IMPLEMENTATION OF AN INSECTICIDE TREATED BEDNET PROGRAMME FOR MALARIA PREVENTION THROUGH THE PRIMARY HEALTH CARE SYSTEM IN MOZAMBIQUE:
Socioeconomic factors associated with sustainability and equity

MARTINHO DO CARMO DGEDGE, MD., M.Sc.

Thesis submitted to the University of London in fulfilment of the requirements for the degree of Doctor of Philosophy in the Faculty of Medicine

Disease Control and Vector Biology Unit

Department of Infectious and Tropical Diseases

London School of Hygiene and Tropical Medicine

JANUARY 2000

ABSTRACT

Malaria is the principal cause of morbidity and mortality in Mozambique, accounting for more than 40% of the attendance in the public health clinics. Insecticide-treated bednets (ITNs) have proved to be a cost-effective means of preventing of malaria.

Most previous ITN projects have been implemented in pilots or trials and with substantial financial, human and technical resources. Presently however, in many African countries services can no longer be provided "free" (at no charge to users). There is still a lack of knowledge of how financially sustainable and equitable a cost-sharing ITN programme implemented through the primary health care system would be.

In Mozambique no ITNs were available, and very few households had bednets before the start of this study. Thus before introducing an ITN programme in Mozambique, it was important to evaluate whether the primary health care system could deliver ITNs, and to determine how sustainable and equitable such a programme would be.

The study which forms the basis for this thesis took place in Boane, Mozambique from, 1996 to 1998. The aim of the study was to determine how financially sustainable and equitable an ITN programme could be when implemented through the primary health care system, and how the socio-economic level of the community would affect such a programme.

Bednets were treated with *Lambdacyalothrin* and sold at the health centre at price equal to the factory's wholesale price. The willingness to pay of the households, the ITN coverage which was achieved, the total cost of implementing the project, and the financial resources which would be required to implement a national ITN programme in Mozambique were calculated. The main findings of the study were as follows:

- The Boane community accepted the ITNs very well. However, the purchase of ITNs was dependent on the socio-economic level of the buyer; poor households were less likely to buy than richer households ($p<0.001$). Thus, there was not an equitable distribution of ITNs in the community.

- Many households whose stated maximum willingness to pay before the project was less than US$5 actually did pay that amount for an ITN during the project. Thus, willingness to pay was not a reliable way of predicting the households' probable purchase of ITNs.

- The estimate of the cost of the project demonstrated that the financial cost per ITN delivered ($9.60) was much higher than the price at which the ITNs were sold to the consumers ($5 on average). Thus, the project was not financially sustainable. Moreover, given the cost structure covering a larger area or achieving wider coverage would have required an even higher level of subsidy.

- In order to guarantee an equitable national ITN programme through the public health system in Mozambique, the government will have to mobilise external donors to finance the ITN programme.

This study contributes to an understanding of the implications of how the price of ITNs affects the financial sustainability, equity and coverage of the programme, and makes recommendations for obtaining the funds required to heavily subsidise ITN programmes in Mozambique in particular, and in Sub-Saharan Africa in general.

DEDICATION

To my wife ***Esselina*** and our children ***Carmen*** and ***Marcelino***

ACKNOWLEDGEMENTS

My sincere thanks to Dr. Jo Lines and Dr. Lilani Kumaranayake, my supervisors, for their encouragement and invaluable advice, comments and criticisms during this work.

I give particular thanks to the Ministry of Health of Mozambique for giving me the opportunity to attend this course. Special thanks go to Dr. Birthe Hogh, Dr. Chandana Mendis, Dr. Margarida Macome, Dr. Ricardo Thompson, Dr. Ricardo Trindade, Dr. Humberto Cossa, Dr. Aurelio Gomes, Dr. Nelson Cuamba, Dr. Sonia Enosse, Dra. Sonia Casemiro, Professor Robert Sinden and Dr. Andrew Karlyn for their support, ideas and stimulating discussion.

This thesis could not have been possible without the hard work of the Blood Parasitology Department team. I am indebted to Mr. Matsinhe and his entomologist team, Mrs Avelina and her blood Parasitology team, the computer data processing team Mr. Muxanga and Mr. Zucula, Mr. Acacio and his GPS field team and particular Mr. Periquito and his field team for their invaluable help in the data collection and in the laboratory data processing. Many thanks for their for tireless contribution to the success of the study.

My heartfelt thanks is extended to the staff of the Boane Health District Directorate, particularly, Mr. Diogo, Dr. Luisa, Mr. Assane, Mr. Novela (posthumously) and all the staff of the Boane district health center for their invaluable help during the implementation of the project.

My very special thanks goes to the Boane District Government and the population of Boane for their lively participation and whose co-operation made the study possible.

I am grateful to Dr. John Cox who gave his time to help to produce the digitised maps of the study area. My thanks are extended to Mrs Ilona Carneiro who helped with statistical analysis. I am also grateful to Dr. Carolina Jones, who visited the project, for her comments on my work.

My very special thanks goes to Dr. Halima Mwenesi for her comments and encouragement during this work.

I am grateful to my PhD colleagues in the unit, particularly Edward, Yolande, Morten, Sarai, Lyda, Liesbeth, Gustavo, Funke (visiting research fellow) who were supportive in every way to see this work come to a fruitful end. My thanks to Willie, Bhatia and Obinah, my PhD colleagues at the School for their support and encouragement throughout my study. I am most grateful to Mss Irina Somerton, for her comments and helpful discussion of my work.

I would like also to thank the ENRECA HEALTH NETWORK-DANIDA (Bilateral programme for Enhancement of Research Capacity in Developing Countries) for financial support during this work. I am also grateful to Professor Mads Melbye and to all staff of the Epidemiology department of the Statens Serum Institute, and Dr. Thomas Kristensen and the staff of the Danish Bilharziasis Laboratory for their support and cooperation. I extend my gratitude to ZENECA, the company who offered the insecticide. My gratitude goes to TDR-WHO who supported some of the surveys of this study.

