *et al.*, 1998; Mdachi, 2000), it becomes necessary to exercise special care in drug use in livestock in trypanosomiasis endemic areas if onset of drug resistance is to be delayed or avoided altogether. It, therefore, becomes imperative that smallholder farmers, who are increasingly treating cattle, are provided with guidelines on sound disease control practices. Appropriate information should be made available to the farmers to improve the quality of animal health services by improving their current knowledge and practices.

For effective control, vector-borne diseases require immediate and appropriate treatment to avoid losses of livestock through debility from prolonged illness and death. Trypanosomiasis does not always cause dramatic clinical signs or kill a lot of animals, but it affects the animals' general condition and reduces their productivity and ability to reproduce (Stephen, 1986). This loss in production affects farmers' livelihoods and is economically damaging because its non-dramatic nature results in failure by farmers to take any steps to control it.

In any disease, sick animals show certain abnormalities, or clinical signs, that the farmers notice (Radostits *et al.*, 2000). These are the most apparent features of disease in a farmer's animals. In most cases in rural and peri-urban areas, it is necessary to attempt a diagnosis in order to take immediate action pending a visit of a trained animal health worker, or when one is unavailable altogether. Farmers can use clinical signs as a guide to identify type of disease affecting the animal.

Findings from the preceding studies (Chapters IV-VI) showed that farmers lack a clear understanding of disease causality and indicators, and as a result, their disease control practices, especially use of trypanocides, were generally inappropriate.

These findings formed the basis for drafting of extension messages on trypanosomiasis recognition and its control. Printed materials in leaflet and poster format were chosen as the medium for the communication intervention trial which aimed at raising the skills and abilities of farmers to identify bovine trypanosomiasis and the appropriate control methods. Target groups were smallholder cattle-owning farmers in the study villages of Busia and Kwale Districts, school children, local agro-veterinary traders (Agrovets) and Animal Health Assistants (AHAs).

Many trypanosomiasis control projects have focused on tsetse control methods including aerial spraying, traps and targets, and disease control methods including prophylaxis with isometamidium chloride used as a sanative pair with diminazene aceturate. These projects evolved with time from being implemented largely by governments and researchers to inclusion of local beneficiary communities in different aspects of the projects ranging from deploying traps/targets (in southern Africa's by RTTCP) and use of cost-recovery projects of diminazene aceturate treatments in sick cattle in eastern Zambia. Many of these trypanosomiasis control programmes that relied on community-level management are said to have failed because of individual incentive problems arising in the provision of a public good, e.g. maintenance of tsetse traps/targets (Barrett and Okali, 1998). As a result these technologies were not sustained and areas became re-invaded with tsetse flies. In other disease control programmes, attempts have been made to incorporate communication interventions as part of the disease control strategy. A DFID-funded helminthology project conducted by the Kenya Agricultural Research Institute (KARI) in Kenya produced a technical manual targeted at stakeholders; it contained the important extension messages that resulted from the research conducted under NARPs I and II (Bain, 1999). Another KARI/DFID project used a comic book (KARI/DFID, 1998) to test the efficacy of targeting schoolchildren as a means to convey extension messages to parents about husbandry of smallholder dairy cattle. Initial results from impact analysis showed this had achieved a 30% unprompted recall rate and a 10% knowledge conversion rate (Bain, 1998). Another project that used communication intervention as part of its disease control strategy was the trans-border PARC/VAC rinderpest control and eradication campaign (Villet, 1988).

The main objective of the follow-up (or post-intervention) survey, described in this chapter, was to assess the impact of the messages in the print media on smallholder farmers' knowledge and understanding of trypanosomiasis control in Busia and Kwale Districts. This study was guided by the following hypothesis:

> **If trypanosomiasis messages are disseminated to small-scale farmers and school children in an appropriate format that any lay person can understand, then knowledge of trypanosomiasis and its management may be improved during a community education campaign. Disseminating this information through school children may be effective and might enhance information uptake within communities.**

The present chapter also describes the steps and processes that were undertaken to develop, design and disseminate the leaflets and posters.

7.2 Materials and method

7.2.1 Communication intervention study design

The study villages of Busia (two administrative Divisions – Funyula and Butula) and Kwale Districts (two administrative Divisions – Kubo and Kinango) described in Chapter III were included in the communication intervention trial. The residents of the study villages were subjected to three types of treatments:

- Treatment type 'A' – intervention area: focus group discussion (FGD) meetings held (validation of messages and pre-testing of the leaflet and poster drafts); once ready for intervention, leaflets and posters made available to farmers
- Treatment type 'B' – intervention area: no FGD meetings held; leaflets and posters made available to farmers
- Treatment type 'C' – control area: no FGD meetings held; no leaflets or posters made available to farmers

Allocation of farmers to study groups was by administrative divisions as follows:

District	Intervention area	Control area
Busia	Funyula Division (A)	Butula Division (C)
Kwale	Kubo Division (B)	Kinango Division (C)

Posters and leaflets were distributed to residents of villages in the intervention areas, while those from the control areas were not deliberately exposed to the animal health messages. The sample households used in this study are those described in Chapter

IV, as these data were collected at the same time using the same structured questionnaire.

7.2.2 Generation and evaluation of components of trypanosomiasis extension messages

The developments leading up to the communication intervention involved the activities that led to the results described in the preceding chapters (Chapters IV, V and VI). The immediate activities prior to information dissemination through the leaflets are outlined in Box 7.1.

Box 7.1: Timeline of events towards leaflet/poster development and distribution

Date	Event
September 2001	Validation of proposed contents of trypanosomiasis messages; Focus group discussions (FGD) with farmers in Funyula Division, Busia District
February-April 2002	Development and designing of posters and leaflets
April 2002	Field-testing of extension materials with target population during FGD conducted in Funyula Division, Busia District
April-May 2002	Minor revision of poster and leaflet design done following field-testing; 1000 copies of the poster and 1500 copies of the leaflet printed
June 2002	Distribution of extension materials to smallholder farmers, primary school children, DVOs and Agrovet shops; pre-intervention questionnaire survey with primary school children in study areas of Busia and Kwale Districts
July 2002	Follow-up impact assessment: household and primary school questionnaire surveys in study areas of Busia and Kwale Districts

Key topics for trypanosomiasis messages were selected based on the previous findings for evaluation with farmers as shown below:

- Trypanosomiasis transmission
- Disease diagnosis: organs/systems of animals that should be examined to ascertain their health status and predict most likely condition affecting sick animal
- Drug specificity, e.g. trypanocides are indicated for use against disease transmitted by tsetse flies
- Differential diagnosis of trypanosomiasis from other endemic vector-borne diseases, i.e. tick-borne diseases and helminthiasis (especially liver fluke disease in adult cattle)

The FGD meetings were held in three administrative sub-locations of Funyula Division (Bukhulungu, Sigulu and Wakhungu Sub-locations) in Busia District in September 2001. Meeting participants for the FGDs were selected from lists of farmers (Funyula Division only) drawn from the databases designed using the quantitative data collected during household structured questionnaire surveys (Chapters IV and VI). These lists were given to the respective village headmen at a community meeting; they were also asked to invite other farmers not on the lists within their respective villages. Dates, times and venues were set for each meeting. A semi-structured interview (SSI) guide was prepared based on the proposed contents of animal health messages for the target farmers (Box 7.2); it formed the focus around which the discussions were centred.

Box 7.2: Interview guide on proposed contents of animal health messages

- Why must we learn about trypanosomiasis
- How can we tell when an animal is suffering from trypanosomiasis
- What other diseases have some of the signs seen in trypanosomiasis; how can we tell them apart
- How do animals get trypanosomiasis
- What are the medicines that can treat and/or prevent trypanosomiasis
- What are the uses of trypanocides
- How are trypanocides used
- What methods can be used to control trypanosomiasis
- What are the best ways of providing this information
- What are the best ways to distribute this information

A pair-wise ranking exercise was conducted to compare and contrast the perceived major disease constraints to livestock production, their clinical signs and causes, and also to differentiate trypanosomiasis from any other diseases perceived to be similar to it. Formats and channels for information dissemination considered to be relevant and important to farmers were discussed during these meetings by means of preference ranking. This was used to identify potential obstacles of media formats and distribution channels.

7.2.3 Leaflet and poster design

Leaflets and posters on 'How to check for trypanosomiasis' were developed by Mediae Trust in Nairobi, Kenya and were designed and published by another company called Development Communication (DevCom). They were originally prepared in English, and were later translated into Swahili as it is a widely spoken language in Kenya and could, therefore, be used in both study areas of western and coastal Kenya. The ethnic languages in the two study areas are different (*Luhya* in Busia District and *Mijikenda* in Kwale District); they would have, therefore, raised the production costs if each area had received extension materials prepared in the respective local language.

The animal health messages on trypanosomiasis identification and appropriate trypanocidal drug use were layered for multi-targeting such that illiterate farmers could follow the messages from the illustrations and pictures with little explanatory text, while the fuller text would act as a guide and reminder for the local agro-veterinary traders and AHAs when dispensing drugs and giving advice to farmers at point of care. On the A2-sized poster (Figure 7.1), the first frame shows a cartoon strip illustration of a farmer talking to an AHA about a sick cow. This is followed by a frame showing a series of photos of indicative clinical signs for trypanosomiasis. Each photo has simple text beneath it explaining what is happening. The third frame illustrates methods of preparation of locally available trypanocides, with the dosages for different sizes of cattle beneath it. The final frame shows options for tsetse control and treatment strategies for trypanosomiasis. The leaflet design was adapted from the poster on A4-sized paper, and folded into three sections (Figure 7.2 and Figure 7.3). It is printed on both sides; the outer page includes the cover showing the title "how to check for and treat trypanosomiasis" in Swahili, and has a picture of a thin cow and an inset of a tsetse fly as in the last frame of the poster. Two thirds of the outer page shows illustrations of preparations of different trypanocides and a section with information on "how to avoid trypanosomiasis". The inner page of the leaflet has the same cartoon strip described above on the poster, with the "how to check for trypanosomiasis" row of photos and simple explanatory text beneath it. The leaflet, unlike the poster, also includes a highlighted strip at the bottom of the page describing some clinical signs that are not commonly associated with bovine trypanosomiasis. The frame containing information on trypanocide dosages for different sizes of animals is not included in the leaflet.

Figure 7.1: Poster containing trypanosomiasis messages designed for small-scale subsistence farmers in tsetse endemic areas of Busia and Kwale Districts of Kenya

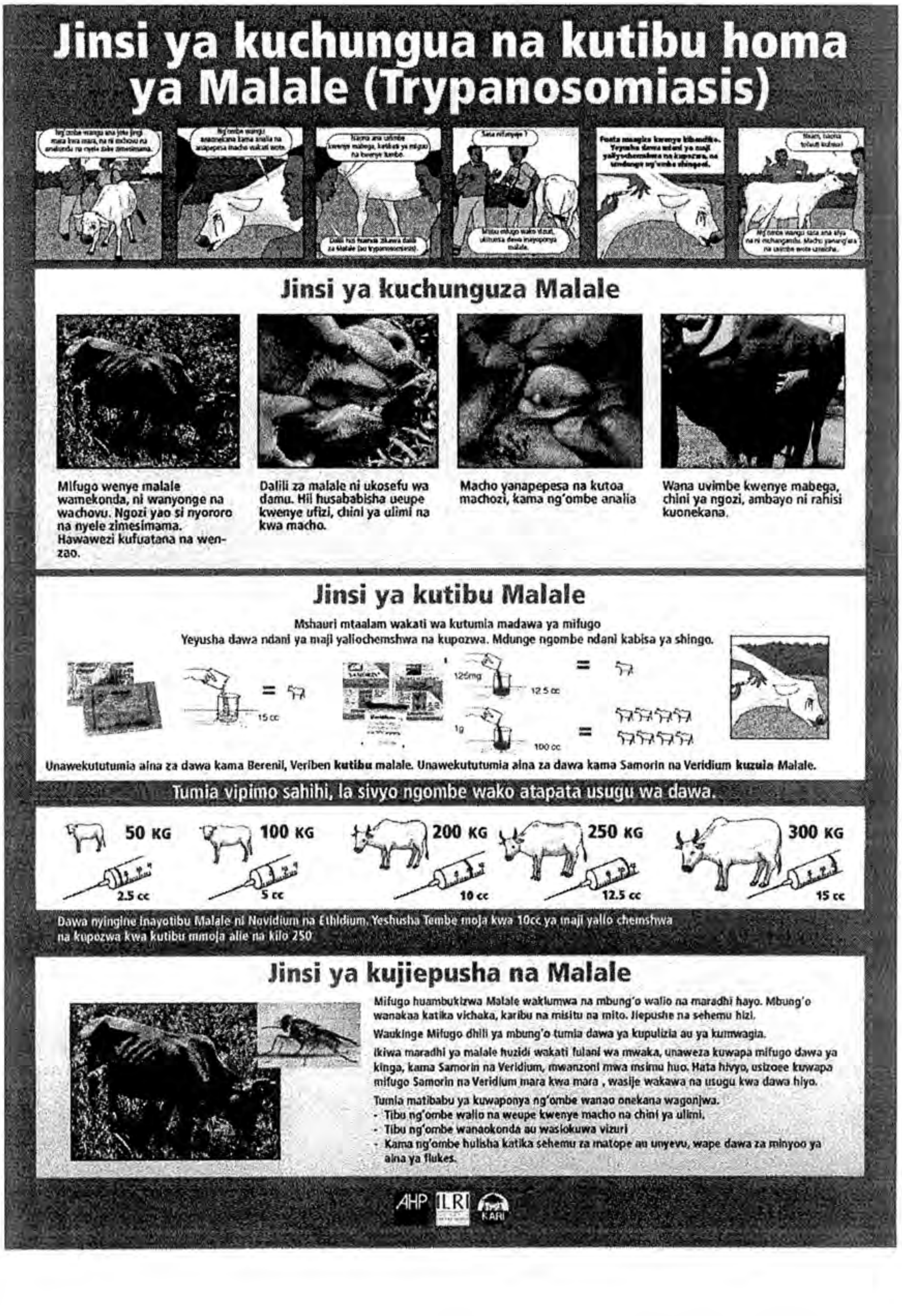


Figure 7.2: Inside page of leaflet containing trypanosomiasis messages designed for small-scale subsistence farmers in tsetse endemic areas of Busia and Kwale Districts of Kenya

Figure 7.3: Outside page of leaflet containing trypanosomiasis messages designed for small-scale subsistence farmers in tsetse endemic areas of Busia and Kwale Districts of Kenya

7.2.4 Pre-testing and validation of the poster

As soon as an acceptable draft of the poster was ready, several copies of it were made and were taken back to the study area of Funyula Division, Busia District, for evaluation with the target audience and other stakeholders within Busia District. The poster field-test was conducted in April 2002 by holding FGD meetings with groups of local farmers. The discussions followed an adaptation of the SSI guidelines provided in the FAO manual for designing print media (Villet, 1988):

- What do you see here?
- What is happening?
- What is the condition of the cow?
- What are these pictures showing?
- What is the message of this story?
- How might we change these drawings and pictures to show the message better?

Copies of the draft poster were left with the Busia DVO HQ, the AHAs at the Funyula Division Veterinary Office and local agro-veterinary traders in Funyula trading centre for comments and suggestions to contribute towards revision, if required, of the extension materials. Farming in Tsetse Controlled Areas (FITCA) and KETRI-Alupe staff in Busia District were also involved in the review process of the materials. They were asked to translate the Swahili text back into English to see if they retained the original meaning, and were also asked to comment on whether the design was simple and clear enough for the target audience of smallholder farmers. The members of staff at the Director of Veterinary Services (DVS) in Nairobi, Kenya were also included in this exercise before the final versions of the materials were printed.

Minor revisions of the draft leaflet and poster designs were performed following field-testing. Thesc were then sent to the DVS in Nairobi, for approval of dissemination to smallholder farmers.

7.2.5 Distribution of leaflets and posters

One thousand copies of the poster and 1500 copies of the leaflet were printed after revision and approval was given by the DVS. Distribution of extension materials was conducted in June 2002 to smallholder farmers through primary schools, village elders and animal health assistants (AHAs) in Busia and Kwale Districts. The numbers and points of distribution of the leaflets and posters are indicated in Appendix X. After the follow-up survey, the leaflets and posters were made available to everybody in the study areas including those in the control areas.

7.2.6 Follow-up household survey

A follow-up household survey was conducted 4-6 weeks later (July 2002) in the study villages of Busia and Kwale Districts on understanding of trypanosomiasis messages contained in the extension materials. Using a structured questionnaire (Appendix II), information was sought on farmers' source of advice for trypanosomiasis, their membership to community-based organisations, their perceptions of the extension materials, knowledge of trypanosomiasis as well as their knowledge of disease transmission and drug specificity as was conducted previously (Chapter VI).