Lastly but not least I would like to thank my wife Esselina, for her love, understanding, encouragement and support during many long weekends and late hours of writing, and for her patience in enduring the long period of separation. It has been much appreciated. To my daughter, Carmen and my son Marcelino for their love and comprehension of the father being away from home. To my parents, Alfredo and Ana, who with their love and encouragement and their confidence in me. Finally I would like to thanks to my entire family and friends who supported my work and courage.

TABLE OF CONTENTS

LIST OF TABLES

Chapter 2:

Chapter 3:

Chapter 4

LIST OF FIGURES

LIST OF MAPS

CHAPTER 1: INTRODUCTION

1.1. Introduction

More than 40% of the world's population of 6 billion people is still exposed to varying levels of malaria risk in 90 countries. It has been estimated that about 1 million people die from malaria each year and there are over 200 million clinical episodes among people in Africa (Snow *et al.* 1999).

Malaria control programmes in Africa depend mainly on the use of chemotherapy and insecticides (indoor sprays and/or insecticide-treated nets). Despite the encouraging results obtained in Tanzania with the malaria vaccine (Alonso *et al.* 1994), other trials conducted in The Gambia (D'Alessandro *et al.* 1995a) and in Thailand (Nosten *et al.* 1996) have shown no impact on malaria morbidity. During recent years, the parasite has developed a resistance to drugs, which has led to rising malaria morbidity and mortality (WHO 1995).

Insecticide-treated nets (ITNs) have proved to be one of the best tools for reducing malaria (Lengeler and Snow 1996, Nevill *et al.* 1996). The promotion and implementation of the use of insecticide-treated nets are research and operation priorities of the World Health Organisation (Lengeler *et al.* 1996).

Lengeler *et al.* (1998) presented the results of four completed large-scale controlled trials that have assessed the impact of ITNs and curtains on overall child mortality in Africa. They observed that the impact of ITNs on child mortality ranged from 3.8 to 6.9 lives saved per 1000 children protected per year. The TDR News (1996) stated that some 500,000 young African children might be saved every year from dying of malaria if ITNs were widely and properly used.

Moreover, Kirigia *et al.* (1998) described that an insecticide-treated bednet project undertaken in Kilifi district (Kenya) found a 41% reduction in paediatric malaria admissions to Kilifi District Hospital. According Kirigia *et al.* (1998) them the reduction in admissions resulted in an estimated saving of US $6240 in the total cost of treating paediatric malaria admissions from the Kilifi district hospital. Thus, the introduction of ITNs programmes can led to a substantial reduction in costs of treating paediatric malaria admissions.

In addition, clinical trials have indicated that treating mosquito nets with insecticide could be a potentially cost-effective method of preventing malaria (Binka *et al.* 1997, Aikins *et al.* 1998). Binka *et al.* (1997) calculated the cost per Disability Adjusted Life Year (DALY) in a study conducted in Ghana. The cost per DALY averted of ITNs was US$66. Some authors have suggested that any DALY cost below US$150 is attractive (Goodman *et al.* (1999). Thus, ITNs can be considered an attractive malaria control intervention.

There has been substantial interest in whether such findings can be replicated, in practice, in the malaria control programmes in other countries. For example, the government of The Gambia based its decision to implement a national insecticide-impregnated bednet programme on the evidence that ITNs can decrease child malaria mortality (Cham *et al.* 1996).

Although the use of ITNs has had a major impact on child mortality in several countries in Africa, there are concerns that the dramatic effects achieved initially may not be financially sustainable (Greenwood 1997). A classical definition would assume that sustainability is the capacity of the government to absorb the responsibility for the project and the ability to maintain the project's benefits, assuring continuity without external funds (La Fond 1995). Thus, a rational distribution of resources between different health sectors calls for an economic evaluation in order to ensure that the available resources are used efficiently. Moreover, there has been increased interest in the possibility of reducing man - vector contact at individual and household levels with direct financing by the community, which may contribute to sustaining the programme.

However, it has been said that many households who are at risk of getting malaria cannot afford to pay for any effective means of control of malaria (such as household-sprays and/or insecticide-treated nets) (TDR News 1996). Therefore, there is a need to determine how many households can afford to make a financial contribution towards the reduction of malaria in their areas.

On the other hand, many African governments do not have sufficient financial resources to initiate the free distribution of insecticide-treated nets or household-sprays. In most cases, when there is a free distribution of such items, (Mozambique is an example), it is made possible through external donor agencies. Thus, it is important to address the issue of how much a malaria control programme will cost, and how much financial support the government will have to raise in order to implement the programme.

Therefore, the issue of the financial sustainability of insecticide-treated bednet (ITN) projects has been raised by many organisations. However, it is still not well defined what sustainability means for donor agencies, and the government. Nevertheless, there is one common view: the people have to pay at least something. This in turn raises the issue of the equity of the programme.

Some insecticide-treated net projects have not taken into consideration the ability of the people to pay, and therefore, when a fee has been introduced, a reduction in the coverage achieved by the programmes in countries such as Kenya (Snow *et al.* 1999) and The Gambia (Muller *et al.* 1997) has been observed. Thus, the issue of equity needs to be addressed.

There are various ways of implementing ITN programmes. For example, some governments have been responsible for delivering the ITNs through the existing malaria control programmes (Philippines, Vanuatu, Vietnam) (Chavasse *et al.* 1999). In other projects the ITN programmes have been run by non-governmental organisations (Keanjhar, India, Bagamoyo, Tanzania, some districts in Kenya) (Ibid.).

The primary health care system (PHC) may be used to promote the use of ITNs; the Gambia can be seen as an example of this approach (Cham *et al.* 1996), but very few studies have been conducted to assess the role of the PHC system in selling or distributing ITNs. There is also a lack of experience in how to decide on the price of the ITNs, taking into account the real cost of the ITNs and the ability of the people to pay for them.

This thesis examines the first insecticide-treated bednet project in Mozambique. Prior to this project almost none of the people in Mozambique had bednets. Before embarking on a larger scale ITN implementation programme, there are some questions that still need to be answered, particularly in relation to coverage and compliance on the one hand and financial sustainability and equity on the other hand.

The present study was carried out in Boane, a semi-rural district of South Mozambique. The primary health care system was used to promote and deliver ITNs among the population of the district.

The aim of this thesis is to determine the degree to which demand for ITNs and compliance with and coverage of the ITN programme are affected by socio-economic and malaria epidemiological factors, and to analyse the financial sustainability and equity of an ITN programme implemented through the primary health care system.

This thesis will contribute to knowledge about malaria control programmes by presenting information about the action taken by the government (via the primary health care system) in stimulating the use of ITNs in an area where malaria mortality is high. The thesis will discuss the use of public sector resources to finance and distribute ITNs among the population who most need them.

1.2. General objective

To evaluate the financial sustainability and equity of an ITN programme implemented through the Primary Health Care System.

1.2.1. Specific objectives

a) To determine the socio-economic factors associated with the potential for a successful ITN programme;

b) To examine willingness to pay for ITNs and the implications for price-setting and revenue generation;

c) To calculate the financial and economic cost of the ITN project if it were implemented throughout the primary health care system;

d) To assess the financial sustainability and equity of the ITN project if it were implemented through the PHC system, and to establish a balance between subsidy and revenue;

e) To contribute to the development of a policy of ITN programme expansion in Mozambique.

The questions addressed in this study include the following:

-What are the socio-economic and epidemiological features of Boane, which may affect demand and coverage (equity) of an ITN programme?

-How would the price of ITN affect coverage?

-Are the nets affordable by the population and what would be the appropriate bednet price to cover a large enough population to achieve a public health impact?

-What is the unit cost of an ITN programme implemented through the PHC system?

-Would a programme within the primary health care system be sustainable in the long run and at what cost?

1.3. Conceptual framework of the study

The study analysed the cost and the financial sustainability and the equity of the project.

The choice of implementing the project within the primary health care was based on the evidence (in Ecuador) that Ministry of Health Programmes are more equitable in terms of the distribution of funds available for primary health care among different population groups (Robertson *et al.* 1991).

In order to study equity in health and access to care in an appropriate way, data is needed on an individual level and must include information about health, mortality, morbidity, utilisation of care, age, sex, residential area, family situation and the social and economic circumstances of each individual as well as the household (Rosen 1999). In the present study, the household was the basis of the study and relevant information about the socio-economic characteristics of the study group and the affordability of ITNs was collected. The study also observed and analysed the socio-economic characteristics of the acceptance and use of ITNs by the Boane community.

The study also collected and analysed epidemiological data correlated with the coverage and use of ITNs.

Finally, the study comprehensively analysed both the costs of the project and malaria epidemiology in Boane, in order to develop a policy strategy based on what was observed.

1.4. Organisation and plan of the thesis

This thesis consists of 9 chapters. Additional materials relating to the study (*i.e.* questionnaires, forms, manuals and tables) are provided in the appendices.

Given the limited knowledge regarding the financial sustainability and equity of ITN programmes under operational circumstances, the Boane study will address issues related to the demand of ITNs, the cost to implement the programme and if either the consumer or the health care system are able to finance the programme.

Chapter 1 is the introduction of the thesis, with a statement of the problems it addresses, the objectives of the study, the methodology that is employed, and the organisation of the thesis.

Chapter 2 is a comprehensive review of the literature relevant to this study. It is in two parts; the first part deals with studies on the use of ITNs to control malaria, and with related socio-economic and epidemiological factors. The second part presents background information about Mozambique and reviews economic evaluations of malaria control programmes, with the emphasis on the use of ITNs.

Chapters 3 to 7 present the results of the various components of the Boane study, each being organised into five parts: introduction, methodology, results, discussion and conclusion.

Chapter 3 introduces the Boane study area and presents the "pre-programme" data collection, in terms of the socio-economic background of the population, the demography, the malaria situation, and knowledge, attitudes and practices in relation to malaria prevention. This information is useful because it introduces the socio-economic and environmental landscape of the study area, and provides guidance to interpret the results achieved by the ITN project.

Chapter 4 discusses the implementation of the ITN programme in Boane, through the primary health care system, and the socio-economic factors associated with demand. This chapter shows that demand was created for the purchase of ITNs, examines the use of ITNs by the households, and analyses how equitable the project was and what were the factors associated with the coverage that was achieved.

Chapter 5 analyses the households' willingness to pay and ability to pay for ITNs. The monthly household income and household expenditure are calculated, and this information is related to the households' willingness to pay and ability to pay, and the households' purchase of ITNs. In addition the chapter explores how the socio-economic characteristics of the households were associated with their willingness to pay. This information relates to the level of equity achieved by the project, and to how much the price influenced the purchase of ITNs.

Chapter 6 calculates the financial and economic costs of the project. The financial cost was calculated in order to track the use of the resources allocated by the project to run the study from the provider's perspective. The economic cost was calculated to measure the total cost of the project, as well as the unit cost to the project for the delivery of each ITN. Based on this information and the price that the price at which the ITNs were sold, it was then possible to analyse the financial sustainability of the project.

Chapter 7 presents a marginal analysis of the costs of the project under different ITN price and coverage scenarios, examines the financial sustainability of a nation-wide ITN project, examines different ITN price and coverage scenarios, considers the question of the financial resources which will be needed to increase coverage, and addresses the issue of the need for a subsidy.

Chapter 8 calculates the cost of implementing a national ITN programme in Mozambique. In addition, the chapter discusses the problem of setting the price for the ITNs, the impact that the price will have on achieving an equitable ITN programme, and discusses the prospects for a nation-wide ITN programme in Mozambique; and the financial resources and mechanisms needed to implement such a national programme.