7.2.7 School children interviews

Two short questionnaire surveys were conducted with Standard 6 and 7 primary school children in the study villages to assess their understanding of trypanosomiasis. Eight primary schools were selected for this purpose within the study areas described above. Four of these schools were situated within the intervention area and the other four within the control area, thus four in Busia District (Dadira and Ikonzo Primary Schools in Butula Division and Sigulu and Sijowa Primary Schools in Funyula Division) and the other four in Kwale District (Mwachanda and Ndavaya Primary Schools in Kinango Division and Mtsamviani and Mzinji Primary Schools in Kubo Division). The first questionnaire was administered in June 2002 before the extension materials were distributed to assess the school children's indigenous knowledge of trypanosomiasis, and was thus treated as the 'primary school baseline survey'. The school child's name, age, gender, school, year of study and village name were recorded; they were also asked to supply information on their household's livestock inventory and husbandry, their membership to community-based organisations and their current knowledge of trypanosomiasis and its control (Appendix IV). The second questionnaire (Appendix V) was administered at the same time as the follow-up household survey in July 2002, 4-6 weeks after dissemination of extension material. Its purpose was to investigate whether the extension materials had any influence on their knowledge of trypanosomiasis, and was therefore treated as the 'post-intervention primary school survey'. Social characteristics used to assess influence on trypanosomiasis knowledge included location (Busia/Kwale), gender (girl/boy), age (pre-teens: 10-13 years/early-teens: 14-16 years/late-teens: 17-20 years), year of study (Standard 6/7), cattle ownership (Yes/No), 4K Club membership (Yes/No), and Young Farmers Club membership (Yes/No).

7.2.8 Data analyses

All the data collected from households and school children were stored in separate relational databases designed with Microsoft© Access 2002 software. In analysing the trypanosomiasis knowledge scores data, householders (farmers) and school children were classified, firstly, as either being in the intervention or control divisions based on the communication intervention study design, and secondly, as either having been exposed or not exposed to the trypanosomiasis messages contained within the leaflets and posters. Once the groups were defined, comparisons were made, separately, between farmers and school children in the intervention and control areas, and also between those exposed and not exposed to the messages. The household and school children's pre-intervention data were also subjected to comparisons of social characteristics (location, gender, age, education level, main occupation, cattle keeping experience, year of study at school and membership to CBO) to assess any inherent differences in trypanosomiasis knowledge.

The Mann-Whitney U test was used to compare the trypanosomiasis knowledge scores. This is a non-parametric test which is an appropriate test for data measured on an ordinal scale and is equivalent to the t-test. For comparison of the paired pre- and post-intervention school children's trypanosomiasis knowledge scores data, the Wilcoxon Signed-Ranks test was performed; this is another non-parametric test that is suitable for paired data and is equivalent to the correlated/paired t-test. Differences in school children's knowledge of key trypanosomiasis signs (anaemia, swollen lymph nodes, staring coat, lacrymation, weight loss and fever) during the pre-intervention survey to that observed during the post-intervention survey were measured using McNemar's test. This test assesses the significance of the difference between paired proportions and is most suited to "before and after" type of data such as that presented in the present study. It was used to measure the effects of the communication intervention in terms of two possible outcomes – 'yes' or 'no' – of knowledge of the key clinical signs. Therefore, four types of pairs were possible for each key trypanosomiasis clinical sign:

- Increase in knowledge (– to +)
- Maintenance of knowledge (+ to +)
- Lack of improvement in knowledge (– to –)
- Decline in knowledge (+ to –).

McNemar's test is based on the observed frequencies of the discordant pairs, i.e. – to + and + to –.

In order to determine how much the communication intervention contributed towards any changes in trypanosomiasis knowledge, chi-square (χ^2) tests were performed to compare 'knowledgeable' and 'lacks knowledge' respondents; it was then possible to fit logistic regression models on significant variables due to the presence/absence nature of the dependent variable. In general, significance was accepted at $p < 0.05$. Statistical software packages used included Microsoft© Excel and SPSS© 11.0 for Windows.

7.3 Results

7.3.1 Outcome of focus group discussion meetings on trypanosomiasis extension

7.3.1.1 Trypanosomiasis messages

Following the general discussions on livestock diseases with farmers during FGD meetings conducted in September 2001 (described in Chapter IV), attention was drawn by the meeting facilitator towards trypanosomiasis extension messages. The ensuing discussions on this topic indicated that farmers wanted all aspects of trypanosomiasis to be included in the extension materials. The FGD participant farmers emphasised that they need to be given guidelines on drugs used for curing and preventing the disease. They especially wanted to be given information on correct dosages for different age groups and sizes of animals. They also wanted to know 'exactly' how they could decide that an animal had trypanosomiasis or another disease.

7.3.1.2 Information distribution channels

A list of information networks was generated during discussions with the farmers; advantages and disadvantages of these networks as potential channels for disseminating extension materials were discussed. Churches, Chief's *barazas* (meetings), village elders, schools (children), community based organisations (CBO) and animal health workers were the most frequently mentioned information sources for farmers' animal health knowledge.

The main problems associated with religious organisations as a source of information were that not all people go to church, and that there are various denominations arising in the fear that some of the churches would be left out, and also that the non-church goers would not benefit from the extension messages. Schools posed the problem of arrears in school fees; parents whose children had not paid the school fees in full felt that the teachers would use the extension materials as a bargaining tool for them to make sure all the parents paid-up the school fees. As a result, schools as a channel of information might also mean that not every farmer benefited from the planned communication intervention. Village elders were the most favoured option as they were locally known to everybody in the respective communities. Discussions about membership to CBOs brought to light one of the major obstacles faced by most farmers; this was the issue of membership fees which most farmers felt were too high for them to be able to afford them. It was given as the reason why few farmers belong to local farmers' associations.

7.3.1.3 Farmers' expectations

Apart from discussing the major disease constraints on their farms, participating farmers also expressed a wish to be provided with free drugs on top of the information that would be provided. They felt that information on its own was not enough. They would also like to be provided with tsetse control measures such as nets to stop their cattle from being bitten by *mabuko* (tsetse flies and other nuisance flies), although they do not think that would be enough as "people still get malaria even if they sleep under a mosquito net". All the groups met expressed these desires.

7.3.2 Pre-testing of poster

Two FGD meetings were conducted in April 2002 for the purpose of field-testing the extension materials produced in a poster format. The numbers of participants per group were seven (four females and three males) and 14 (five females and nine males). The meetings lasted approximately 100 minutes each.

Before discussing the poster contents and design, the FGD participants described how they monitor their animals for any signs of ill health and the steps taken when an animal is considered to be unwell. Animals are checked in the evenings when they are brought back from grazing and/or watering, and any that show signs of ill health are given a closer examination.

7.3.2.1 Poster contents and design

A draft version of the final poster (Figure 7.1) was used for the pre-testing meeting sessions held with the farmers. The participants in the FGD meetings were able to follow the storyline in the cartoon-strip without any difficulties. They understood it to be a scenario of a farmer consulting an animal health worker about his sick cow; they were in agreement that the scenario represented what happens when they consult AHW in reality. The series of pictures in the frame on "how to check for trypanosomiasis" elicited some questions from some of the participants on anaemia diagnosis. The female participants felt that it would be difficult to examine the mouth as it involved restraining the animal and they were not strong enough to do so. However, they added that they receive help when their cattle require drenching, and would therefore call for assistance from the same people who normally help them.

The translated Swahili text on the poster into English showed that the original meaning and wording of the texts was retained. Some editing made to the poster included change of measuring units from millilitres (ml) to cubic centimetres (cc) as this is the commonly used expression for liquid volume in the study areas.

7.3.3 Follow-up questionnaire survey sample household characteristics

Two hundred and sixty-seven households were interviewed in Busia (158) and Kwale (109) Districts. Of these, 125 were located in the intervention area (Funyula Division of Busia District and Kubo Division of Kwale District) and the remaining 142 were in the control area (Butula Division of Busia District and Kinango Division of Kwale District).

In addition to information on socio-economics and demographics of the smallholder farmers in the study (described in Chapter IV), the respondents were asked to supply information about current membership to community-based organisations (CBOs). More than half of the farmers in the study (56.9%, 152/267) did not belong to any CBO. There were more than twice as many respondents in Busia (55.1%, 87/158) as in Kwale (25.7%, 28/109) District who said that they belonged to a CBO. There were more female (50.4%, 60/119) than male (37.2%, 55/148) respondents who belonged to a CBO.

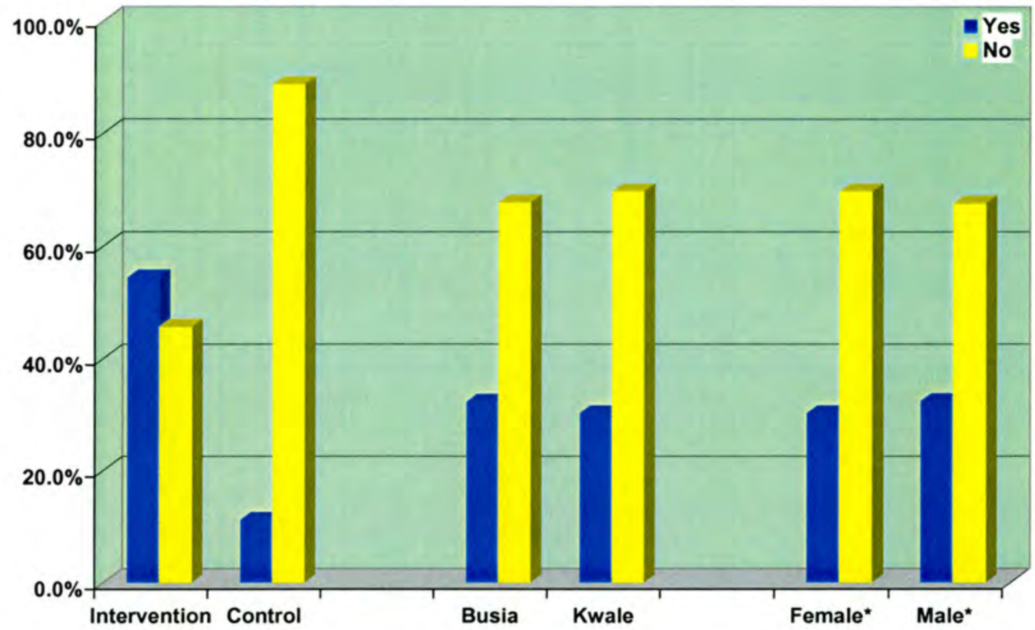
The CBOs with the most membership were Farmer Self Help Groups (20.2%, 54/267), followed by Women's Groups (11.6%, 31/267) and Religious organisations (10.1%, 27/267); very few respondents mentioned a family member belonging to co-operatives or Non-governmental Organisations (2.2%, 6/267), Dip or Water Committees (2.2%, 6/267) and Youth clubs (1.9%, 5/267).

7.3.4 Extent of leaflet and poster distribution

All the respondents were initially asked whether they had received any information on trypanosomiasis in the past year prior to the interview before being specifically asked about the leaflets and posters distributed 4-6 weeks before. Sixty six percent (176/267) of the respondents said they had received some information about trypanosomiasis within the last year; 63.1% of them were from Busia District and the remainder were from Kwale District. Forty five percent of the respondents who had received some information about trypanosomiasis were female, and the majority of these respondents (88.1%, 155/176) came from male headed households. This information was mostly received from friends and neighbours (35.8%, 63/176), farmers' "own knowledge and experience" (21.0%, 37/176), animal health and extension workers (14.2%, 25/176), radio (11.9%, 21/176), school children (6.3%, 11/176), spontaneous mentions of leaflets and posters (5.1%, 9/176) and the remaining 11.4% (20/176) from agro-veterinary shops, community-based organisations (CBOs), relatives and community leaders. Only one respondent (from Busia District) mentioned having received information from the project "Farming in Tsetse Controlled Areas (FITCA)".

A summary of the results obtained about distribution of the leaflets and posters is presented in Figure 7.4. In response to questions pertaining to the leaflets and posters, 54.4% (68/125) of the sample households in the intervention area received or saw the extension material, whereas only 11.3% of them received or saw them in the control area (16/142). Sixty-one percent (51/84) of those who received them were from Busia District and the remainder were from Kwale District; the proportions of respondents who said they received or saw the leaflets and posters were not significantly different between the two districts ($\chi^2 = 0.120, p = 0.729$). Slightly fewer respondents from female (20.6%, 7/34) than from male (33.0%, 48/233) headed households received the extension material; however, there was no significant difference in the overall proportions of female and male headed households in the sample population that received extension materials ($\chi^2 = 2.136, p = 0.144$). The most commonly mentioned source of the extension materials from the 84 respondents in this category was from school children (33.3%), followed by neighbours and friends (31.0%), animal health and extension workers (13.1%), agro-veterinary shops (13.1%) and community leaders, CBOs and relatives (25.0%). There was a significant association between membership to a CBO and receipt of trypanosomiasis extension materials in the intervention areas, ($\chi^2 = 5.687, p = 0.017$). Most of the respondents who received or saw the leaflets and/or posters belonged to a CBO (68.1%, 32/47), unlike those who did not (46.2%, 36/78).

Figure 7.4: Distribution of leaflets and posters to the target audiences in Busia and Kwale Districts



* Female and male respondents

7.3.5 Farmers' perceptions of the leaflets and posters

Farmers' responses about the contents of the messages indicated that a large proportion of them were aware about the subject matter of the leaflets and posters. Over 2/3 of them (70.2%, 59/84) said the messages were about livestock disease identification and how to prevent and treat it; 62.7% of this group of respondents specifically named the disease as being trypanosomiasis and the remainder used the general term 'disease'. Twenty percent (17/84) of the respondents said they did not read the leaflets and/or posters, and 9.5% (8/84) said they were unable to read.

Respondents' views on the ease of understanding of the extension material were divided into those that felt the information was easy to follow (54.8%, 46/84) and those that needed help in following the messages (45.2%, 38/84). More respondents in Kwale (63.6%) than in Busia (49.0%) District found the messages easy to follow ($\chi^2 = 1.728, p = 0.189$), whereas in terms of gender, more male (62.5%) than female (44.4%) respondents found the messages easy to follow ($\chi^2 = 2.707, p = 0.100$). More of the respondents who were exposed to the messages and also came from households where the head had no formal education said they did not understand the messages (39.5%, 15/38) compared to 28.3% (13/46) who said they did; this finding, however, was not statistically significant ($\chi^2 = 1.177, p = 0.278$). The measurements and units contained in the leaflets and posters were found to be easy to follow by 47.6% of the recipients, more so by those from Kwale (63.6%, 21/33) than Busia (37.3%, 19/51) District. There was no appreciable gender difference in this view between male (52.1%, 25/48) and female (41.7%, 15/36) respondents.

The information contained in the leaflets and posters was considered to be new by 53.6% (45/84) of the respondents. There were significantly more farmers in Kwale (72.7%, 24/33) than in Busia (41.2%, 21/51) District who found the information to be new to them ($\chi^2 = 8.019, p = 0.005$), whereas there was no significant difference ($\chi^2 = 2.110, p = 0.146$) in the proportion of female respondents (44.4%, 16/36) who held this view compared to the male respondents (60.4%, 29/48). The information that was considered to be new to the 45 respondents with this opinion ranged from 'everything' (24.4%) to specific aspects such as trypanosomiasis drugs for treatment and protection (37.8%), trypanosomiasis signs (26.7%) with 2 respondents specifically mentioning anaemia, and correct use of trypanocides (8.9%). Only one respondent said that involvement of tsetse flies in trypanosomiasis transmission was a new piece of information to them. Some farmers expressed a wish for similar types of information on other vector-borne diseases as well as more emphasis on tsetse control drugs, good animal husbandry practices and information on effective ethno-veterinary treatments.

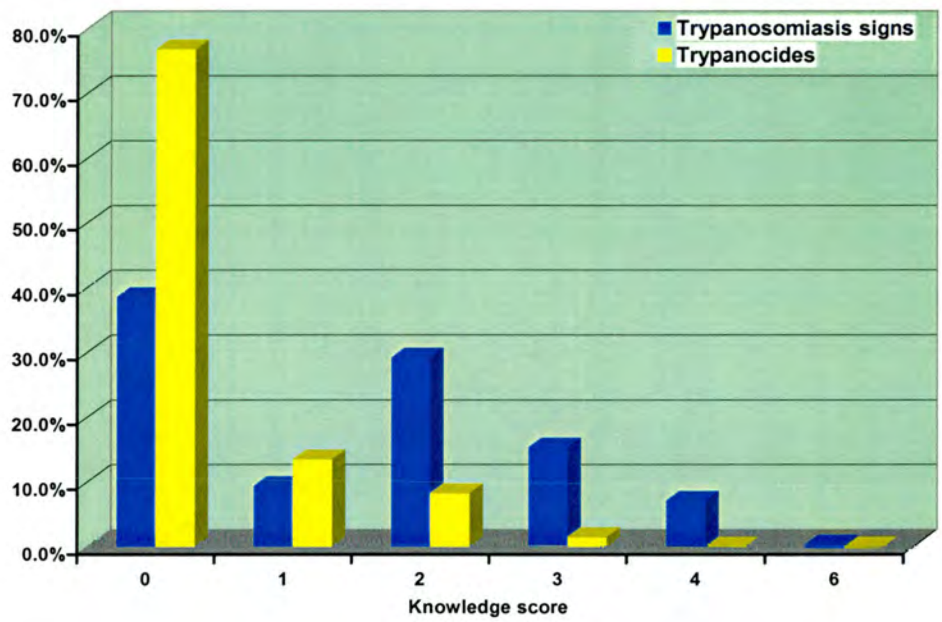
The relevance of the information to the farmers was investigated by asking them whether or not they considered it to be useful for disease management. Over 2/3 of the recipients of the messages considered them to be useful; 32.1% of them did not offer an opinion mostly because they had not read the materials or were unable to read.

Onward dissemination of the information is claimed to have been achieved by 48.8% (41/84) of the respondents (i.e. the primary recipients). Twice as many respondents in Kwale (69.7%, 23/33) as in Busia (35.3%, 18/51) District said they shared the information; meanwhile, a comparison of the gender proportions showed that more male (58.3%, 28/48) than female (36.1%, 13/36) respondents did so. Four groups of people were identified with whom the information from the leaflets and posters is said to have been shared with; these included neighbours and friends (80.5%, 33/41), relatives including children (22.0%, 9/41) and an extension worker.