Finally chapter 9 presents the conclusion of the thesis, gives some policy options for ITN programmes with respect to the major findings in this study, and makes recommendations as to future policies for an ITN programme in Mozambique. Finally, the chapter highlights future operational research needs and recommends future research to fill some of the gaps which are revealed in this study.

CHAPTER 2: LITERATURE REVIEW AND BACKGROUND INFORMATION ON MOZAMBIQUE

2.1. Introduction

One of the most important events in the history of malaria control took place at the beginning of the Second World War (early1940's) when a synthetic insecticide which had a high insecticidal action, *dichloro-diphenyl-trichloroethane* (DDT), was discovered. In 1944 and 1945 Venezuela and Guyana became the first countries to institute wide-scale malaria control programmes, mainly based on household sprays with DDT (Bruce-Chwatt 1985). This programme was successful and encouraged many health care workers to press for the eradication of malaria. Thus, in 1955 the Eighth World Health Assembly voted to initiate a programme for the global eradication of malaria (Packard 1998).

Two years later the World Health Organisation launched a global campaign. The campaign achieved excellent results in Europe, North America, and some parts of Asia, the USSR and Australia. However, the campaign made little progress in Africa, and other tropical areas encountered problems such as the exophilic habits of some anopheline species (the mosquitoes enter houses to feed and then leave for outdoor sheltered resting sites), the resistance of malaria vectors to insecticides, the resistance of *Plasmodia* to antimalaria drugs, and socio-economic, financial and political problems (Bruce-Chwatt 1985).

By the late 1960's the eradication campaign was abandoned. In 1979 the 31st World Health Assembly adopted a resolution on a new strategy for malaria control, stressing five principles: 1) the national will to control the disease should be expressed through a government decision to support antimalaria activities on a long-term basis; 2) malaria control should be an integral part of the country's health care programme; 3) the feasibility and practicability of reducing malaria to a low level should be demonstrated; 4) the participation of the community should be obtained, since the success of various methods of control will greatly depend on this; 5) wherever applicable, permanent measures for the control of malaria should be made an integral part of the relevant development programmes (Ibid.).

These principles were reinforced in 1992 in Amsterdam, by the political commitment of the Ministers of Health of the participating countries, as shown by the adoption of the Malaria Control Strategy. However, despite these initiatives and commitments, the malaria problem continued to get worse in some places.

In December 1998 a group of National Government representatives, heads of bilateral donor organisations, and representatives from the private sector, together with the heads of WHO, UNDP, UNICEF and the World Bank, formally created the Roll Back Malaria (RBM) movement. The reasons for the creation of this new initiative were the lack of co-ordination of international assistance to the countries which needed help for malaria control, the failure to deliver and implement malaria control tools due to weak health care systems in malaria-endemic countries, a lack of funding, and technical reasons such as drug resistance and insecticide resistance (Nabarro 1998).

The objective of the RBM is to provide overarching co-ordination of all efforts at malaria control, to develop better means of utilisation of all tools – old, new and future - for malaria control as and where appropriate, and to help strengthen the health care sector. The RBM depends on Technical Resource Networks to provide help for countries and to monitor all programmes. Some of the stated values of the RBM are the following: a) RBM is a social movement supported by many partners; b) RBM is owned by all the partners; c) action plans are clear, evidence-based, prioritised and adapted to local realities and d) the ultimate objective is to reduce poverty and promote development (Nabarro 1998).

The RBM aims to reduce malaria-specific mortality by 50% by the year 2010 through strengthening the health care systems in malaria endemic countries so that Africa's socio-economic development can improve (Roll Back Malaria 1999). The tools for malaria control that will be implemented include insecticide-treated bednets, a package of essential treatment for the Care of the Sick Children, simple packaging of anti-malarials, improved referral for severe malaria, and others. The components of the malaria programmes in Africa are as follows:

-early diagnosis and treatment of malaria cases;
-selective and sustainable measures of vector control;
-forecast and control of malaria epidemics;
-development of operational research;
-integration into primary health care.

Although most people in Africa have heard about untreated bednets, it was estimated that only one in twenty uses them (TDR News 1996). Other vector control methods available to control malaria are shown in table 2.1.

Table 2.1: Methods of vector control

Approach	**Method**	**Drawbacks**
-Residual house spraying	Spraying inside walls to kill resting mosquitoes	-Resistance to insecticides, for example to DDT -Needs expensive logistics and well-equipped workforce
-Larviciding	Chemicals in breeding sites	-Not feasible in many areas due to large numbers and scattered nature of vector breeding sites
-Source reduction	Identifying and destroying vector breeding sites	-Not feasible and too expensive for most malaria control programmes
-Biological control	-Mosquito larvae predators such as fish -Biological insecticides such as *Baccillus thuringiensis israelensis*	-Only applicable in a limited number of ecological situations - Has the same operational difficulties as larvicing with chemicals
-Untreated bednet	-Individual protection by a physical barrier when sleeping under a bednet	-Mosquitoes can enter if the bednet is torn or hung badly -Mosquitoes can bite any part of the body which is in contact with the bednet -Mosquitoes still fly around the nets making a noise which disturbs sleep
Insecticide-treated bednet	-Bednet treated with insecticide – improved personal protection by killing or repelling mosquitoes	-Not well known how to sustain long term high coverage of ITNs and insecticide distribution

Source: adapted from Chavasse *et al.* 1999

Since the present study focuses on insecticide-treated bednets, this chapter concentrates on reviewing the studies and literature on ITN to prevent malaria.

The chapter is divided into two parts. The first part reviews the literature on the efficacy, delivery of ITNs, the safety of insecticide, the cost-evaluation studies of ITNs, people's willingness and ability to pay for ITNs, and finally the issues of the sustainability and equity of ITN projects. The second part presents background information on Mozambique.

PART I

The objective of this part is to present a comprehensive literature review of the existing evidence concerning the efficacy and the different socio-economic and epidemiological factors associated with the demand, usage and coverage of ITNs, and with the implementation of ITN programmes.