7.3.6 Effect of leaflets and posters on farmers' understanding of trypanosomiasis and its control

The mean score for knowledge of signs consistent with trypanosomiasis for a respondent in this study was 1.4 (median: 2, range: 0-6) and that for knowledge of trypanocidal drugs was 0.3 (median: 0, range: 0-4) (Figure 7.5). Twenty three percent (61/267) of the respondents mentioned at least three signs consistent with trypanosomiasis, and a similar proportion 23.2% (62/267) mentioned at least one trypanocide.

Figure 7.5: Post-communication intervention knowledge scores of respondents from target households for trypanosomiasis identification in Busia and Kwale Districts



7.3.6.1 Knowledge of trypanosomiasis clinical signs

A comparison of scores for knowledge of trypanosomiasis signs by intervention treatment, exposure to leaflets/posters, district and respondent's gender is presented in Table 7.1. Knowledge scores for respondents who saw the leaflets/posters were significantly higher than for those who did not see the extension materials; similarly, mean score for those who were in the intervention areas was higher than for those who were in the control areas. Meanwhile, male respondents scored higher than their female counterparts. On the contrary, there was no significant difference between the mean trypanosomiasis knowledge scores for respondents in Busia and Kwale.

Table 7.1: Trypanosomiasis signs knowledge scores attained by respondents in the study sites of Busia and Kwale Districts

Parameter	Intervention		Exposed to leaflets/posters		District		Respondent's gender	
Trypanosomiasis clinical signs score	Yes	No	Yes	No	Busia	Kwale	Female	Male
n	125	142	84	183	158	109	119	148
Mean	1.7	1.3	2.0	1.2	1.5	1.4	1.3	1.6
Median	2	1	2	1	2	2	2	1
Standard deviation	1.34	1.34	1.38	1.27	1.37	1.34	1.34	1.35
Range	0-6	0-4	0-6	0-4	0-4	0-6	0-4	0-6
Mean rank	146.7	122.8	163.9	120.3	135.1	132.4	124.5	141.7
Mann-Whitney U	7285.5		5175.5		8437.5		7674.0	
p-value	0.004		<0.001		0.386		0.029	

Chi-square assessments showed no significant effects of respondent and household characteristics on getting a score of three or more for trypanosomiasis knowledge, except with respect to membership to a CBO ($\chi^2 = 5.993, p = 0.014$). Meanwhile, a comparison of respondents' knowledge scores of three or more between those who were exposed to trypanosomiasis extension messages disseminated through leaflets and posters and those who were not ($\chi^2 = 21.610, p < 0.001$), intervention areas and control areas ($\chi^2 = 6.082, p = 0.014$), and between those who had experienced trypanosomiasis in their cattle herds and those who had not ($\chi^2 = 18.187, p < 0.001$), showed a significant effect on their understanding of trypanosomiasis. Fitting these significant variables into a logistic regression model indicated that exposure to the extension materials was significantly more predictive of getting a knowledge score of three or above than being in an intervention area in general (Table 7.2). Furthermore, not having experienced trypanosomiasis in cattle significantly reduced a respondent's chances of obtaining a knowledge score of three or above.

Table 7.2: Predictive factors for small-scale farmers' knowledge of trypanosomiasis signs in Busia and Kwale Districts during the post-communication intervention survey

	Trypanosomiasis clinical signs score			Wald	*p*-value	OR	95% CI for OR	
	n	3-6 (%)	0-2 (%)				Lower	Upper
Communication treatment	267	22.8	77.2					
Intervention	125	29.6	70.4	0.689	0.406	1.360	0.658	2.807
Control	142	16.9	83.1					
Exposed to Leaflets/Posters	267							
Yes	84	40.5	59.5	10.916	0.001	3.350	1.635	6.863
No	183	14.8	85.2					
Had bovine trypanosomiasis								
Yes	151	32.5	67.5	13.729	<0.001	3.905	1.900	8.026
No	116	10.3	89.7					
Member of farmer association								
Yes	92	31.5	68.5	2.836	0.092	1.736	0.914	3.298
No	175	18.3	81.7					

7.3.6.2 Knowledge of trypanocidal drugs

The pattern when comparing average scores for knowledge of trypanocidal drugs between exposure and non-exposure to leaflets/posters; being in intervention and control areas; and being a female or male respondent, was similar to that for knowledge of trypanosomiasis signs (Table 7.3). However, unlike in the case for trypanosomiasis signs described above, there was a significant difference in average scores between respondents in Busia and Kwale Districts (Table 7.3).

Table 7.3: Trypanosomiasis treatment knowledge scores attained by respondents in the study sites of Busia and Kwale Districts

Parameter	Intervention		Exposed to leaflets/posters		District		Respondent's gender	
Trypanocidal drugs score	Yes	No	Yes	No	Busia	Kwale	Female	Male
n	125	142	84	183	158	109	119	148
Mean	0.5	0.2	0.6	0.2	0.1	0.7	0.3	0.4
Median	0	0	0	0	0	0	0	0
Standard deviation	0.79	0.58	0.89	0.54	0.43	0.86	0.61	0.75
Range	0-3	0-3	0-3	0-3	0-2	0-3	0-3	0-3
Mean rank	143.9	125.3	155.2	124.3	114.8	161.9	125.6	140.8
Mann-Whitney U	7639.0		5902.0		5574.0		7801.0	
p-value	0.004		<0.001		<0.001		0.015	

As in the case of knowledge of trypanosomiasis clinical signs, communication treatment of a study area ($\chi^2 = 6.794, p = 0.009$) and exposure to the trypanosomiasis extension materials in particular ($\chi^2 = 15.209, p < 0.001$) were significantly associated with knowledge of at least one trypanocidal drug, as was having had trypanosomiasis previously in cattle ($\chi^2 = 19.074, p < 0.001$). However, in this case, unlike the case for trypanosomiasis signs knowledge, location ($\chi^2 = 44.765, p < 0.001$) and a respondent's gender ($\chi^2 = 4.954, p = 0.026$) were also significantly associated with trypanocides knowledge, but being a member of a CBO was not ($\chi^2 = 1.771, p = 0.183$). Results from fitting these significant variables into a logistic regression model indicated that exposure to extension materials, living in Kwale District and previous experience of trypanosomiasis in cattle were highly (and significantly) predictive of knowledge of trypanocides (Table 7.4). Meanwhile, living in an intervention area was not a useful predictor for knowledge of any trypanocidal drugs, nor was the gender of a respondent.

Table 7.4: Predictive factors for small-scale farmers' knowledge of trypanocidal drugs in Busia and Kwale Districts during the post-communication intervention survey

	Trypanocidal drugs score			Wald	*p*-value	OR	95% CI for OR	
	n	1-3 (%)	None (%)				Lower	Upper
Communication treatment	267	23.2	76.8					
Intervention	125	30.4	69.6	0.037	0.847	0.923	0.411	2.074
Control	142	16.9	83.1					
Exposed to Leaflets/Posters								
Yes	84	38.1	61.9	12.983	<0.001	4.949	2.072	11.774
No	183	16.4	83.6					
Had bovine trypanosomiasis								
Yes	151	33.1	66.9	19.881	<0.001	6.283	2.801	14.093
No	116	10.3	89.7					
District								
Busia	158	8.9	91.1	39.037	<0.001	0.075	0.033	0.169
Kwale	109	44.0	56.0					
Respondents' gender								
Male	148	28.4	71.6	1.528	0.216	1.581	0.765	3.266
Female	119	16.8	83.2					

7.3.6.3 Knowledge of drug specificity and disease transmission

The scores from the 'True/False' questions showed that the respondents were more aware of disease transmission (mean: 1.0, median: 1, range: 0-2) than they were of drug specificity (mean: 0.8, median: 0, range: 0-6); the overall mean score was 1.8 (median: 2, range: 0-8). An overall knowledge score of at least 3/8 was attained by 26.6% (71/267) of respondents; this was not significantly more than was observed for similar questions to cattle-keeping farmers in the information survey conducted in April 2001 (24.5%, 48/196; Chapter VI), $\chi^2 = 0.26, p = 0.609$. When knowledge scores (of at least 3/8) of farmers not exposed to the leaflets in the present study (22.0%, 41/186) were compared to those of cattle-keeping farmers interviewed in household survey described in Chapter VI (24.5%, 48/196), there was, again, no significant difference between the respective proportions of the two groups ($\chi^2 = 0.32, p = 0.572$).

Knowledge significantly varied with respondent gender, education level, cattle herd size (in TLU) and exposure to leaflets. More male (31.8%, 47/148) than female (20.2%, 24/119) respondents gave correct responses ($\chi^2 = 4.54, p = 0.033$) to at least 3/8 'True/False' statements. Proportions of knowledgeable respondents were highest in the group that came from households where the head had a secondary school education (39.6%, 21/53); unlike those groups from household heads with no formal (25.0%, 28/112) or primary school education (21.6%, 22/102), ($\chi^2 = 6.07, p = 0.048$). There was an increasing trend in proportions of knowledgeable farmers with a rise in cattle herd size such that there were fewer farmers with small cattle herds of ≤5 TLU (20.4%, 37/181) than those with medium cattle herds of ≥5-10 TLU (34.8%, 16/46) and large cattle herds of ≥10 TLU (45.0%, 18/40), $\chi^2 = 12.03, p = 0.002$. Nearly twice as many respondents who had been exposed to leaflets (37.0%, 30/81) as those who had not been exposed to them (22.0%, 41/186) obtained knowledge scores of at least 3/8, ($\chi^2 = 6.50, p = 0.011$).

7.3.7 School children trypanosomiasis communication survey

7.3.7.1 Profile of school-children: pre-intervention survey

Five hundred and three primary school children were interviewed in the study areas of Busia (54.7%, 275/503) and Kwale Districts (45.3%, 228/503) prior to information dissemination on trypanosomiasis identification and control. Their distribution within the study areas is presented in Table 7.5. Forty six percent of the school children were girls whose average age was 13.9 years (range, 11-18 years); the rest of them were boys with an average age of 14.5 years (range, 10-20 years). The average age of the school children increased with their year of study at primary school, thus, children in Standard 6 (n = 264) had an average age of 13.8 years (range, 10-19 years), while those in Standard 7 (n = 239) had an average age of 14.7 years (range, 11-20 years). Seventy three percent of the school children came from cattle-keeping households; most of the children in Kwale District (82.5%, 188/228) came from cattle-keeping households, while significantly fewer of them ($\chi^2 = 18.35$, $p < 0.001$) did so in Busia District (65.5%, 180/275).

Table 7.5: Distribution of school children included in the trypanosomiasis knowledge survey in the study sites of Busia and Kwale Districts

Parameter	Frequency	Intervention area (%)	Control area (%)	Busia (%)	Kwale (%)
Grand total	503	34.0	66.0	54.7	45.3
Girls	231	38.1	61.9	57.1	42.9
Boys	272	30.5	69.5	52.6	47.4
Standard 6	264	34.5	65.5	53.8	46.2
Standard 7	239	33.5	66.5	55.6	44.4
Pre-teens (<=13 years)	151	37.1	62.9	62.3	37.7
Early-teens (>13-16 years)	318	32.4	67.6	51.6	48.4
Late-teens (>16 years)	34	35.3	64.7	50.0	50.0
Have cattle	368	33.4	66.6	48.9	51.1
Have no cattle	135	35.6	64.4	70.4	29.6

Only 7.1% (33/467) of the school children were involved in looking after livestock in their households, with most of them saying that their fathers (42.6%, 199/467) were in charge of livestock care, followed by herdsmen (28.1%, 131/467) and their mothers (15.4%, 72/467). Even fewer of them (1.4%, 6/436) said they took part in nursing sick cattle and that their fathers (70.0%, 305/436) and mothers (15.4%, 67/436), again, were the main caretakers of sick cattle.

There was only a small proportion of the school children who were not members of any social clubs at school (8.3%, 42/503), whereas a larger proportion of them did not belong to any community-based organisation (CBO) within their respective villages (42.1%, 212/503). The most commonly reported school club membership was the 4K Club, a school-based agricultural club, with more children in Kwale District (59.6%, 136/228) mentioning it compared to 34.2% (94/275) in Busia District; furthermore, slightly over a quarter of them mentioned being members of a CBO called Young Farmers Club (26.8%, 61/228 and 26.9%, 74/275, respectively). Other clubs/associations mentioned included Debate, Anti-AIDS, Sports and Children's Drama Clubs at school, as well as Christian Union and Choir Groups within their respective communities. On information dissemination, 71.8% (361/503) of the school children gave an affirmative response when asked whether or not they shared agricultural information with their families and friends; fewer of them said "yes" to this question in Busia District (64.7%, 178/275) than was the case in Kwale District (80.3%, 183/228).

7.3.7.2 School children's pre-communication intervention awareness of trypanosomiasis

The average score for clinical signs consistent with trypanosomiasis was 2.6 (median: 3, range: 0-7) and that for knowledge of trypanocidal drugs was 1.0 (median: 0, range, 0-6). Twenty one percent (107/503) of the children scored at least four for knowledge of clinical signs consistent with trypanosomiasis, and 19.9% (100/503) scored at least three for knowledge of trypanocidal drugs; meanwhile, only 7.0% (35/503) of them achieved these scores in both categories of knowledge – at least four for trypanosomiasis signs and at least three for trypanocidal drugs knowledge. Eight percent of the school children did not list any clinical signs (39/503), while 2.8% (14/503) only listed those that are inconsistent with trypanosomiasis; a look at the other children indicated that as well as listing clinical signs that are consistent with trypanosomiasis, 62.4% (314/503) of them listed other clinical signs that are inconsistent with the disease, with mean 'incorrect' score per child being 1.9 (median: 1.5, range: 0-7). When it came to knowledge of trypanocidal drugs, a high proportion of the children (15.1%, 76/503) did not know (or name) any drugs for treating trypanosomiasis, and a further 54.9% (276/503) of them only named non-trypanocidal drugs as treatment for trypanosomiasis; meanwhile the remaining 16.5% (83/503) named some non-trypanocidal drugs, in addition to trypanocidal drugs, as being treatments for trypanosomiasis.

Trypanosomiasis prevention methods known to the school children included use of acaricides or insecticides (71.6%) and restricted grazing (42.7%); other methods mentioned by a minority of the children included bush clearing near villages (14.1%) and use of isometamidium chloride and homidium chloride/bromide (1.8%). A quarter (25.8%) of the children said that vaccination was one of the preventive measures for trypanosomiasis, with very few of them also mentioning diminazene aceturate and anthelmintics (1.6%) and traditional treatments (18.1%).

Social factors influencing school children's trypanosomiasis knowledge

Social factors investigated using the Mann-Whitney non-parametric test indicated that there was a significant difference ($p < 0.05$) in children's trypanosomiasis signs knowledge when compared by location, membership to CBOs, 4K and Young Farmers Clubs (Table 7.6). Student's gender was almost statistically significant ($p = 0.054$) in showing a difference in children's trypanosomiasis signs knowledge, where as age group, year of study and cattle ownership did not make a difference in the children's knowledge. None of these variables made a significant difference in the children's knowledge of trypanocidal drugs. Mean knowledge score for clinical signs consistent with trypanosomiasis was higher for children in Busia District than those in Kwale District. Children who belonged to Young Farmers Clubs scored higher than those that did not; however, 4K Club members scored less than non-members.

Table 7.6: Pre-intervention trypanosomiasis knowledge of school children in the study sites of Busia and Kwale Districts

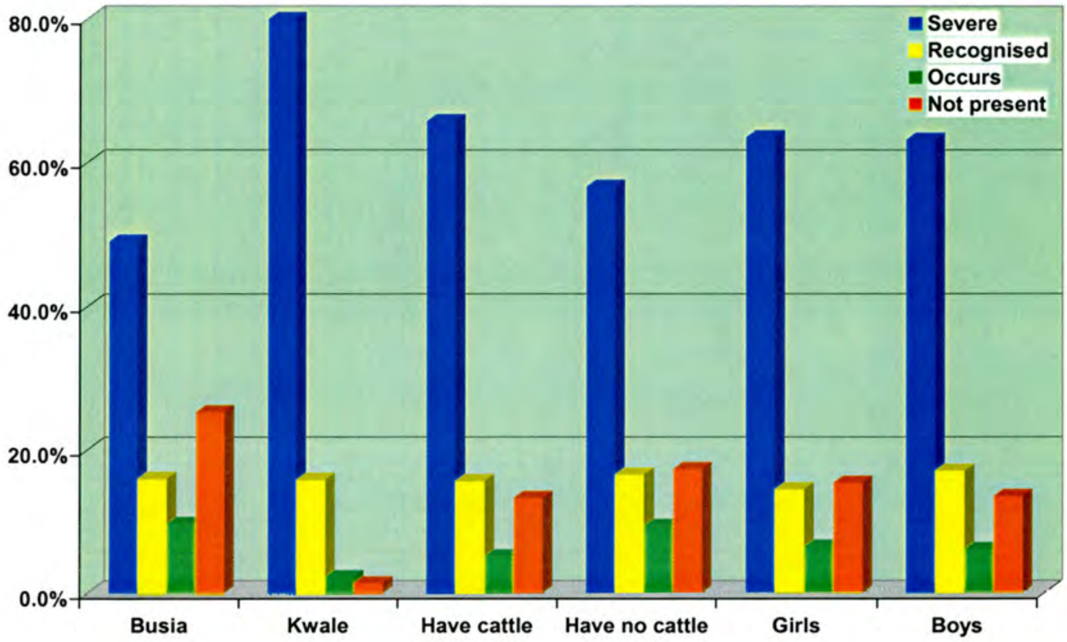
Parameter	District		Student's gender		Young Farmers' Club		4K Club	
	Busia	Kwale	Girl	Boy	Yes	No	Yes	No
n	275	228	231	272	126	377	192	311
Mean	2.7	2.4	2.7	2.5	2.8	2.5	2.2	2.8
Median	3	2.5	3	3	3	3	2	3
Standard deviation	1.35	1.47	1.46	1.37	1.55	1.36	1.65	1.20
Range	0-7	0-6	0-6	0-7	0-7	0-6	0-7	0-6
Mean rank	268.3	232.3	263.0	242.7	271.2	215.6	211.9	276.8
Mann-Whitney U	26856.0		28880.0		21326.5		22151.5	
P-value	0.002		0.054		0.039		<0.001	

7.3.7.3 Attitudes towards trypanosomiasis

The diseases that the school children in this study considered to be major livestock production constraints included foot and mouth disease (FMD) (48.5%, 244/503), trypanosomiasis (44.5%, 224/503), East Coast fever (ECF) (43.9%, 221/503), anthrax (39.2%, 197/503) and less than 14% mentions of rinderpest, mastitis, heart water, diarrhoea, anaplasmosis and lumpy skin disease. The three most commonly mentioned diseases in Busia District were 63.6% for FMD, 55.6% for anthrax and 38.5% for ECF; whereas those mentioned by the children in Kwale District included 54.4% for trypanosomiasis, 50.4% for ECF and 30.3% for FMD. The boys' frequently mentioned major livestock diseases including FMD (51.1%), trypanosomiasis (50.7%) and ECF (44.9%); this was quite similar to the girls' views – FMD (45.5%), ECF (42.9%) and trypanosomiasis (37.7%).