2.2. Efficacy, safety and delivery of insecticide ITNs

The effect of an ITN programme on morbidity and mortality is the main justification for introducing a national strategy to control malaria (Brinkmann and Brinkmann 1995). The following subsections will review the efficacy of ITN projects.

2.2.1. Efficacy of ITNs

Bednets without insecticide have been used in many countries, not only to prevent mosquito bites, but also to protect against cold, or as a sign of wealth (MacComarck and Snow 1986, Aikins *et al.* 1993). Some authors have reported that an untreated bednet is not as good as a treated bednet to protect people against mosquito bites, for a number of different reasons. For examples holes in the bednet, or skin contact of the person with an untreated bednet, allow mosquitoes to bite. Some studies have shown that untreated bednets have provided a limited degree of protection against mosquito bites (Campbell *et al.* 1987, Snow *et al.* 1987, Nevill *et al.* 1990, D'Alessandro *et al.* 1995b, Genton *et al.* 1994). However, other studies showed no protection at all (Kroeger *et al.* 1995). The main conclusion on the efficacy of the bednets in these studies is that ITNs provide greater protection against malaria and are more effective than untreated bednets (Lengeler 1998).

The first application of insecticide to bednets was the use of DDT in this way by Russian troops during the Second World War (Blagovescenky *et al.* 1945). However, it was only during the 1980s that controlled trials demonstrated that bednets treated with pyrethroid insecticides protect against malaria (Choi *et al.* 1995) and substantially decrease mortality (Alonso *et al.* 1991).

ITNs tend to repel or kill mosquitoes that contact the treated fabric, protecting people sleeping under the bednet and also at the same time extending protection to people sleeping in the same room (Lines *et al.* 1987). ITNs can give an individual protection (D'Alessandro *et al.* 1995b) and if used widely by the community on a large scale they can decrease the mosquito population density by reducing the mosquitoes' survival time. The latter form of protection is also called the "mass killing effect" (observed in Tanzania) (Magesa *et al.* 1991). However, the mass killing effect was not observed in some of the trials such as in The Gambia (Quinones 1996).

The efficacy of ITNs against malaria have been clearly demonstrated in many studies in Africa, where the use of ITNs has significantly reduced malaria morbidity (Choi *et al.* 1995, Carnevale *et al.* 1992, Beach *et al.* 1993, Robert and Carnevale 1991) and child mortality by a percentage range between 17% to 42% (Alonso *et al.* 1991, D'Alessandro *et al.* 1994, Nevill *et al.* 1996, Binka *et al.* 1996, Habluetezel *et al.* 1997).

Lengeler (1998) undertook a review to compare the impact of ITNs, untreated bednets and no ITNs on malaria mortality among children under five years old. Sixty-five studies were reviewed, however only eighteen matched the inclusion criteria. Overall ITNs gave a 17% decrease in mortality when compared with no bednets. The protection increased to 23% when ITNs were compared with untreated bednets. The conclusion was that ITNs provided an effective reduction in child mortality, when compared with untreated bednets or no bednets at all.

However, it is still not clear if the decline in exposure will lead to a decline in immunity and shift the burden of disease to older groups (Lines and Armstrong 1992, Snow and Marsh 1995, Trape and Rogier 1996). Therefore more research on long-term efficacy is needed to answer that question. In the mean time, the results of many trials are encouraging and ITNs can be seen as a very important tool to control malaria, particularly among children (Lengeler *et al.* 1996).

Although the impact of ITNs under trial conditions is known, there is not much data on the impact of ITNs under programme conditions. Two studies carried out in The Gambia illustrate the differences between a scientific trial and a large-scale programme. In the scientific trial malaria mortality was reduced by 42% (Alonso *et al.* 1991), while subsequently under programme conditions, the impact on mortality was reduced to 23% (D'Alessandro *et al.* 1995b). Some of the problems related to the programme were the lower dosage of insecticide on the bednets and the lower coverage rate. It has been said that the killing power of insecticide is reduced when the nets are washed, irrespective of which insecticide was used (Jawara *et al.* 1998). Therefore, it is imperative to study the effectiveness of ITNs within a programme.

2.2.2. The insecticide

Pyrethroids are the only class synthetic insecticides available to treat bednets. The dosage of different types varies from 200-500mg/m2 of permethrin to 10-30mg/m2 of lambdacyalothrin and deltamethrin (Curtis *et al.* 1996). Without washing the bednet, the permethrin can be effective for 6 months, and lambdacyalothrin or deltamethrin for about 12 months (Curtis *et al.* 1996). Other pyrethroids available are alphacypermethrin, bifenthrin, cyfluthrin, and etofenprox although they are not yet used widely (Chavasse *et al.* 1999). Pyrethroids are safe and are not thought to be carcinogenic or teratogenic and do not accumulate in food chains. The major environmental concern about pyrethroids appears to be toxicity to fish (Lines 1996).

During the last few years resistance of *Anopheles* mosquitoes to pyrethroids has been reported in a few places (Chandre *et al.* 1999). At the moment there is no solution to the problem of pyrethroid resistance management (Curtis *et al.* 1998a).

Table 2.2 summarises what is known and what is not known about ITN projects (both trials and programmes).