School children's views on the importance of trypanosomiasis in their areas was measured on a scale ranging from "severe", "recognised, but other diseases more important", "occurs, but not a problem" up to "not present". Six percent (31/503) of the children in this study did not respond to this question. Of those that did, 63.3% (299/472) considered trypanosomiasis to be a severe disease, 15.9% (75/472) recognised it but considered other diseases to be more important, 6.4% (30/472) of them did not consider it to be an important problem, and a number of them (14.4%, 68/472) felt that it was a non-existent problem in their area (Figure 7.6). There were significantly more children in Kwale District (80.5%, 173/215) who considered trypanosomiasis to be a major livestock problem compared to 49.0% (126/257) who shared this opinion in Busia District ($\chi^2 = 49.831, p < 0.001$); meanwhile, a comparison of school children's gender in sharing this point of view showed no difference between the girls (63.6%, 136/214) and boys (63.2%, 163/258), $\chi^2 = 0.007, p = 0.933$. When comparison was made between children who come from households with cattle and those who did not, the indication was that more of the former (65.8%, 227/345) considered trypanosomiasis to be severe in their areas than the latter (56.7%, 72/127), however, this finding was not statistically significant ($\chi^2 = 3.314, p = 0.069$).

Figure 7.6: School children's attitudes towards trypanosomiasis in the study areas of Busia and Kwale Districts



7.3.7.4 Impact of communication materials on school children's understanding of trypanosomiasis

A total of 558 school children were interviewed 4-6 weeks after trypanosomiasis information dissemination in the same primary schools and years of study described in section 7.3.7.1 above. Forty five percent of the school children were girls with an average age of 14.2 years (range: 10-19 years); the rest of them were boys (mean: 14.7 years, range: 10-19 years).

Overall, 43.7% (244/558) of the school children in the study area received or saw the leaflets and posters; almost all the children within the intervention areas (96.4%, 187/194), and only 15.7% of those in the control areas (57/364) received or saw them (Table 7.7). Sixty nine percent (168/244) of this group of children claimed to have understood the trypanosomiasis messages contained within the leaflets and posters. There appeared to be a wide onward dissemination of this information as 96.7% (236/244) of the children who received the extension materials said that they shared it with their parents/guardians (82.4%, 201/244), other members of their families (78.7%, 192/244), as well as their friends (62.7%, 153/244).

Table 7.7: Distribution of leaflets and/or posters containing trypanosomiasis messages amongst school children from primary schools in the study sites of Busia and Kwale Districts

Parameter	Exposed to leaflets/posters		
	Frequency	Yes (%)	No (%)
Grand total	558	43.7	56.3
Intervention area	194	96.4	3.6
Control area	364	15.7	84.3
Busia	324	27.2	72.8
Kwale	234	66.7	33.3
Girls	251	45.8	54.2
Boys	307	42.0	58.0
Standard 6	274	49.3	50.7
Standard 7	284	38.4	61.6
Pre-teens (<=13 years)	142	51.4	48.6
Early-teens (>13-16 years)	374	40.4	59.6
Late-teens (>16 years)	42	47.6	52.4
Have cattle	292	53.8	46.2
Have no cattle	266	32.7	67.3

Post-intervention knowledge of trypanosomiasis by school children

The trypanosomiasis knowledge scores of the school children were generally high throughout the study areas (Figure 7.7 and Figure 7.8). The average score for clinical signs consistent with trypanosomiasis was 4.9 (median: 5, range: 0-8) and that for knowledge of trypanocidal drugs was 4.5 (median: 5, range: 0-6). Eighty four percent (468/558) of the children scored at least four for knowledge of trypanosomiasis signs and 86.0% (480/558) scored at least three for knowledge of trypanocidal drugs; meanwhile, 73.7% (411/558) of them scored at least four and three, respectively, in both categories for knowledge of trypanosomiasis signs and trypanocidal drugs. Despite the high trypanosomiasis knowledge scores, some children did not list any clinical signs (3.8%, 21/558), and a further 1.1% (6/558) of the children *only* listed clinical signs that are inconsistent with the disease; meanwhile, other children listed clinical signs that are inconsistent with trypanosomiasis alongside those that are consistent with the disease (80.6%, 450/558). These clinical signs inconsistent with trypanosomiasis resulted in an average 'incorrect' score per child of 1.4 (median: 1, range: 0-5). With respect to drugs for treating trypanosomiasis, very few of the children were unable to name any drugs (3.6%, 20/558), and only 9.1% (51/558) of them named non-trypanocidal drugs as part of trypanosomiasis treatment (mean: 0.1, median: 0, range: 0-2).

Trypanosomiasis signs and control knowledge scores attained by the school children within the post-intervention study were compared and are presented in Table 7.8.

Figure 7.7: Trypanosomiasis signs knowledge scores attained by school children who were exposed and those who were not exposed to trypanosomiasis messages disseminated through leaflets and posters during the post-communication intervention survey in Busia and Kwale Districts

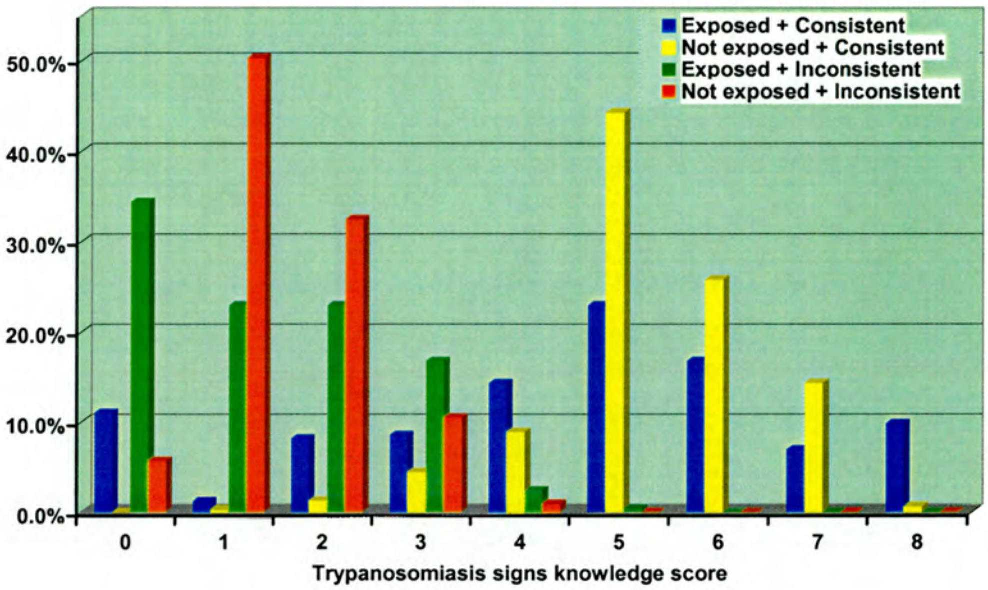


Figure 7.8: Trypanocidal drugs knowledge scores attained by school children who were exposed and those who were not exposed to trypanosomiasis messages disseminated through leaflets and posters during the post-communication intervention survey in Busia and Kwale Districts

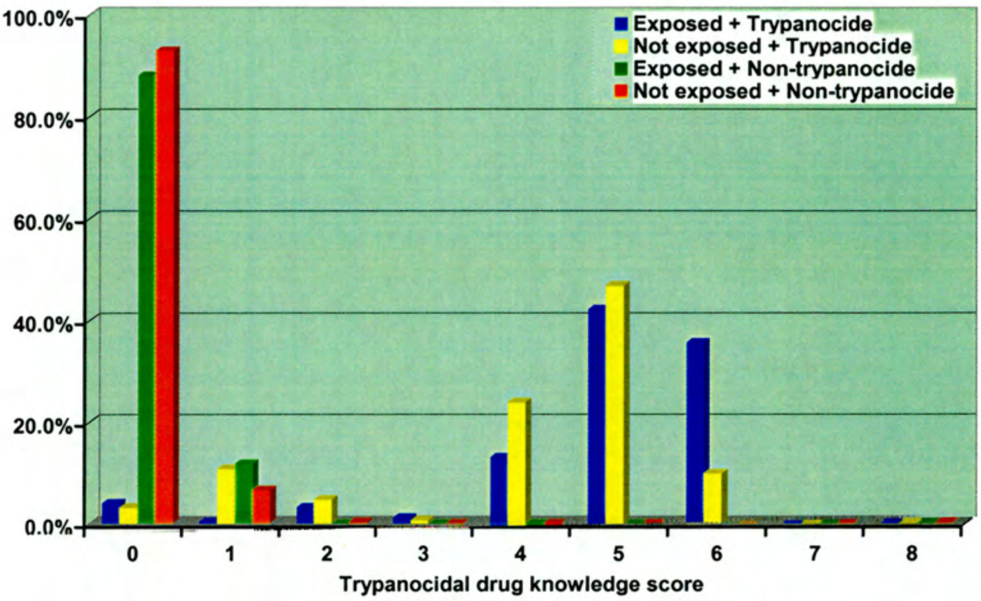


Table 7.8: Trypanosomiasis identification and control knowledge scores attained by school children in intervention and control areas, and by those exposed and not exposed to the communication materials in Busia and Kwale Districts

Parameter	Trypanosomiasis clinical signs score				Trypanosomiasis treatment score			
	Consistent		Inconsistent		Trypanocides		Non-trypanocides	
Communication intervention	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*
n	194	364	194	364	194	364	194	364
Mean	4.3	5.3	1.0	1.6	4.8	4.3	0.0	0.1
Median	5	5	1	1	5	5	0	0
Standard Deviation	2.488	1.081	1.149	0.843	1.420	1.592	0.174	0.341
Range	0-8	2-8	0-5	0-4	0-6	0-6	0-1	0-2
Mean rank	234.6	303.4	216.7	313.0	318.7	258.6	262.6	288.5
Mann-Whitney U	26597.5		23128.5		27696.0		32032.0	
p-value	<0.001		<0.001		<0.001		<0.001	
Exposure to trypanosomiasis messages	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*
n	244	314	244	314	244	314	244	314
Mean	4.4	5.3	1.3	1.5	4.9	4.1	0.1	0.1
Median	5	5	1	1	5	5	0	0
Standard Deviation	2.286	1.102	1.201	0.796	1.384	1.594	0.324	0.273
Range	0-8	1-8	0-5	0-4	0-6	0-6	0-1	0-2
Mean rank	244.3	306.9	258.4	295.9	333.3	237.7	287.1	273.6
Mann-Whitney U	29712.5		33163.5		25193.5		36453.5	
p-value	<0.001		0.002		<0.001		0.025	

Knowledge scores for clinical signs consistent with trypanosomiasis attained by the children in the intervention primary schools that received the extension leaflets and posters were lower than those attained by their contemporaries in the control primary schools. However, their average scores for citing clinical signs inconsistent with trypanosomiasis were favourably less than those scored by the children from the control schools. This pattern in knowledge scores was observed again when comparing the same knowledge category between children who had received/seen the leaflets or posters and those that had not; children exposed to the extension materials attained lower scores than those that did not, but they, however, made fewer mistakes than the children who were not exposed to the extension materials. When comparing trypanosomiasis treatment knowledge scores between the children in the intervention and control areas and, in particular, between children exposed to extension materials and those not exposed to them, the results were all in favour of the children either in the intervention schools or exposed to trypanosomiasis messaging materials. These two groups of children scored higher than their contemporaries and also made less mistakes of naming non-trypanocidal drugs as being treatments for trypanosomiasis.

Comparison of school children's pre- and post-communication intervention trypanosomiasis knowledge levels

The Wilcoxon Signed-Ranks test was performed on 444 pairs of school children's pre- and post-intervention trypanosomiasis knowledge scores. This dataset consisted of 79.6% (444/558) of the children who were present at school on both days of the communication intervention surveys – i.e., the pre- and post-intervention surveys. There were highly significant improvements in the children's trypanosomiasis knowledge from the baseline pre-intervention survey to the follow-up post-intervention survey (Table 7.9). The mean scores attained for clinical signs consistent with trypanosomiasis during the post-intervention survey were double those attained during the pre-intervention survey. Furthermore, there was a noticeable reduction in average number of signs listed per child that are inconsistent with trypanosomiasis from the post-intervention survey compared to that observed during the pre-intervention survey. This trend was greater when comparing scores for knowledge of trypanosomiasis treatment. There was more than a four-fold difference in average score for knowledge of trypanocidal drugs between the pre- and post-intervention surveys, whereas citing of non-trypanocidal drugs as part of trypanosomiasis treatment was greatly minimised by 13 times from the pre- to the post-intervention surveys.

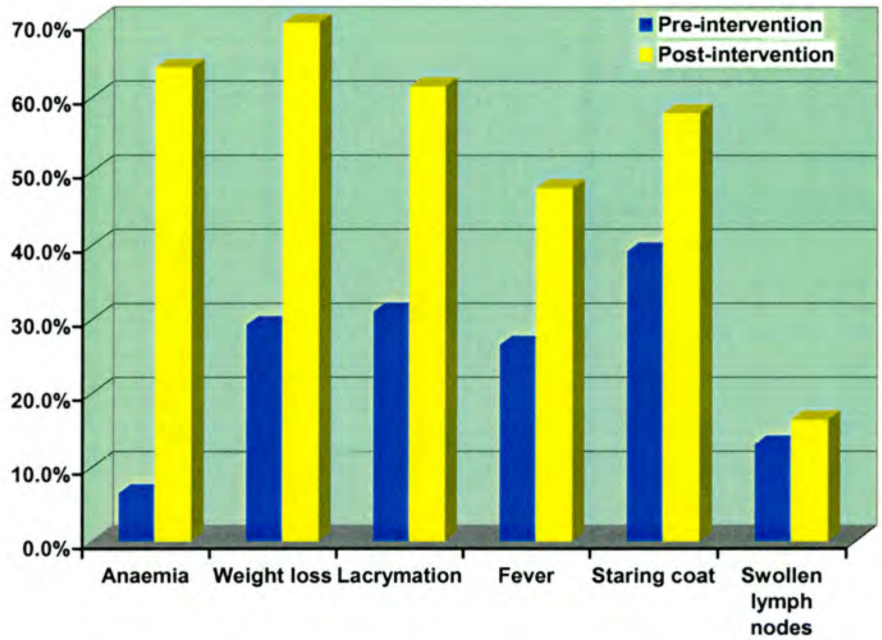
Table 7.9: Trypanosomiasis knowledge scores attained by school children during the pre- and post-communication intervention surveys conducted in Busia and Kwale Districts (n paired data = 444)

Parameter	Trypanosomiasis clinical signs score				Trypanosomiasis treatment score			
	Consistent		Inconsistent		Trypanocides		Non-trypanocides	
Communication intervention	*Pre*	*Post*	*Pre*	*Post*	*Pre*	*Post*	*Pre*	*Post*
Mean	2.5	5.1	2.0	1.4	1.0	4.6	1.3	0.1
Median	3	5	1	1	0	5	1	0
Standard Deviation	1.45	1.71	1.99	0.98	1.74	1.45	0.96	0.33
Range	0-6	0-8	0-8	0-5	0-6	0-6	0-5	0-2
n Negative Ranks[a]	32		193		12		350	
n Positive Ranks[b]	370		175		381		2	
n Ties[c]	42		76		51		92	
Negative Sum of Ranks	2831.5		43054.5		611		61880	
Positive Sum of Ranks	78171.5		24841.5		76810		248	
Z	-16.231[d]		-4.527[e]		-17.121[d]		-16.880[e]	
p-value	<0.001		<0.001		<0.001		<0.001	

[a]Pre > Post
[b]Pre < Post
[c]Pre = Post
[d]Based on negative ranks
[e]Based on positive ranks

Using the McNemar test to compare the paired proportions of 444 school children citing individual key clinical signs for trypanosomiasis, it was observed that the post-intervention mentions of anaemia ($\chi^2 = 220.191$), weight loss ($\chi^2 = 136.313$), lacrymation ($\chi^2 = 66.751$), fever ($\chi^2 = 42.397$) and staring coat ($\chi^2 = 23.107$) increased significantly ($p < 0.001$) from the levels seen during the pre-intervention school survey (Figure 7.9). However, proportions of school children mentioning swollen lymph nodes barely increased during the post-intervention survey from the levels seen during the pre-intervention survey ($\chi^2 = 2.685, p = 0.051$).

Figure 7.9: Proportions of school children citing the key clinical signs for trypanosomiasis during the pre- and post-communication intervention surveys in Busia and Kwale Districts (n paired data = 444)



Knowledge of tsetse habitats and prevention of trypanosomiasis

The school children mostly mentioned thick bushes or forests (89.2%, 498/558) as places where tsetse flies are found; this view was shared by nearly all the children in Kwale District's intervention (92.3%, 96/104) and control (86.2%, 112/130) areas as well as Busia District's control area (99.6%, 233/234) and by just under two thirds (63.3%, 57/90) of the children in the intervention area of Busia District. The second most commonly mentioned tsetse habitat was vegetation adjacent to rivers by 47.8% (267/558) of the children (28.1% in intervention and 71.9% in the control areas). Grasslands, as a tsetse habitat, was mentioned by 22.0% (123/558) of the children, most of whom (95.9%, 118/123) came from the control area of Busia District.

As observed from the pre-intervention survey, methods of trypanosomiasis prevention mentioned by the school children consisted largely of use of acaricides or insecticides (45.0%, 251/558) – mentioned more by children from the intervention areas (54.6%, 106/194) than those from the control areas (39.8%, 145/364). Interestingly, only children from Kwale District and none from Busia District mentioned bush clearing near villages (15.9%, 89/558) and restricted grazing away from bushes and forests (14.3%, 80/558) as a preventive measure for trypanosomiasis; there were more of these responses from children in the intervention (57.7%, 60/104) than control (22.3%, 29/130) areas of Kwale District for bush clearing, and less from the intervention (6.7%, 7/104) than control (56.2%, 73/130) areas of Kwale District with respect to restrictive grazing. Other appropriate methods mentioned by a minority of the children included use of isometamidium chloride (9.0%, 50/558) and homidium chloride/bromide (1.4%, 8/558); these drugs were not mentioned by any children from the control area of Busia District, but by more children in Kwale District (intervention area: 15.4%, 16/104; control area: 28.5%, 37/130) than in the intervention area of Busia District (5.6%, 5/104). More children (35.3%) in the post-intervention study mentioned vaccination as one of the preventive measures for trypanosomiasis than was previously seen in the pre-intervention study (25.8%); however, only two of them mentioned traditional treatments (0.4% compared to 18.1% in the pre-intervention study). Meanwhile, a small increase in children mentioning diminazene aceturate (6.3% from 1.0%) was observed, although this was mainly from children in the control area (91.4%, 32/35).

7.4 Discussion

A controlled communication intervention study was conducted in the study sites of Busia and Kwale Districts by disseminating leaflets and posters containing bovine trypanosomiasis messages. There was a 54% rate of exposure to trypanosomiasis extension materials amongst the target audience who reside in the intervention areas and an 11% exposure rate for the residents in the control areas. This exposure rate was not surprising as the distribution of the leaflets and posters was conducted deliberately in the intervention areas but not in the control areas. There was even distribution of extension materials between the two districts and between female and male headed households (Figure 7.4). Results from this study showed a positive and significant impact of the communication materials on farmers' and school children's understanding of bovine trypanosomiasis and its control.

Following the communication intervention, the number of farmers able to answer questions on trypanosomiasis signs and treatment correctly within the intervention areas, and especially those exposed to the trypanosomiasis messages, was significantly higher than those in the control areas or those not exposed to the messages (sections 7.3.6.1). The long-term expected impact of this increase in knowledge is that it should result in prompt diagnosis and treatment of suspected trypanosomiasis conditions and thus reduce severity and duration of morbidity. Other evidence of positive outcomes of increased trypanosomiasis knowledge is available in the findings from a tsetse control project in another region of Busia District from that described in the present study (Mwangi, 1996). This project also showed an increase in farmers' awareness of trypanosomiasis after initiating community education through posters and drama, and further demonstrated that significantly more of the farmers who were exposed to this community education also responded positively by contributing money towards community-based tsetse control efforts compared to those not exposed to it (Kamara *et al.*, 1995; Mwangi, 1996).

A similar observation to that of householders concerning increase in knowledge about trypanosomiasis identification and treatment due to the communication intervention was made amongst school children who were included in the school-based trypanosomiasis education study. The results showed that the proportions of school children able to answer trypanosomiasis questions correctly during the post-communication intervention survey had risen from that observed during the pre-communication intervention survey (Table 7.9 and Figure 7.9).

A large proportion of school children in the control areas also attained high trypanosomiasis knowledge scores during the post-intervention study. This finding can be attributed to the fact that they were expecting to be re-interviewed in a few weeks' time after the pre-intervention survey. The knowledge that there would be an imminent repeat questionnaire survey conducted in approximately two months' time from the initial one must have resulted in a search for trypanosomiasis information, and in the meantime increased their knowledge about the subject. Despite this, it was still possible to show that the children who were exposed to the trypanosomiasis messages contained in the leaflets and posters had a more accurate understanding of the disease than those that had not been exposed to them (Table 7.9). This finding was further supported by the fact that children exposed to the trypanosomiasis messages from the leaflets and posters made fewer mistakes in their trypanosomiasis knowledge recall responses than their counterparts who were not exposed to the communication materials. Similar results from another school-based community education study on ruminant helminthiasis control in Central Kenya were obtained which showed a high message recall rate (30%) from participating children (Bain *et al.*, 1999).

The importance of children as sources of animal health management information was highlighted by the results from the present study, and thereby confirmed the earlier findings observed during the farmer information networks survey (Chapter VI). There were high levels of onward dissemination of trypanosomiasis information by school children in that nearly all (97%) of the message recipients said that they shared the information with their parents and other family members and friends (63%). Furthermore, the household respondents' answers to questions about their source of trypanosomiasis extension materials or trypanosomiasis information indicated that they were largely (33%) from school children. The importance of a school-based approach to community education has also been shown in a study conducted in south-eastern Nigeria which used a health club in a community school to increase adults' knowledge of onchocerciasis and ivermectin treatment compliance (Shu *et al.*, 2000). More evidence of effectiveness of school-based community education activities includes the Chinese schistosomiasis disease control programme which sought to increase awareness of transmission and prevention of the disease amongst primary school children at risk in endemic areas (Yuan *et al.*, 2000).

Membership to CBOs had a positive effect on proportions of the target audience that were exposed to trypanosomiasis messages from leaflets and posters, which suggests sharing of information and materials amongst members. Therefore, the implication is that encouraging non-members to join existing farmers' associations and formation of new ones where none exist would increase the numbers of livestock farmers likely to be reached by extension activities.

The pair-wise ranking exercise conducted during FGD (presented in Chapter IV) was effective at introducing the topic of proposed contents of bovine trypanosomiasis messages and greatly contributed towards evaluating them with the target smallholder farmer audience. Farmers admitted to their own lack of knowledge of trypanosomiasis and its control. Preference ranking, as a participatory method was effective at contributing towards highlighting the strengths and weaknesses, from the farmers' points of view, of formats and channels of information dissemination.

The study design for implementing the communication intervention considered the possibility that the activities of the EU-funded Farming in Tsetse Controlled Areas (FITCA) in Busia District might confound the findings on farmers' awareness and knowledge of trypanosomiasis; this possible confounding factor did not extend to Kwale District as FITCA only covered western Kenya. It was therefore considered that using one division in each district as a control area would contribute towards addressing this. Another consideration taken was that having control areas would account for the 'secular knowledge' that people acquire naturally through time and experience without any deliberate external intervention. As such, the data analyses consisted of comparisons between the intervention and control areas to assess if any differences in trypanosomiasis knowledge were present between the two districts. Despite these reservations, only one respondent from Busia District mentioned having received information on trypanosomiasis from FITCA even though this project had been running for more than three years in the district at the time of the follow-up survey.

Compared to tsetse fly vector control, trypanosomiasis prevention is relatively easy to achieve and accessible to small-scale farmers as they have been shown to widely use trypanocides on an individual basis, and the drugs are also available within their areas. The requirement in this instance would be to design messages targeted at increasing use of prophylactic drugs and encourage use of sanative pairs to delay onset of drug resistance.

Changes in animal health practices can reduce infection rates and severe morbidity through having a preventive and promotive animal health approach and improved prompt diagnosis and treatment. The RTTCP socio-economic survey findings in Southern Africa concluded that, at present for Malawi, Mozambique and Zambia, the continued use of trypanocides to control the disease was the most sustainable and transferable option available, but that the logical strategy for Zimbabwe was to hold the target barrier which prevents the re-invasion of tsetse flies from neighbouring countries (Doran, 2000).

8 Chapter VIII: General discussion and recommendations

The thesis examined smallholder livestock owners' perceptions of bovine trypanosomiasis and the methods used for its control, within the context of primary animal health care in Busia District in western Kenya and Kwale District in coastal Kenya, areas endemic for animal trypanosomiasis. Animal health messages for recognition of clinical signs of trypanosomiasis and means for control were developed, tested and disseminated to the farmers in the study areas. The farming systems in these two study sites are predominantly characterised by small-scale subsistence, mixed crop-livestock producers who keep local East African zebu cattle. The areas show a marked difference in cattle holdings with households in Busia District owning fewer cattle than those in Kwale District where livestock keepers have occasional contact with pastoralist farmers.

Quantitative (standardised questionnaires) and qualitative (participatory rural appraisal) methods of data collection were employed throughout the studies. These methods were used together for validating and supplementing of the findings from each dataset. Interviews were conducted with local small-scale livestock producers, veterinarians, para-veterinarians and local traders in veterinary pharmaceuticals.

The issue of primary animal health care delivery has received much attention in recent years, as increasingly under-funded veterinary services and extension services have struggled to provide adequate outreach to rural livestock keepers. However, the thesis has not been approached with a view to improving the quality of grassroots healthcare on small-scale farms, by improving farmers' diagnostic skills, clinical care and drug usage. It has focussed on the activities surrounding disease episodes in cattle from the time owners first became aware that their animal was unwell, tracing the sequence of events that occurred to the point at which the animal either did or did not receive veterinary care. Bovine trypanosomiasis and the appropriate use of drugs for its treatment was the focus of interest. It is arguably the major health constraint affecting cattle in these parts of Kenya and farmers cope with it as best as they can, mostly by using trypanocides.

First, since conducting a physical clinical examination on sick animals is critical to appropriate management of disease, it was important to ascertain how adequately this is done by the healthcare giver on these farms. Thus, the activities immediately surrounding animal healthcare provision with regards to treatment options based on clinical findings on small-scale farms were scrutinised. This revealed the level of inadequacy and poor quality of animal healthcare provided to livestock in these rural communities. This finding was true for both study areas, despite the fact that the farmers studied in Busia District have animal health facilities relatively nearby, unlike their counterparts in Kwale District whose animal health facilities are further from the households in the study. Farmers dealt with these animal disease problems in a variety of ways: visits to the veterinary services, purchase of drugs from Agrovet shops, owner or fellow-farmer treatment of sick animals and use of traditional and modern (or allopathic) veterinary drugs. However, many disease episodes were dealt with by the farmers themselves, the vast majority (85%) in Kwale District and over a third (34%) in Busia District. Trypanocides were by far the most frequently administered drugs for all cattle ailments (36% of all treatments given during the baseline survey and 34% during the follow-up survey) with farmers in Kwale District using them more than their counterparts in Busia District.

An evaluation of the farmers' current knowledge, attitudes and practices (KAP) in recognising and controlling animal health problems in both study sites showed that they had difficulties in understanding the characteristics of bovine trypanosomiasis. During the baseline household survey, approximately 15% of the disease episodes in cattle were perceived by the farmers to be trypanosomiasis. This figure rose to 30% during the follow-up survey. However, farmers' knowledge was limited in that nearly two thirds (64%) of the diagnoses were inconsistent with the clinical signs described while fewer than half (44%) associated tsetse flies with trypanosomiasis. Several factors were shown to have an influence on farmers' knowledge of trypanosomiasis. These include location, with farmers from Busia District being more knowledgeable than those from Kwale District, despite the latter keeping more cattle than the former. Having had episodes of trypanosomiasis in their cattle herd also influenced farmers knowledge of trypanosomiasis, in that those whose cattle had recently had trypanosomiasis were more likely to know some of the clinical signs and know of a trypanocidal drug. Surprisingly, among the social factors, coming from a female-headed household and coming from a resource-poor household was positively associated with knowledge of trypanosomiasis. Conversely, those farmers who patronised Agrovet shops seemed to have little or no knowledge of trypanosomiasis, largely relying on these shopkeepers for advice.

There was inappropriate use of trypanocidal drugs in that over half of those used during the baseline survey were given to cattle believed to have diseases other than trypanosomiasis. Furthermore, some farmers in the study overused trypanocides (administering treatments too frequently) especially when treating conditions they perceived to be due to tsetse flies; this overuse of trypanocidal drugs can cause toxicity to animals (Eisler *et al.*, 1997a) and accelerates the onset of drug resistance (Geerts and Holmes, 1998). Evidence of drug misuse was more common in Kwale District than in Busia District, which may be due to influence from pastoralists who are said to have some inappropriate drug use habits such as using commercially prepared injectable antibiotics for diluting trypanocides (DVO, Kwale District, *pers. comm.*). So, while farmers administer most of the treatments and are obviously willing to invest money and time in their animals' health, the results are, nevertheless, very often suboptimal. Inappropriately dealing with an animal health problem results in farmers' investments in drugs being wasted and their animals continuing to be unthrifty due to prolonged illness. These problems can be cost-effectively dealt with if the knowledge is there, and this knowledge can be provided, as has been demonstrated by the community education study and as discussed below.

Farmers who have to treat their own livestock without the assistance of professionally qualified animal health workers would find it useful to have clear diagnostic indicators enabling them to identify and distinguish the main endemic diseases in their area. Accordingly, diagnostic indicators for African bovine trypanosomiasis that would be useful in this context were evaluated. To understand the current situation, clinical examinations of cattle were conducted together with smallholder farmers to find out what parts of the animal's body or physiological systems they use to decide the health status of their cattle. Their ability to distinguish between a collection of useful predictors of endemic diseases including trypanosomiasis, East Coast fever and fascioliasis was also assessed. This study showed that physical examinations of sick cattle rarely occur, although about 30% of farmers stated that they usually noted appetite, coat/skin condition, animal's demeanour, faeces and general body condition of sick animals. Farmers were also found to have great difficulty in distinguishing between the diseases common in their areas, which present with a range of similar clinical signs (trypanosomiasis, East Coast fever and fascioliasis). However, this finding was not very surprising considering that trypanosomiasis has no pathognomonic signs and therefore makes clinical diagnosis very difficult. Nevertheless, there are some signs in East Coast fever (e.g. presence of respiratory signs and diarrhoea) and fascioliasis (e.g. absence of enlarged lymph nodes) that can be used to distinguish them from trypanosomiasis.

Simple messages were put together by the author to attempt to address the observed difficulties faced by farmers in the management of their animals' health. Simple disease indicators for the recognition of bovine trypanosomiasis, that a lay person can recognise, were highlighted. The main subjects that needed to be addressed, which were incorporated into the trypanosomiasis messages disseminated, were raising farmers' levels of awareness of trypanosomiasis transmission and their knowledge about drug specificity. Other subjects dealt with in the messages were illustrations of the useful indicators of disease in animals and highlighting the similarities and differences between the endemic vector-borne diseases present in the study areas.

In order to ensure that these proposed animal health messages reached the targeted group of cattle keepers an audience analysis of the sample households in the study sites was undertaken. This examined farmers' agricultural information networks and assessed their media habits. Learning about these provided a useful insight into their most widely used and accessible channels of information. This in turn informed the choice of channel used for the purpose of disseminating bovine trypanosomiasis messages. Although the radio and Chief's *Barazas* were cited as the most commonly used information channels, school children (the third most commonly reported source of information) and village elders were selected as the optimal dissemination pathways for this study. Radio is more suitable for large-scale public awareness campaigns than for specific problems relevant to small audiences in a particular location, in this case bovine trypanosomiasis on smallholdings with zebu cattle. Chief's *Barazas* were not used in this study either because they are often seen by the local people as a political forum and many people are disillusioned with their value. Also, most women do not attend these meetings. However, information passed on by village elders carries more weight in the local communities as they are the traditional means of information dissemination and thus provide an endorsement of externally sourced information. Accordingly, this route was selected alongside school children to disseminate the messages.

The communication intervention for improved trypanocidal drug usage was seen as an important contribution towards disease control. The contents of the extension messages integrated the conventional control methods through encouraging use of both insecticides and trypanocides, while emphasising targeting the latter at those animals exhibiting clinical features consistent with trypanosomiasis.