Table 2.2: What is known and what is not known about the efficacy of ITNs

	What is known	What is not known	Comments
Efficacy	-ITNs reduce the incidence of mild malarial episodes by 48% (controls=no bednets) and 34% (controls=untreated bednets) (Lengeler 1998) -ITNs decrease child mortality between 17% and 33% (Lengeler 1998, Binka *et al.* 1996 (Ghana), Nevil *et al.* (Kenya) 1996, D'Alessandro *et al.* 1995b (The Gambia) -ITNs can prevent six deaths each year for every 1,000 children protected (Lengeler *et al.* 1998) -ITNs do not improve birth weight, and do not improve perinatal mortality (Schulman *et al.* 1998, Kenya) -ITNs can protect people not sleeping under an ITN (killing mass effect) (Magessa *et al.* 1991 (Tanzania), -mass killing effect was not seen everywhere (Magbity *et al.* 1997 (Sierra Leone), Quinones *et al.* 1998 (The Gambia) -ITNs are usually washed more than once per year, therefore a 'low-dose, frequent-wash' retreatment system might be technically more appropriate and more affordable where nets are washed frequently (Miller *et al.* 1999; Tanzania) -mosquitoes populations resistant to permethrin, deltamethrin and alphacypermethrin have been identified (Koffi *et al.* 1999; Chandre *et al.* 1999)	-what is the efficacy of an ITN at the individual or household level (Lengeler 1998) -what is the minimal coverage to get a mass killing effect (Lengeler 1998) -what is the impact of ITNs in the immunosystem and how does it will affect in future the burden of malaria infection (Modiano *et al.* 1998) -Can long-term use of ITNs in areas of high transmission lead to mortality rebound in later childhood, which would reduce the cost-effectiveness of the programme? (Habluetzel *et al.* 1997, Coleman *et al.* 1999). - What is the solution to the problem of pyrethroid resistance (Curtis *et al.* 1998a) -does use of ITNs protect against malaria in pregnancy? Inconsistent results from Schulman *et al.* 1998, Browne 1996, Jo Lines (personal communication)	-more research is need to look at the individual and community protection of ITNs -more research is need to look at the immunity and the burden of disease -there is a need to investigate other insecticides to replace pyrethroids, when the level of resistance will call for replacement -there is a need to investigate the efficacy of ITNs under programme implementation setting

2.2.3. Delivery of the ITNs

ITNs can be sub-divided into 2 key components: the net (bednet and curtains), and the insecticide. This division is important because there are different ways of delivering each of the components. At present, the bednet without insecticide is what people have more experience in using. Bednets are usually sold in formal and informal markets (Lines 1996). There are four basic designs: rectangular, conical, A-frame and triangular. The rectangular bednet is the most used imported bednet (particularly by the donor-funded projects in Africa).

2.2.3.1. Delivery of bednets

The delivery of bednets can take place through both the public and private sectors (Feilden 1996).

Bednets can be supplied through the primary health care system. This approach was used in Kenya by UNICEF (Liambila 1994). The main concern is that this will overload the health personnel if it is not very well planned. Another alternative, using public services, is to supply the ITNs through the vertical Malaria Vector Control Programmes, where the staff who normally carry out the house spraying deliver the bednets. This approach was used in Ecuador (Kroeger *et al.* 1995). The problem with this approach is sustainability, in particular where there is a lack of funds for malaria vector control, and the absence of such home spraying programmes in most parts of Africa. Although house spraying is carried out in Mozambique the extent of coverage is limited.

Non-Governmental Agencies (NGOs) have been supplying bednets in many different regions of Africa (very limited coverage). In most cases those bednets have a high level of subsidy. The major constraint is the sustainability of the process when the NGO leaves the community or is not willing to provide any more bednets because of lack of funds.

Another way of delivering bednets is using employer schemes, whereby bednets are distributed to the workers and paid for by the employer. Some companies in Malawi, Zimbabwe and Kenya are already using this system (Feilden 1996).

There is an active commercial market in nets in some African countries (e.g. The Gambia, Tanzania) but in most countries, the market is limited in volume and is confined to the major cities. Not many private firms are encouraged to deliver bednets, particularly when the demand is not high enough. The reasons for that are the lack of available space for bednet storage and import taxes (Lines 1996). Potential candidates for selling bednets in the private retail sector are pharmacies, drug stores, supermarkets, local general stores and street sellers (Evans 1994). Table 2.3 presents the advantages and disadvantages of different ways to deliver bednets. Experience shows that the private sector can meet the needs of upper and middle-income groups, and that the public sector or donor-funded NGOs are required to reach the poorest people (Chavasse *et al.* 1999).

Table 2.4 shows some of the prices for bednets in different countries. As can be seen, the price varies from country to country, it goes from less than US$2 to more than US$30. However, the majority of prices range between US$4 and US$10. The price range of bednets which was observed depended on whether the projects selling bednets were taking into account the willingness to pay of the consumers, the proportion of costs that they were trying to recover, and whether the aim of the project was to achieve good coverage or to maximise profits.

When prices are set too low, high coverage is achieved, but less revenue is generated. This is the case with many government and NGO sponsored projects. If the projects intend to establish a revolving fund to replenish the supplies of bednets, the prices should be as close to the replacement cost as possible. These projects usually sell the bednets at a unit price of around $5.

On the other hand, when bednets are sold by the private sector, they need to recover the costs and to make a profit.

The price of a bednet in the private sector in Mozambique is among the highest observed in the literature; retailers there sell bednets for more than US$30. One of the reasons is the lack of a bednet market.