The initial indication from the post-communication intervention surveys conducted at both household and primary school levels was that the farmers in the study sites, who were exposed to trypanosomiasis extension messages, increased their knowledge and understanding of trypanosomiasis control. The mean trypanosomiasis knowledge score obtained by the householders exposed to the extension materials was significantly higher than that obtained by those not exposed. Similarly, school children's pre-communication intervention trypanosomiasis knowledge was significantly lower than that observed in the post-communication intervention survey. Thus, the indications from these studies were that improvement of farm-based trypanosomiasis control by poor livestock keepers can be achieved through provision of sound veterinary extension materials. The dissemination of such information through primary schools was seen to be an effective channel, as it has the advantage of reaching many households; this was observed by the frequency with which school children (33%) were cited by the householders as a source of the extension materials produced. Neighbours and friends were the second most common source, followed by animal health and extension workers, Agrovet shops and community leaders. Moreover, illiterate farmers seemed to benefit from the children's explanation of the contents of the extension materials; this may explain the lack of any significant differences in ease of understanding the trypanosomiasis messages between farmers with no formal education and literate farmers with a basic formal schooling. Farmers' own views about the messages were positive in that they found them easy to follow and understand and were able to share the information with their neighbours.

Furthermore, these extension messages do not require extra investments of money or time from farmers since they already buy and use veterinary products. Instead, the messages encourage farmers to use these products more appropriately, with the ultimate result of reduced morbidity, mortality and enhanced drug efficacy.

As this study has shown, farmers administer most of the drugs, spend money on drugs and are very grateful for help and animal health management information. This is true in Busia District with its relatively good and accessible animal health coverage, and even more so in Kwale District. Animal health workers in the study sites are well trained but are handicapped by inadequate resources. However, current veterinary drug use legislation only allows professionally trained animal health workers to administer drugs. This is not in line with the current situation, where untrained farmers and local veterinary drug traders have ready access to trypanocides and other veterinary pharmaceuticals and administer them, especially in areas where there is poor coverage by the animal health services. Training and information provision in appropriate use of veterinary drugs, including trypanocides, could be a major component in the activities of the various governing bodies such as the Director of Veterinary Services, Kenya Veterinary Board, Kenya Veterinary Association Privatisation Scheme, Pharmacy and Poisons Board and similar institutions in other sub-Saharan African countries. It should, however, be acknowledged that despite the existing legislation on trypanocidal drug use, which prevents use of trypanocides by non-professionals, there is a lack of monitoring and regulation of these drugs at the community (e.g. Agrovet shops) and/or farm levels (Bett, 2001) in most sub-Saharan African countries. Thus, it will be necessary also to examine whether policies should be revised such that clear guidelines are given to vendors/farmers on their use. A clear policy of empowering the various stakeholders actively involved in animal health service and information provision at grassroots level is therefore indicated. Recent attempts to train Agrovet shop keepers initially met with resistance from the governing bodies, but indications are that considerations are being made to make a provision in the legislation to allow training of this cadre of people in veterinary drug use and information provision (Kajume, 1998).

Provision of animal health information *per se*, should be conducted more regularly as is already the case for crop production. Extension activities specifically targeting trypanosomiasis control would benefit from taking the form of offering strategically timed messages. The possibilities of timely messaging for farmers on trypanosomiasis control can be achieved by adapting some of the crop production messaging formats, which tend to be attached to seasonal cropping patterns. In terms of trypanosomiasis control for example, messages about chemoprophylaxis using isometamidium chloride can be disseminated to coincide with the start of the rainy season, and then be followed by messages advising farmers to use chemotherapy with diminazene aceturate about 10 weeks later to clear any infections which might have occurred. This would be a good way of introducing the idea of 'sanative pairs' to farmers as a way of avoiding or delaying the occurrence of drug resistance (Whiteside, 1958, 1961, and 1962; Geerts and Holmes, 1998). This format of messaging would fit in with the extension workers' current practice of timing horticultural advice to coincide with seasonal change (Barton and Reynolds, 1996). It would also take care of continuity of extension by choosing relevant animal health management practices to be in line with the major constraints of the season/period of year. This way, a sequential increase in complexity of messages could be achieved by building on a previous topic to incorporate other desirable practices and disease management strategies for diseases other than trypanosomiasis. These sessions of information dissemination could also be used as an opportunity for strengthening linkages between researchers-extensionists-farmers through feedback from farmers about their perceptions of the animal health messages and thus maintain the extension continuum. Further research would need to be conducted to assess whether the cost of the extra knowledge generates a return, and also whether a seasonal approach is more cost-effective than a 'one-off' approach in information provision.

With respect to trypanosomiasis control, the messages could eventually build up to promoting an integrated approach in order to minimise reliance on and repeated use of trypanocides, thus reducing the selection pressure caused by these drugs. This can be achieved by combining the available control methods such as tsetse control, chemoprophylaxis and chemotherapy. This approach would be most suited to sedentary farmers who have access to the inputs from market centres required for chemotherapy, chemoprophylaxis and ecto-parasiticides. Knowledge of seasonal patterns of tsetse prevalence and trypanosomiasis risk can be used to design a control strategy that was both optimal and economical for the individual farmer.

The work that has been described in the thesis has revealed a number of other areas where extra information could be relatively easily obtained as described below. The anticipation from this is that it would enormously improve the effectiveness of animal health interventions by small-scale farmers, bearing in mind the moral hazard about drug use and policy issues related to this as discussed above. For example, the insights obtained in the different studies would benefit from observational data on farmers' management of bovine clinical conditions at the time they occur. Recording the steps taken by farmers to deal with trypanosomiasis and other diseases would provide strong evidence of knowledge gained from extension materials being put into practice in their treatment choices taken. This limitation in data collection was inevitable in that diseases do not occur 'to order'; therefore observing farmers' behaviour around livestock disease events is difficult as it requires that the investigators station themselves in the study locations (both in the control and intervention areas) for a very lengthy period of time to have a reasonable dataset for comparison, which was impractical with respect to both time and funding. A possible solution to overcome this lack of 'on-farm' observational data of farmers' disease management practices would be to conduct exit questionnaires at Agrovet shops. A comparison could then be made between the veterinary drug purchasing behaviour of farmers from the control and from the intervention study sites. An evaluation of their reasons for choosing the purchased products in conjunction with the observed clinical signs of the sick animal could then be conducted. The long term impact of the farmers' actions on drug resistance would require quantification, especially since an externality exists from these actions which may affect the value of trypanocides for other farmers.

Another area that merits further investigation is the longer term impact of the leaflets and posters, investigating how the proportion of farmers with acquired knowledge of trypanosomiasis changes, seeing whether it has increased, or at the very least, has been maintained at the levels described in Chapter VII. Furthermore, in order to assess the impact of this knowledge on disease management and control, this work could be combined with further studies of farmers' management of clinical cases that occur very close to the time of the investigator's farm visit to see whether the extension material had an influence on how farmers manage cases they suspect to be due to trypanosomiasis compared to those that they perceive to be caused by other endemic diseases. This would show how well and for how long the knowledge promoted by the animal health messages is applied, providing an indication of how sustainable this approach is.

In order to improve the basis on which farmers' case management decisions are made, their differential diagnostic skills need to be strengthened. To do this, it is suggested that an objective study be undertaken to investigate what clinical parameters can be practically used by lay farmers with minimum training and without much supporting technology. This research work would include an assessment of farmers' ability to correctly estimate the body weight of their animals, especially as it relates to dosages of therapeutic drugs, to judge the pallor of visible mucous membranes for anaemia assessment and to judge whether lymph nodes are abnormally enlarged. It would also be a first step towards extending the approach developed to cover other diseases. Undertaking research with this end in view would be a logical next step.

A more detailed study of the pathways along which information flows once it has reached the initial target group would be another profitable line of investigation. An evaluation of the key links and dead-ends in the interactions among children, women, men, fellow farmers, village elders and animal health and extension workers could be made. This would help in understanding how to extend the approach used in this thesis to other areas and production systems.

Once some of these things have been demonstrated, there is a great potential for scaling up this work to other production systems, other locations and other diseases, especially the endemic vector-borne diseases like East Coast fever and fascioliasis which can be confused with trypanosomiasis. Research described in this thesis has helped farmers to take control of managing animal trypanosomiasis in two areas of Kenya. It has also highlighted the difficulties faced by farmers in knowing what clinical signs are important and what information is needed for effective diagnosis. Furthermore, it has developed and tested one solution to this problem, in the form of messages which are shown to be effectively delivered by school children and successfully taken up by livestock keepers.

Efforts towards sustainable disease control should be increased mainly through provision of general information that leads to good husbandry practices. While this study has focussed on trypanosomiasis and was used to test the potential for effective messaging, ultimately a more holistic approach to an animal's health and well-being is required. For example, being well-nourished helps animals to fight off infection and if they do become infected, they stand a better chance of recovering. Specific information on the transmission of endemic diseases should be provided to enhance farmers' awareness of the available preventive measures. A series of messages should be designed that contain information about appropriate use and storage of veterinary medicines. Provision of information on the differences between vaccinations and treatments for farmers is also necessary; this will increase the range of control methods available to them and they can therefore make informed choices of disease control strategies on their farms. Such information provision would raise the social capital of the communities and would increase cohesion, thereby also increasing the speed with which sound animal health practices spread amongst the small-scale farming communities. One method of encouraging social cohesion, and indeed, a method of information delivery and uptake, would be to adapt the farmer field school approach of extension that encourages farmers' sharing of their experiences, experimenting and problem solving.

A wide range of dissemination pathways exist in most communities that can be tapped into; however, school children are still likely to be a key group and an ideal dissemination pathway in many situations. With limited pre-testing and appropriate permission from schools, the present study approach can be extended to other geographical areas within Kenya and the sub-region. School children could be given practical assignments involving examination of cattle on their farms with their parents and thus take part in training farmers on routine examinations of animals. In the case of more specialised farmers, e.g. exotic/mixed breed dairy cattle keepers, the farmer field school approach would be very suitable as they have the incentive and self-motivation to maintain their exotic/mixed breeds and will thus conform to a more organised setup for receiving instruction and sharing knowledge with fellow dairy farmers. In pastoralist farming systems, a self-help approach is more appropriate as farmers are more dispersed and therefore need to be more self-reliant. Training some pastoral farmers as community animal health workers for animal health and information provision would, therefore, be a suitable delivery pathway for this farming system as occurs in some areas.

For pastoralist farmers, the trypanosomiasis messages used in this study would be adapted to reflect their transhumance seasonal grazing patterns which expose their livestock to different levels of risk at different times of the year as they search for fertile pastures. The emphasis of messages would be on seasonal chemoprophylaxis for the occasions when they graze livestock in or near tsetse habitats. Pastoralists are often more knowledgeable about diseases, but probably require more information about the value of careful observation of particular clinical signs for differential diagnosis and appropriate disease management.

Farmers in Busia and Kwale Districts are committed to their cattle and are highly receptive to ideas for mitigating the effects of the endemic diseases which burden their cattle's health. Applying the results of this research will empower farmers in poor communities to take control of the management of their animals' health. The expected long-term impact of trypanosomiasis messages recommending targeted treatment in the form of timely interventions with chemotherapy (and chemoprophylaxis) would improve farm-level trypanosomiasis control, resulting in better cattle productivity and a reduction in unnecessary expenditure on drugs. Improving farmers' ability to recognise and correctly treat animals suffering from trypanosomiasis will in turn contribute towards the control of the disease at the primary animal healthcare level.

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10 Appendices

Appendix I

QUESTIONNAIRE ON FARMER KNOWLEDGE OF TRYPANOSOMIASIS

****First find out if farmer keeps livestock - if not go to next farm****

(Please count the number of households without livestock)

Name of enumerator	
Contact address	

SECTION ONE: LOCATION AND INTERVIEW DETAILS

1	Date			
2	Division			
3	Sublocation			
4	Village			
5	GPS reading (readings in decimal degrees with 5 decimal places, ARC1960)	NORTH (N) SOUTH (S) EAST (E) ALTITUDE		Format N00.01217 Format S00.01217 Format E35.22283 Format 2489 m

SECTION TWO: HOUSEHOLD INFORMATION

1	Name of head of household:
2	Sex of head of household: Male Female
3	Name of respondent: Self Other:
4	Sex of respondent: Male Female
5	Relationship of respondent to head of household
6	Total number of people in household
7	Number of adult[1] male in household
8	Number of adult[1] females in household
9	Number of children[2] in household
10	Total number of workers employed on the farm

Definitions

[1] an adult is defined as any individual over the age of 14 years of age

[2] a child is an individual of or below 14 years of age

SECTION THREE: FARMING ENTERPRISE

1. What is your main farming activity? *(Tick appropriately)*

Mainly livestock ☐ Mixed livestock/crop ☐ Mainly crop ☐

2. What is more important for your subsistence and cash income Livestock ☐ Crops ☐

3. What percentage of your income for livelihood comes from the farm?

<20%	20-40%	41-60%	61-80%	>80%

3a. How many acres is your land	
3b. How many acres is for crops	
3c. How many acres is for livestock grazing	

4. What types of crops do you grow?

Crops grown	Tick main reason of production		Crops grown	Tick main reason of production	
	Consumption	Sale		Consumption	Sale
Maize			Rice		
Millet			Beans		
Sorghum			Soy beans		
Cassava			Sugarcane		
Sweet potatoes			Coffee		
Fruit/tree crops			Cotton		
Natural pasture			Bananas		
Improved pasture			Tobacco		

SECTION FOUR: CATTLE INVENTORY

1. Livestock numbers and herd structure at time of visit (Circle either LOCAL or GRADE)

	Males			Females	
	b	f	d	b	f
Adult (≥ 2yrs)					
Weaned					
Suckling					

b = kept for breeding **f** = kept for fattening **d** = kept for draught power
NB: *Breeding females have had at least one calf or are in-calf

1. How long has the farmer been keeping cattle? (Give answer in years)

SECTION FIVE: CATTLE MANAGEMENT

1. Who looks after livestock? (*Please circle*):

Husband Wife Children Herdsman Other

2. What is the **main** grazing system for each of the following (*please tick*):

	Zero-grazed	Semi-zero grazed	Tethered	Paddock	Free-grazed
Adults					
Calves					

*(**Zero grazed** - all fodder cut and carried, **Semi-zero grazed** - majority of fodder cut and carried, **Free-grazed** - majority of fodder by grazing, including roadside grazing.)*

2. What are the sources of water for the cattle?

River Well Borehole Other

3. What is the MAIN breeding system in your cattle? *(Please circle)*

Bull AI Price/service

4. Where do your cattle rest at night?

SECTION SIX: ANIMAL PRODUCTION
(A) Cattle Products

1. How much milk (in litres) does your cow produce per day?

	Co-operatives	Neighbours/hawkers	Keep for home consumption
How much milk do you sell to:			
Price of milk when sold to:			

2. Do you use cattle manure? Yes/No

Amount produced	Amount used on crops	Amount sold	Price per unit sold

3. Do you use cattle for draft power? Yse/No

(a) How much do you charge when you **hire out** your livestock for traction? (State whether per day or per week or per acre.)

(b) How much do you pay when you **hire in** livestock for traction? (State whether per day or per week or per acre.)

(B) Problems associated with Cattle Production

Ask the farmers about factors that s/he feels are problems in livestock production. *(Read the list of problems at least twice, then ask respondent if there are others s/he would wish to add.)* (Score the following problems in livestock production from 1 to 3 (1 = unimportant; 3 = very important):

Problems	**Score**
Disease	
Feed	
Water	
Fertility	
Access to livestock services (including vet services)	
Stock theft	
Information	
Land for grazing	
*	
*	

*Problems not listed can be added

SECTION SEVEN: ANIMAL HEALTH

1. What are the most important diseases affecting your *CATTLE*:

	Disease 1	Disease 2	Disease 3
Local name of disease			
English/scientific name (if known)			
Clinical signs			
Did animal(s) die? If so, were there any abnormalities in the carcass?			
What causes this disease?			
Description of treatment, including traditional medicine, given			
Date of last case (Please circle)	Last week Last month 6 months ago Last year 2 years ago	Last week Last month 6 months ago Last year 2 years ago	Last week Last month 6 months ago Last year 2 years ago

1. What are the most important diseases affecting your *CATTLE*:
(...continued)

	Disease 4	Disease 5	Disease 6
Local name of disease			
English/scientific name (if known)			
Clinical signs			
Did animal(s) die? If so, were there any abnormalities in the carcass?			
What causes this disease?			
Description of treatment, including traditional medicine, given			
Date of last case (Please circle)	Last week Last month 6 months ago Last year 2 years ago	Last week Last month 6 months ago Last year 2 years ago	Last week Last month 6 months ago Last year 2 years ago

2. What is the most important disease in this area?

3. What drugs have been given to your animals?

Description of drug and **name** (if known)	**1.**	**2.**	**3.**	**4.**	**5.**
When was it given: This week (**W**) This month (**1M**) Last 6 months (**6M**) This year (**Y**) Sometime (**S**) (Please circle the answer)	**W** **1M** **6M** **Y** **S**	**W** **1M** **6M** **Y** **S**	**W** **1M** **6M** **Y** **S**	**W** **1M** **6M** **Y** **S**	**W** **1M** **6M** **Y** **S**
Why was the drug given?					
Who chose the drug?					
Who gave the drug to the animal?					
1. What was the **dosage** given? 2. How was it **prepared**? **3.** How was it **given** to the animal? 4. How **much** did you pay? 5. Was the price **fair** or **expensive**?					

4. Have your animals ever been given:

Drug given	Berenil /Veriben /Norotryp /Trypan /Diminaphen	Novidium /Ethidium	Samorin	Acaricides or Insecticides
When was it given: This week (**W**) This month (**1M**) Last 6 months (**6M**) This year (**Y**) Sometime (**S**) (Please circle the answer)	**W** **1M** **6M** **Y** **S**	**W** **1M** **6M** **Y** **S**	**W** **1M** **6M** **Y** **S**	**W** **1M** **6M** **Y** **S**
Why was the drug given?				
Who chose the drug?				
Who gave the drug to the animal?				
1. What was the **dosage** given? 2. How was it **prepared**? 3. How was it **given** to the animal? 4. How **much** did you pay? 5. Was the price **fair** or **expensive**?				**Method of application:** (please circle) Dip (D) Hand wash (H) Pour-on (P) Spray (S)

5. Where do you obtain these drugs?
Ask the farmer to list the sources (e.g. neighbours, vets, AHAs, associations, Agrovets, etc) where the drugs s/he uses come from.

Sources of drugs
1.
2.
3.
4.
5.

6. Where do you get your advice about *treatment* of animal diseases?
Ask the farmer to list the sources (e.g. neighbours, vets, AHAs, associations, Agrovets, etc) of information that guide him/her in control of **nagana** and other animal diseases.

Sources of information and advice
1.
2.
3.
4.
5.

7. What is the indigenous knowledge of nagana (trypanosomiasis)?

What do you know about nagana (trypanosomiasis)?
Cause:
Clinical signs:
Post mortem signs:
Season of occurrence:
Animals affected:
Treatment given, dose, route of administration:
Price of treatment:

THANK YOU FOR ASSISTING IN ANSWERING THESE QUESTIONS

Appendix II

POST-INTERVENTION HOUSEHOLD SURVEY QUESTIONNAIRE

Name of enumerator	
Enumerator code	House number:
Qnaire ID	Old Qnaire ID:

SECTION 1: INTERVIEW LOCATION DETAILS

1	Date		
2	Start time:	End time:	
3	Division		
4	Sublocation		
5	Village		
6	GPS readings in decimal degrees with 5 decimal places, ARC1960	SOUTH (S)	Format S04.29217
		EAST (E)	Format E39.14283
		ALTITUDE	Format 289 m

SECTION 2: HOUSEHOLD AND FARMER DETAILS

1	Name of head of household:
2	Sex of head of household: Male / Female Age:
3	Main activity[a]:
4	Education level[b]:
5	Years of keeping cattle:
6	Name of respondent: Self / Other:
7	Sex of respondent: Male / Female Age:
8	Relationship of respondent to head of household:
9	Total number of workers employed on the farm:

[a]**Main activity**: Farm management; Formal employment; Businessman; Labourer; Retired with/without pension; Other (specify)

[b]**Education level**: No formal education; 1ry school; 2ry school; College (Agric, Teacher, etc.); Adult education; Other (specify)

SECTION 3: FARMING ENTERPRISE

1. What is your main source of income? (circle answers)

   LIVESTOCK CROPS BOTH

2. How much of your income for livelihood comes from the farm?

   <20% 20-40% 41-60% 61-80% >80%

3. How many acres is your land?

4. What cash crops do you grow? (tick answers)

Sugarcane		Tobacco	
Coffee		Fruit/tree crops	
Cotton		Improved pasture	
Bananas			

5. What are the livestock numbers at the time of visit?

	Males	Females		Males	Females
Local adult cattle (≥ 2yrs)			Goats		
Local weaned cattle			Sheep		
Local suckling cattle			Pigs		
Grade cattle			Chickens		

6. What benefits do you get from keeping these animals, especially cattle?

7. Who looks after livestock? (circle answers)

   Husband Wife Children Herdsman Other

8. Who mainly looks after sick cattle? (circle answers)

   Husband Wife Children Herdsman Other

9. Is the respondent involved in looking after cattle?

   YES / NO

SECTION 4: FARMER INFORMATION AND ANIMAL HEALTH KNOWLEDGE

1. Have you heard or seen any messages about animal trypanosomiasis in the last one year? (circle answer)

   YES / NO

2. From where or from whom?

3. Have you seen this leaflet or poster before? (circle answer)

   YES / NO*

   If answer is* NO *go to Question* ***12*

4. Where did you receive or see the leaflet or poster from? (circle answers)

Women's groups	Farmers' groups	Primary school	School-children
Co-ooperatives	Dip committees	Religious groups	Neighbours/friends
Youth clubs/4K clubs	Clinic/Health centre	Chief's Barazas	Extension workers
Agrovet shops	AHAs/Vets	Market centres	Relatives
Traditional healers	Other		

5. What were the messages about?

6. Were the messages easy to follow?

   YES / NO (circle answer)

7. Was the information useful?

   YES / NO (circle answer)

8. Did you share this information with other people?

   YES / NO (circle answer)

   If YES, who are they?

9. Was there anything new in this leaflet or poster that you did not know before?

   YES / NO (circle answer)

   If YES, what was it?

10. Were the measurements and units for preparing medicines shown in a way that was easy for you to follow and use them?

    YES / NO (circle answer)

11. What information is missing? What else would you like to know?

12. What groups or organisations do you belong to?

13. What are the main signs of trypanosomiasis, the disease of tsetse flies (Mabuko, Mbung'o)? (list answers)

1.	5.
2.	6.
3.	7.
4.	8.

14. What are the medicines used to treat trypanosomiasis? (list answers)

1.	4.
2.	5.
3.	6.

15. What are the 3 main diseases that you encounter in your animals?

Start with the disease that is the biggest problem. Why is it the biggest problem? Which of these diseases is less important?

1.

2.

3.

16. How do you protect your cattle from these diseases?

17. How important do you think trypanosomiasis is in your area? (circle answer)

    (a) Severe, the most important problem

    (b) Recognised, but other problems are more important

    (c) Occurs, but not a problem

    (d) Not present or not recognised

18. Please say whether the following sentences are TRUE or FALSE. (circle answer)

a. Trypanosomiasis is caused by infected tsetse flies (mbung'o).

TRUE FALSE DON'T KNOW

b. East Coast fever (ECF) is also caused by tsetse flies (mbung'o).

TRUE FALSE DON'T KNOW

c. Veriben, Novidium, Samorin or Veridium can be used to treat trypanosomiasis.

TRUE FALSE DON'T KNOW

d. Veriben, Novidium, Samorin or Veridium can also be used to treat other livestock diseases.

TRUE FALSE DON'T KNOW

e. Nilzan or Wormicid can be used to treat animals with trypanosomiasis.

TRUE FALSE DON'T KNOW

f. Penstrep, Tetracycline, Limoxin, Adamycin or Alamycin can also be used to treat animals with trypanosomiasis.

TRUE FALSE DON'T KNOW

g. Butalex and Parvexon can be used to treat East Coast fever.

TRUE FALSE DON'T KNOW

h. East Coast fever cannot be treated with Veriben, Novidium, Samorin or Veridium.

TRUE FALSE DON'T KNOW

SECTION 5: ANIMAL DISEASES AND TREATMENTS IN THE LAST ONE YEAR

1. What diseases have affected your CATTLE in the last **1** year?

Disease 1	**Disease 2**
Local disease name	Local disease name
English name (if known)	English name (if known)
Breed: Local Grade	Breed: Local Grade
Sex/Age: Cow Bull Calf	Sex/Age: Cow Bull Calf
Clinical signs	Clinical signs
Did animal die? YES NO If yes, what abnormalities were in the carcass?	Did animal die? YES NO If yes, what abnormalities were in the carcass?
What causes this disease?	What causes this disease?
Who examined the animal?	Who examined the animal?
What medicines were given? 1. 2. 3.	What medicines were given? 1. 2. 3.
When did disease occur? (Circle) This week 5-8months ago This month 9-12 months ago 1-4 months ago	**When** did disease occur? (Circle) This week 5-8months ago This month 9-12 months ago 1-4 months ago

2. Describe the medicines given to cattle for the diseases above in the last **1** year

Drug 1	**Drug 2**	**Drug 3**
Drug name	Drug name	Drug name
Drug type (circle) Powder Liquid Tablet	Drug type (circle) Powder Liquid Tablet	Drug type (circle) Powder Liquid Tablet
Drug colour (circle) Red Yellow Brown White	Drug colour (circle) Red Yellow Brown White	Drug colour (circle) Red Yellow Brown White
When did you give drug after animal was sick? Same day Next day 2-3 days later 4-7 days later More than a week later	When did you give drug after animal was sick? Same day Next day 2-3 days later 4-7 days later More than a week later	When did you give drug after animal was sick? Same day Next day 2-3 days later 4-7 days later More than a week later
Which disease was being treated? (indicate disease number)	Which disease was being treated? (indicate disease number)	Which disease was being treated? (indicate disease number)
Who chose the drug?	Who chose the drug?	Who chose the drug?
Who gave it to the animal?	Who gave it to the animal?	Who gave it to the animal?
What was the dosage given?	What was the dosage given?	What was the dosage given?
How was it prepared?	How was it prepared?	How was it prepared?
How was it given to the animal? (circle) By mouth Injection	How was it given to the animal? (circle) By mouth Injection	How was it given to the animal? (circle) By mouth Injection
How many times was this drug given?	How many times was this drug given?	How many times was this drug given?
Did animal get better after treatment? YES / NO / DIED	Did animal get better after treatment? YES / NO / DIED	Did animal get better after treatment? YES / NO / DIED
How uch did you pay?	How much did you pay?	How much did you pay?

SECTION 6: TSETSE FLY AND TICK CONTROL

TSETSE FLY CONTROL	TICK CONTROL
What methods do you use to protect your animals from **tsetse flies**? *Local cattle*: None / Insecticides / Acaricides / Restricted grazing / Traditional methods (describe) *Grade cattle*: None / Insecticides / Acaricides / Restricted grazing / Traditional methods (describe) *Sheep*: None / Insecticides / Acaricides / Restricted grazing / Traditional methods (describe) *Goats*: None / Insecticides / Acaricides / Restricted grazing / Traditional methods (describe)	What methods do you use to protect your animals from **ticks**? *Local cattle*: None / Insecticides / Acaricides / Hand-picking / Restricted grazing / Traditional methods (describe) *Grade cattle*: None / Insecticides / Acaricides / Hand-picking / Restricted grazing / Traditional methods (describe) *Sheep*: None / Insecticides / Acaricides / Hand-picking / Restricted grazing / Traditional methods (describe) *Goats*: None / Insecticides / Acaricides / Hand-picking / Restricted grazing / Traditional methods (describe)
What are the names of the medicines you use to protect your animals from **tsetse flies**?	What are the names of the medicines you use to protect your animals from **ticks**?
How do you apply these medicines? Dip tank / Hand spraying / Hand wash / Pour-on / Other (describe)	How do you apply these medicines? Dip tank / Hand spraying / Hand wash / Pour-on / Other (describe)
When is the last time that you used any of these medicines?	When is the last time that you used any of these medicines?
How many times did you use them this past **1** year?	How many times did you use them this past **1** year?
Where did you get the advice about the medicines for controlling **tsetse flies**? Own experience / Friends / Neighbours / Relatives / AHA / Extension worker / Agrovet	Where did you get the advice about the medicines for controlling **ticks**? Own experience / Friends / Neighbours / Relatives / AHA / Extension worker / Agrovet

ASANTE SANA. THANK YOU VERY MUCH FOR YOUR ASSISTANCE AND PATIENCE!!

Appendix III

Section on farmers' agricultural knowledge and information networks

1. Does the household head talk about animal diseases and treatment with the following people?

Wife/Husband	Yes / No	Agrovet shopkeepers	Yes / No
Children	Yes / No	Community leaders	Yes / No
Neighbours/Friends	Yes / No	Teachers	Yes / No
AHAs/Vets	Yes / No	Traditional healers	Yes / No

2. Is information received from these people important to the household head? *(Please circle answer)*

Wife/Husband	Yes / No / Don't Know
Children	Yes / No / Don't Know
Neighbours/Friends	Yes / No / Don't Know
AHAs/Vets	Yes / No / Don't Know
Agrovet shopkeepers	Yes / No / Don't Know
Community leaders	Yes / No / Don't Know
Teachers	Yes / No / Don't Know
Traditional healers	Yes / No / Don't Know

3. Do you think the services of animal health assistants (AHA) are good or poor? *(Please circle answer)*

Quality of service	Good / Poor
Cost of clinical service	Good / Poor
Provision of information	Good / Poor
Trustworthiness	Good / Poor
Training	Good / Poor

4. Do you need information on animal diseases and treatment? Yes / No

   If NO, why not?

5. Are you happy to receive this information from school children? Yes / No

   If NO, why not?

6. What services and sources of information have you used in the past 12 months, and how many times have you used them?

AI	Extension	Veterinary services	Livestock workshops
NGOs	Co-operatives	Women's groups	Religious organisations
SHGs	Posters/adverts	Chief's *Barazas*	Neighbours/friends
Relatives	Farm field days	Health services	Agrovet shops

7. Please rank the following sources of information; starting with the one you think is the most important and ending with the least important.

School-children	TV/Video	Radio	Newspapers	Agrovet shops
Traditional healers	AHAs	CBOs	Co-operatives	Chief's *Barazas*

8. Do you or other-household-members belong to any of the following clubs or social organisations in the community? YES/NO *(If YES, please circle answers)*

Self-help groups	Farmers' groups	Women's groups
Water committees	Dip committees	Religious groups
Youth clubs	4K clubs	Chief's Barazas
Other (specify)		

9. What are the benefits from being members of these clubs/organisations?

Benefit	**Club(s) associated with this benefit**
Advice	
Information	
Credit	
Loan	

10. Decision-making within the household

- Who decides to seek information about animal diseases and treatment?

Wife	Husband	Other (Specify)

- Who decides to seek veterinary services?

Wife	Husband	Other (Specify)

- Who decides to pay for drugs?

Wife	Husband	Other (Specify)

- Who makes most of the general decisions in the family, e.g. about children's education, finances, or crop production?

Wife	Husband	Other (Specify)

11. Use of printed material

- How many times do you read newspapers? *(Please circle one answer only)*

Everyday	4-5 days/week	1-3 days/week	Less often	Never

- Did you read a newspaper yesterday or today? YES/NO
- What newspapers do you usually read?

Nation	Taifa Leo	Standard	Kenya Times	Coast Weekly

- How many times do you read magazines in a month?

4 times	3 times	2 times	Once	Never

- What are your 2 favourite magazines?

  1. 2.

- Do you read leaflets or pamphlets brought to you by your children or received from other people? YES/NO
- Do you read posters, adverts or billboards pinned-up in Agrovet shops, veterinary offices, health centres, market places and other public places? YES/NO *(If YES please circle where they are seen or read)*

12. Use of radio

- Do you have a radio in this household? YES/NO (If YES, do you use batteries or electricity for the radio? *(Please circle answer*)
- How often do you listen to the radio? *(Please circle one answer only)*

Daily	Few days/week	Once/week	Once/month	Weekends only	Rarely	Never

- If you listen to the radio, what times do you normally listen to the radio? *(Please circle one answer only)*

All the time	6-9 Hrs	9-12 Hrs	12-17 Hrs	17-20 Hrs	20 Hrs-till-end of broadcast

13. Types of programmes and language preference

- What radio station(s) do you listen to? *(Please tick answers)*

KBC *Kiswahili*	KBC English	KBC Vernacular	Other stations

- What 2 languages do you prefer? *(Please circle one or two answers only)*

Kiswahili	English	*Luhya*	*Luo*	*Kikuyu*
Kalenjin	*Kamba*	*Kisii*	Other	

- What types of programmes do you listen to usually? *(Please tick answers)*

Salaams	Children's	Music	*Tembea na Majira*	Educational
Maisha bora	Health	News	*Kwenu wakulima*	Agricultural

Akina mama	Religious	Adverts	Other	

- Where do you listen to the radio from?

At home	Neighbours/friends' home	At school	Shop/market	Car/*matatu*	At work

14. Have you heard or seen any messages about animal diseases and treatment from the following sources of information in the last six months? *(Please circle answers)*

Self-help groups	Farmers' groups	Women's groups	Posters/Billboards/Adverts
Water committees	Dip committees	Religious groups	Leaflets/Pamphlets
Youth clubs	4K clubs	Chief's Barazas	Extension workers
Agrovet shops	AHAs/Vets	Market centres	Neighbours/friends
Relatives	Co-ooperatives	School-children	Traditional healers
Newspapers	TV/Video	Radio	Other

15. Please say whether the following statements are TRUE or FALSE. *(Please circle answer)*

- Trypanosomiasis can be caused by tsetse flies. TRUE / FALSE
- East Coast Fever can also be caused by tsetse flies. TRUE / FALSE
- Samorin, Novidium, Berenil, Veriben or Diminaphen can be used to treat trypanosomiasis. TRUE / FALSE
- Samorin, Novidium, Berenil, Veriben or Diminaphen can also be used to treat other livestock diseases. TRUE / FALSE
- Nilzan, Wormicid, Valbazen or Paralben can be used to treat animals with trypanosomiasis. TRUE / FALSE
- Limoxin, Adamycin, Alamycin or Penstrep can also be used to treat animals with trypanosomiasis. TRUE / FALSE
- Butalex and Parvexon can be used to treat East Coast Fever. TRUE / FALSE
- East Coast Fever cannot be treated with Samorin, Novidium, Berenil, Veriben or Diminaphen. TRUE / FALSE

16. What type of information would you like to receive concerning livestock? *(Please list)*

17. What is the best form of giving you this information?

Pictures Radio Magazine story

Appendix IV

SCHOOL CHILDREN PREINTERVENTION SURVEY TRYPANOSOMIASIS QUESTIONNAIRE

SECTION 1: DETAILS OF STUDENT

1	Name		
2	Age		
3	Sex	Girl	Boy
4	School name		
5	Class		
6	Your village name		

SECTION 2: FARMING ENTERPRISE

1. How many animals are there at your home?

	Males	Females		Males	Females
Local adult cattle (≥ 2yrs)			Goats		
Local weaned cattle			Sheep		
Local suckling cattle			Pigs		
Grade cattle			Chickens		

2. Who looks after livestock at your home? (*circle answers*)

   Father Mother Yourself Other children Herdsman

3. Who mainly looks after cattle at your home when they are sick? (*circle answers*)

   Father Mother Yourself Other children Herdsman

SECTION 3: INFORMATION AND TRYPANOSOMIASIS KNOWLEDGE

1. What clubs do you belong to at school? (list answers)

2. What clubs or groups do you belong to in your village? (list answers)

3. Do you share information about animal diseases with your parents? (circle answer)

   YES / NO

4. What are the main signs of trypanosomiasis, the disease of tsetse flies (Mabuko, Mbung'o)? (list answers)

1.	5.
2.	6.
3.	7.
4.	8.