Table 2.3: Advantages and disadvantages of different ways to deliver bednets

Ways	Example	Advantage	Disadvantage	Comments
Public service and through UNICEF, NGOs, or other similar organisations (usually nets are given free or highly subsidised) (bednets and insecticide are sold at subsidised price)	-Kenya (use of Bamako initiative (Liambila *et al.* 1994) -most of the projects in Africa (Chavasse *et al.* 1999)	-covers the majority of people at risk in a setting -equity assured	-overloading of staff -not financial sustainable	-revenue not enough to maintain a regular bednet supply -good approach to introduce a ITN programme -not generally long lasting
Employer scheme (nets are distributed to the workers and funded partially from employee's wage)	-tea plantation companies in Malawi and Zimbabwe (Feilden 1996)	-workers get a net even without ready cash	-only covers the workers and their families	-companies should be encouraged to use this scheme
Village Bednet Committee (the community is responsible to promote and sell nets. Initial capital of nets usually given by external organisations)	-Bagamoyo bednet project, Tanzania (Makemba *et al.* 1995)	-high level of community participation	-poor management of funds -difficult to re-stock nets -difficult to sustain the community participation for a long run	-good idea, but problems with implementation (accountability) and initiative
Private Organisations sell nets at near total cost-recovery on materials, but not on operational costs	PSI in Central Africa (Chavasse *et al.* 1999)	-creates a market for net -creates/stimulates demand -halo effect – may stimulate unsubsidised sales outside project area	-"crowding out": may undercut visible commercial prices and inhibit unsubsidised trades within project area -equity not assured	-an alternative to private sector
Bilateral or multilateral co-operation. (nets are distributed to private and public service and sold at subsidised prices)	JICA/Gov. of Tanzania (180000 nets were distributed) (Lines 1996)	-creates a market for bednets -nets found everywhere	-not sustainable -private sector who did not benefit from the subsidised net has difficulty to compete in the net market	-good way of introducing awareness of nets in short time -needs government commitment and financial support from a donor agency
Private sector (private sector sell nets at profitable price)	Many African Towns (Lines 1996, Chavasse *et al.* 1999, Macdonald and McGuire 1999)	-sustainable	-needs a bednet market -equity not assured	-needs to explore ways to decrease the price, but still generating profit -can increase the bednet coverage

Table 2.4: Variation in bednet price among different countries (in US$; current prices)

Author/Year	Country	Cost/bednet US$
MacComarck *et al.* 1989	Gambia	9-10.50
Njunwa, 1991	Tanzania	15
Zandu, 1991	Zaire	5
Petersen *et al.* 1993	Sierra Leone	3.50-4.50
Sexton, 1994	Cross country (Africa)	5-6.30
Ettling *et al.*, 1994	Malawi – North	12
	Other parts	22-33
Kroeger *et al.* 1995	Ecuador, Peru & Colombia	6-10
Makemba, 1995	Tanzania	4-5
Fraser-Hurt & Lyimo 1998	Tanzania	5-9.20
Chavasse *et al.* 1999	Vanuatu	10-15 4-5

2.2.3.2. Delivery of the insecticide

With the exception of China, where more than 2.4 million ITNs have been used annually since 1987 (Huailu *et al.* 1995), there is a lack of experience with insecticide delivery. The most common approach used to retreat bednets is communal retreatment, where people bring their bednets to specific places on specific days and the bednets are dipped. This approach has been used in most ITN bednet projects (Feilden 1996).

The advantage of this strategy is that it can be organised through the existing health care structure.

An alternative to communal retreatment is the individual bednet treatment service, where bednets are dipped at the individual's convenience at the "treated centre". This approach has been used in the Central African Republic, however this project only lasted a few months (Lines 1996).

A third method of delivery is the dip-it-yourself-kit, where the insecticide is supplied in a size appropriate to treat one bednet. This approach is especially suited for commercial sale of insecticide, it has been recently used in Tanzania (Miller *et al.* 1999, Schellenberg *et al.* 1999).

Table 2.5 presents the advantages and disadvantages of different ways of delivering insecticide.

Table 2.5: Advantages and disadvantages of different ways of delivering insecticides

Ways	Example	Advantage	Disadvantage	Comments
Public service (insecticide are distributed free of charge by vertical approach- spraying teams)	-China (Huailu *et al.* 1995); Vietnam (Hinch Tranduc, personal communication 1999).	-Achieves high level of coverage (in China in 1991 more than 2 million bednets were treated achieving 95% of coverage) -equity assured -can help to create demand	-not sustainable in many African countries -no spray system in most African countries	-main issues is the sustainability in presence of public funds to support malaria programme
Communal retreatment (nets are treated at the community level, usually free of charge)	-the majority of ITN research trials	-can be organised within the existing health structure -allows a good supervision of the impregnation process -can be used to see if people are willing to pay for retreatment	-not sustainable for a long time without external resources -people have to come during certain periods of the year and the day	-good way to familiarise people with the insecticide -should be charged to be sustainable
Insecticide sold to individual at the cost price and nets treated by the consumer at home	PSI projects in Central Africa (Chavasse *et al.* 1999) and in Tanzania (Miller *et al.* 1999, Schellenberg *et al.* 1999)	-people have insecticides at any time when they need -can be sustained	-achieves low coverage	-one of the alternative ways to sustain the project
Dip-it-yourself-kit (insecticide supplied in an appropriate package to impregnate one net)	-sold to tourists (Lines 1996) -some projects are already using (Miller *et al.* 1999 (Tanzania), Schellenberg *et al.* 1999 (Tanzania)	-you can impregnate at any time -insecticide properly stored -easy to carry	-very expensive -no experience in African countries (Schellenberg *et al.* 1999	-kits should be made more available and less expensive -private and public health sector can use kits in future to sell insecticide

2.2.4. Coverage and usage of ITNs

ITNs are widely used in some regions of Africa: The Gambia, Ghana, Brazzaville, Dar-es-Salaam (Carnevale and Cosemans 1995, Aikins *et al.* 1994, Stephens *et al.* 1995, Zandu *et al.* 1991) and to a smaller extent in Cameroon and Mozambique (Lines 1996).

Factors already identified with the usage of ITNs are the recognised lethal effect on mosquitoes and other insects (Njunwa 1991). They are also appreciated because they can be used in the privacy of people's homes and can be enjoyed as decorations (Aikins *et al.* 1994). One of the factors, which encouraged people to buy bednets, appears to be the abundance of mosquitoes. People tend not to use bednets when they do not perceive mosquitoes as an annoyance (Winch *et al.* 1994, Zimicki 1996, Hii *et al.* 1987).

However, it has been seen that the widespread availability of bednets is not always sufficient to encourage people to use them. Seasonal variations in climate and the perception of mosquito density have been shown to influence ITN use (Evans 1994, Makemba *et al.* 1995). Also, usage decreases when the bednets are too small for the bed, or when people feel hot inside the bednets (Louis *et al.* 1992a).