5. What are the medicines used to treat trypanosomiasis? (list answers)

1.	4.
2.	5.
3.	6.

6. What are the 3 main diseases that you see in cattle? (*Start with the most important problem and end with the least important problem.*)

   1.

   2.

   3.

7. How important do you think trypanosomiasis is in your area? (circle one answer)

   (a) Severe, the most important problem

   (b) Recognised, but other problems are more important

   (c) Occurs, but not a problem

   (d) Not present or not recognised

8. How do you protect cattle from trypanosomiasis?

   1.

   2.

   3.

ASANTE SANA! THANK YOU VERY MUCH FOR YOUR ASSISTANCE IN ANSWERING THESE QUESTIONS

Appendix V

SCHOOL CHILDREN POST-INTERVENTION TRYPANOSOMIASIS QUESTIONNAIRE

SECTION 1: DETAILS OF STUDENT

1	Name		
2	Age		
3	Sex	Girl	Boy
4	School name		
5	Class		
6	Your village name		

SECTION 2: INFORMATION AND TRYPANOSOMIASIS KNOWLEDGE

1. Does the household you come from keep cattle? (circle answer)

   YES / NO

2. Have you seen this leaflet or poster before? (circle answer)

   YES / NO

   IF ANSWER IS NO, GO TO QUESTION NUMBER **7**.

3. Did you share the information in the leaflet or poster with your parents? (circle answer)

   YES / NO

4. Did you share the information in the leaflet or poster with other people in your family? (circle answer)

   YES / NO

5. Did you share the information in the leaflet or poster with your neighbours and friends? (circle answer)

   YES / NO

6. Was the information easy to understand? (circle answer)

   YES / NO

7. What are the main signs of trypanosomiasis, the disease of tsetse flies (Mabuko, Mbung'o)? (list answers)

1.	5.
2.	6.
3.	7.
4.	8.

8. What are the medicines used to treat trypanosomiasis? (list answers)

1.	4.
2.	5.
3.	6.

9. Where are tsetse flies found?

10. How do you protect cattle from trypanosomiasis?
    1.
    2.
    3.

ASANTE SANA! THANK YOU VERY MUCH FOR YOUR ASSISTANCE IN ANSWERING THESE QUESTIONS

Appendix VI

Participatory clinical examination sheets

Name of examiner	
Contact address	

SECTION ONE: LOCATION DETAILS

1	Date			
2	Division			
3	Sublocation			
4	Village			
5	GPS reading (readings in decimal degrees with 5 decimal places, ARC1960)	NORTH (N) SOUTH (S) EAST (E) ALTITUDE		Format N00.01217 Format S00.01217 Format E35.22283 Format 2489 m

SECTION TWO: FARMER DETAILS

1	Name of head of household:			
2	Sex of head of household: Male	Female		Age:
3	Name of respondent: Self	Other:		
4	Sex of respondent: Male	Female		Age:
5	Main activity[a]:			
6	Years of keeping cattle:			
7	Education level[b]:			
8	Main source of income: Farm livestock/crops		Other	
9	Farm size:			

[a]Main activity: Farm management; Formal employment; Businessman; Labourer; Retired with/without pension; Other (specify)
[b]Education level: No formal education; 1ry school; 2ry school; College (Agric, Teacher, etc.); Adult education; Other (specify)

SECTION THREE: CATTLE INVENTORY

1. Livestock numbers and herd structure at time of visit (Circle either LOCAL or GRADE)

	Males	Females	Deaths in past year
Adult (≥ 2yrs)			
Weaned			
Suckling			

1. Who mainly looks after sick cattle? (*Please circle*):

   Husband Wife Children Herdsman Other

2. Who mainly milks the cows? (*Please circle*):

   Husband Wife Children Herdsman Other

SECTION FOUR: ANIMAL AND CLINICAL EXAMINATION DETAILS

Farmer's perception	Examiner's perception
Animal No.:	
Breed: Local Grade	
Sex: Male Female	
Age:	
No. calves:	
Daily milk yield:	
Body condition score: Lean Medium Fat	
Body temperature: Normal High	
Respiration: Normal Dyspnoea Coughing	
Mucous membranes: Normal Pale Bloodshot Jaundiced	
Mandibular lymph nodes: Normal Enlarged Excised	
Pre-scapular lymph nodes: Normal Enlarged Excised	
Inguinal lymph nodes: Normal Enlarged Excised	
Pre-crural lymph nodes: Normal Enlarged Excised	
Coat/skin condition: Normal Rough Lumps	
Ecto-parasites: Many(>20) Few(<20) Absent (Give genus of ticks)	
Discharges: Ocular Nasal Vulval Navel None	
Faeces: Normal Diarrhoea Constipation	
Joints: Normal Swollen Hot	
Appetite: Normal Decreased Pica	
Navel (calves): Normal Hernia Inflammed	
Demeanour: Alert/Bright Drooped head Dull	
Recumbency/reluctance to stand: Yes No	
Health status: Ill Healthy	

SECTION FIVE: PAIR-WISE COMPARISONS

(Mental checklist: meat, milk, money, mortality, morbidity, ante mortem, post mortem)

- How does trypanosomiasis differ from ECF in cattle?
- How does trypanosomiasis differ from liver fluke disease in cattle?
- How does liver fluke disease differ from ECF in cattle?
- Which disease is more important between trypanosomiasis and ECF? Why?
- Which disease is more important between trypanosomiasis and liver fluke disease? Why?
- Which disease is more important between liver fluke disease and ECF? Why?

ASSANTE SANA! THANK YOU FOR YOUR ASSISTANCE IN ANSWERING THESE QUESTIONS

Appendix VII

Clinical examination protocol for animal health workers

Please collect the following information for each bovine case seen.

Farmer's details

Please follow this format when collecting clinical information from farmers on sick cattle.

1. Date of visit
2. Village name
3. Name of owner
4. Sex of owner (Male / Female)
5. Age of owner
6. Cattle numbers and herd structure at time of visit. (Circle either LOCAL or GRADE)

	Males	Females	Deaths in past year
Adult (≥ 2yrs)			
Weaned			
Suckling			

Sick animal's details

1. Breed (Local / Grade / Mixed)
2. Sex (Male / Female)
3. Age
4. Number of calves (if female)
5. Daily milk yield (if milking female)

History of sick animal

1. What is the problem with the animal; list the clinical signs that the farmer has seen in the sick animal
2. When did farmer first see the problem
3. Has he given it any medicine

Examination of sick animal

1. Body condition score (Thin / Medium / Fat) (*see attached guide sheet*)
2. Body temperature
3. Respiration (Normal / Breathing too fast / Difficult to breath / Coughing)

4. Mucous membranes; check the eyes or mouth or both (Normal / Pale / Bloodshot / Jaundiced)
5. Mandibular lymph nodes (Normal / Enlarged / Burnt off)
6. Pre-scapular lymph nodes (Normal / Enlarged / Burnt off)
7. Pre-crural lymph nodes (Normal / Enlarged)
8. Coat/skin condition (Normal / Rough / Standing hair / Lumps / Wounds)
9. Ticks on body (Many(>20) / Few(<20) / Absent)
10. Discharges (From eyes / From nose / From Vulva / From navel / None)
11. Faeces (Normal / Diarrhoea / Stool with blood / Hard dung)
12. Appetite (Normal / Decreased / Eating abnormal things like soil or plastic bags)
13. Appearance of animal (Alert or Bright or Active / Drooped head / Dull)
14. General state of animal: Can it stand / Is it weak

Medicine and /or advice given to farmer

Please state the medicines given and whether or not the animal has been followed-up to see if it has recovered or is still sick.

Appendix VIII

Disease terms commonly used in Busia District

1. Helminthiasis
    a. Worms
    b. Minyoo (worms, Swahili)
    c. Tsinsukha (worms, Luhya)
2. East Coast fever
    a. ECF
    b. Kupe (ticks, Swahili)
    c. Mabumba, 'mumps', dinge, masangu (mostly observed in calves, but occasionally in adult cattle): swollen parotid/mandibular/pre-scapular lymph nodes, associated with ECF
3. Other TBD
    a. Anaplasmosis
    b. Indusie (enlarged gall bladder, also bile, Luhya (anaplasmosis?))
    c. Tick-borne disease
    d. Okwado (ticks, Luo)
    e. Tsingwa (ticks, Luhya)
4. Trypanosomiasis
    a. Trypanosomiasis
    b. Lutako (enlarged spleen, Samia Luhya; associated with trypanosomiasis)
    c. Achuya (wasting disease, could be trypanosomiasis, Luhya)
    d. Amabuko (tsetse flies, Luhya)
5. Skin conditions
    a. Lumpy skin disease
    b. Libure (lumpy skin disease?)
    c. Omuyaka (associated with measles in children, also described as 'disease like malaria')
6. Limb conditions
    a. FMD
    b. Foot rot
    c. Malenge (blisters on legs, Swahili)
    d. Atenya (*Samia Luhya*, Arenya – *Marachi Luhya*, associated with limb paralysis and lameness, animals are often recumbent in this case)
    e. Amangwali
7. Gastri-intestinal tract conditions
    a. Diarrhoea
    b. Dieo (Diarrhoea, Luo)
    c. Khunyalala (Diarrhoea, Luhya)
    d. Sinaduku (omasum, Luhya); usually associated with anaplasmosis when hard and dry
    e. Sotoka (rinderpest, swahili)
8. Respiratory conditions
    a. Machukho (lungs, Samia Luhya) and matsukhu (lungs, Marachi Luhya); term used to describe conditions affecting lungs such as pneumonia
    b. Okhuholola (coughing, Luhya)

9. Other
    a. Aremo (pertaining to blood diseases?)
    b. Buche (morning?)
    c. Enjuhi (bees, Samia; Enzuhi, Marachi)
    d. Gwoni (feed, Luo)
    e. Nyabola (anthrax, swahili)
    f. Thero (bow and arrow, Luo)
    g. Yamo: a disease condition described to be similar to malaria

Disease terms commonly used in Kwale District

1. Helminthiasis
    h. Worms
    i. Minyoo
2. Theileriosis
    j. ECF
    k. Kupe (ticks, Swahili)
    l. Kuha (or Kuva; means ticks in Mijikenda)
    m. Ngai (usually in calves only)
3. Other TBD
    n. Mbili (ticks, Kamba)
4. Trypanosomiasis
    o. Trypanosomiasis
    p. Guta
    q. Kibimbi
    r. Mbung'o (tsetse flies, Swahili)
    s. Kula m'changa (Swahili: eating soil, or pica; commonly associated with trypanosomiasis by the local people)
5. Skin conditions
    t. Upele (skin rash, Swahili)
    u. Ngozi (skin, Swahili)
6. Conditions affecting limbs
    v. FMD
7. GIT conditions
    w. Rinderpest
    x. Utumbo
    y. Diarrhoea
    z. Sotoka (rinderpest, Swahili)
8. Respiratory conditions
    aa. Mapafu (affecting lungs, condition commonly associated with ECF by the local people)

Appendix IX

Table I: Crops grown by smallholder farmers in the baseline household survey, Busia and Kwale Districts

Subsistence crops	Busia (n=139)		Kwale (n=117)		Cash crops	Busia (n=139)		Kwale (n=117)	
	n	%	n	%		n	%	n	%
Maize	136	97.8	111	94.9	Coffee	5	11.5	0	0.0
Vegetables	92	66.2	12	10.3	Coconut	0	0.0	71	60.7
Cassava/Sweet potatoes	78	56.1	96	82.1	Cotton	1	0.7	0	0.0
Bananas	56	40.3	39	33.3	Tobacco	1	0.7	0	0.0
Fruit	15	10.8	65	55.6	Cashewnuts	0	0.0	65	60.7
Napier grass	10	7.2	0	0.0	Simsim	0	0.0	2	55.6
Natural pasture	3	2.2	9	7.7	Bixa	0	0.0	36	30.8
Beans	0	0.0	45	38.5	Cow peas	0	0.0	23	19.7
					Sugar cane	16	11.5	0	0.0

Table II: Clinical signs observed by farmers for cattle disease episodes in Busia and Kwale Districts

Clinical sign	Busia (n=269)		Kwale (n=268)		Total (n=537)	
	n	%	n	%	n	%
Inappetence	123	45.7	34	12.7	157	29.2
Lacrymation/salivation	98	36.4	55	20.5	153	28.5
Respiratory signs	47	17.5	78	29.1	125	23.3
Staring coat	76	28.3	29	10.8	105	19.6
Discharges	32	11.9	65	24.3	97	18.1
Weakness	55	20.4	39	14.6	94	17.5
Diarrhoea	52	19.3	22	8.2	74	13.8
Skin conditions	44	16.4	30	11.2	74	13.8
Weight loss	67	24.9	7	2.6	74	13.8
Limb conditions	33	12.3	37	13.8	70	13.0
Eating soil	3	1.1	55	20.5	58	10.8
Swollen lymph nodes	20	7.4	24	9.0	44	8.2
Oedema	26	9.7	8	3.0	34	6.3
Constipation	11	4.1	20	7.5	31	5.8
Demeanour	29	10.8	1	0.4	30	5.6
Nervous signs	10	3.7	15	5.6	25	4.7
Ticks on body	19	7.1	3	1.1	22	4.1
Bleeding from orifices	5	1.9	15	5.6	20	3.7
Low milk yield	13	4.8	1	0.4	14	2.6
Fever	6	2.2	4	1.5	10	1.9
Reproductive conditions	7	2.6	1	0.4	8	1.5
Anaemia	5	1.9	0	0.0	5	0.9
Eye conditions	2	0.7	2	0.7	4	0.7
Bleeding from skin lesions	1	0.4	0	0.0	1	0.2

Table III: Perceived aetiologies of cattle diseases by the farmers in Busia and Kwale Districts

	Busia		Kwale	
Vectors and parasites	**n**		**n**	
Ticks	40	22.6	51	37.2
Tsetse flies	30	16.9	27	19.7
Worms	5	2.8	8	5.8
Biting flies	2	1.1	2	1.5
Mites	1	0.6	0	0.0
Germs	0	0.0	1	0.7
Ox-peckers	0	0.0	1	0.7
Seasons, weather and time				
Rainy season	21	11.9	2	1.5
Hot-dry season	14	7.9	7	5.1
Windy weather	4	2.3	0	0.0
Night-time coughing	2	1.1	0	0.0
Cold weather	0	0.0	2	1.5
Morning dew	1	0.6	0	0.0
Environment				
Contact with neighbouring animals	13	7.3	2	1.5
Watering and feeding at river	13	7.3	0	0.0
Drinking water from stagnant pools	10	5.6	16	11.7
Ingestion of plastic bags	6	3.4	0	0.0
Feeding on lush grass	4	2.3	4	2.9
Dirty animal house	3	1.7	0	0.0
Suckling of bad milk	3	1.7	0	0.0
Poisoning	2	1.1	1	0.7
Dirty feed	1	0.6	0	0.0
Inadequate feed	1	0.6	0	0.0
Ingestion of soil	0	0.0	9	6.6
Lack of minerals	0	0.0	3	2.2
Other				
Witchcraft	1	0.6	0	0.0
Ulcers	0	0.0	1	0.7

Appendix X

Distribution of posters and leaflets

Place	Number of posters	Number of leaflets
Busia DVO HQ	5	10
FITCA Office	2	2
Private vet FITCA (Karanja)	6	5
Karanja's Agrovet shop	1	2
Matayos Vet Office	1	2
Sijowa Primary School	10	190
Magogongo Village Elder (Thomas Odipo)	2	40
Farmer from Ugenya	4	10
Sijowa Village Elder (Maurice Juma)	3	30
Siwongo 'A' Centre (2 shops, 1 Posho Mill)	3	0
Siwongo 'B' Village Elder (Jacob Ojwayo)	3	30
Samia Pharmacy	1	2
Quality Farm Inputs	1	2
Tuungane Women's Group	1	0
Mkulima	1	2
Funyula Chemists	2	2
Matayos Multi-purpose Shop (owner is Matayos extension officer)	2	7
Funyula Division Veterinary Office	50	50
SCODP Busia Township	1	0
Busia Agrovet	1	0
Border Vets	1	0
Chathi Vet Enterprises	1	0
Multivet Agro Suppliers	1	0
Siwongo 'A' Village Elder (Wandera)	3	30
Gulumoyo/Bolori Village Elders (Walter Opiyo/Sebastian Ouma)	4	30
SCODP Bumala Market	1	2
Bumala Multi-purpose Shop	1	2
Bumala Agrovet Shop	1	2
Kwale DVO HQ	6	10
Deri Market Centre	4	2
Mtsamviani Primary School	4	150
Charles Kieti (local farmer, Deri)	1	0
Mtsamviani Market Centre	5	0
Mr Mdala, farmer near Mzinji school	0	1
Kubo Division Veterinary Office	20	50
Mzinji Primary School	10	110