Where an ITN programme is implemented, it is therefore important to verify the level of usage and identify the factors associated with poor usage. There are differences between the large scale trials implemented under controlled situations and the implementation of ITN programmes. The randomised controlled trials provided the most powerful and bias-free means of providing accurate and critical evaluations of the programmes (Lengeler 1996). However these trials are very expensive and need highly skilled personnel. On the other hand, the ITN programmes face immense difficulties such as inadequate training of the service providers, lack of resources, poorly designed promotional campaigns. Therefore, the ITN programmes achieve lower results than the programme trials. For example it was observed in Kenya that three years after the trial ended, the retreatment rates failed and the adults were twice likely as children to use bednets (Kachur *et al.* 1999).

It is believed that the cost of ITNs is outweighed by their benefits (Goodman *et al.* 1999). However, it was said that the initial investment that the households have to make to purchase enough ITNs for all household members, limits the rapid expansion of ITN use (Carnevale and Coosemans 1995, Stephens 1995), and different strategies need to be developed and analysed to overcome this problem. However, the programme cannot work if neither the users, the government nor donors are willing to pay for them.

Binka *et al.* (1998) studied the effects of the distribution among households of permethrin (insecticide)-impregnated bednets on child mortality in a randomised controlled trial in an area highly endemic for malaria in rural northern Ghana. They observed that high coverage of ITNs led to a maximum impact, and that users of ITNs offer some protection to less fortunate neighbours who do not use ITNs.

2.3. Economic evaluation of malaria

Different health policy strategies have to be informed by economic analysis (Brickmann and Brickmann 1995). Therefore, before introducing an ITN programme at a national level, it is important to consider the economic implications of the programme. The following subsections will review the economic aspects of malaria.

2.3.1. Cost-evaluation studies in malaria

Aikins (1995), Bhatia (1996) and Goodman and Mills (1999) extensively reviewed recent cost-evaluation studies on malaria. The following review will mainly focus on cost-evaluation studies related to ITNs.

ITNs can be compared with other programmes. The most frequent comparison seen in the literature was between ITNs and household spraying. In a study conducted in the Solomon Islands (Kere and Kere 1992) and China (Neng *et al.* 1993), ITNs were more cost effective than household spraying. In another study conducted in China Xu-B (1998) found that bednets treated with deltamethrin and household spraying with DDT were equally effective, however, bednets treated with deltamethrin were cheaper and so were considered the method of choice. Curtis *et al.* (1998b) discussed another study conducted in an intensely malarious area in north-east Tanzania, where microencapsulated lambdacyhalothrin was used in four villages for treatment of bednets (provided free of charge) and in another four villages the same insecticide was used for house spraying. They found that the vector control was associated with a reduction in the probability of re-infection per child per week by 54-62%, with no significant difference between the two vector control methods. However, according to them, bednet treatment consumed only about one sixth as much insecticide as house spraying and it was concluded that the ITN programme was cheaper than household spraying.

Other studies have evaluated the cost per death averted (DA), or the discounted healthy life-years gained (DHLY). Goodman and Mills (1999) published a review study comparing different studies with a common outcome, DA or DYLG (table 2.6 presents the cost-effectiveness results of different ITN projects reviewed by Goodman and Mills 1999). The results show that the cost per DYLG for treatment alone ranged from \$9-\$27 and for the provision of bednets and treatment the cost ranged from \$10-\$118. The cost per DA ranged from \$167-\$2117 for treatment of bednets alone and from \$992-\$3120 for the provision of bednets and treatment. The differences observed between the studies depended on whether the bednets were or were not provided by the project and on how many rounds of insecticide treatment were involved. For example, The Gambia study did not provide bednets and it involved only one round of treatment, whereas the Ghana and Kenya studies provided bednets and involved two rounds of treatment.

Another factor that affected the cost of the study was the price of insecticide and other costs related to the implementation of the project (such as the cost of staff and of the promotional campaign); these costs varied from one project to another. The difference observed between the two Gambian studies was due to the fact that one study (Picard *et al.* 1993) was undertaken under trial conditions and therefore achieved better results, whereas the other (Aikins *et al.* 1998) was an evaluation of the national programme. Therefore, all of these results should be compared with caution. Nevertheless, all of these studies showed a DYLG below \$150, which can be considered an attractive use of resources in a low-income country (WHO 1996).

Table 2.6: Cost-effectiveness results for interventions using comparable outcomes (1995 US$) (sensitivity analysis results in brackets)

Author/Year	Country	Intervention(s) evaluated	Cost per child death averted (DA)	Cost per DYLG (Discounted year of life gained)
Picard *et al.* 1993	The Gambia, 1989-1990	Insecticide treatment of bednets	$219 ($167-$234)	$9 ($9-$14)
Aikins *et al.* 1988	The Gambia 1991-1992	Insecticide treatment of bednets	Net costs $494 ($326-$805)	Net costs $21 ($14-$35)
			Gross costs $665	Gross costs $27
Binka *et al.* 1997	Ghana 1993-1995	Provision and insecticide treatment of bednets	$2112 ($992-$2289)	$77 ($37-$84)
Some 1988	Kenya 1993-1994	Provision and insecticide treatment of bednets	$2958 ($2838-$3120)	-
Evans *et al.* `997	Africa (Gambia cost data), 1996	Provision and insecticide treatment of bednets	-	$10-$118
Graves 1998	The Gambia 1990	Insecticide treatment of bednets	$829 ($447-$2117)	-

Source: Goodman and Mills 1999

2.3.2. Cost of malaria and household expenditure on malaria

It is important to understand the social and economic consequences of malaria in the context of household dynamics, including household income and expenditure and also the cultural factors affecting household behaviour (Popkin, 1982). The socio-economic circumstances of a household can be examined by reference to income, expenditure, occupation, education, etc. Income is a direct measure of the household economic situation which also represents a valid measure of ability to pay (Grytten *et al.* 1995).

The household is a decision-making unit, exercising choice and prioritising expenditure on household expenditure relating to various commodities including nets. When people buy nets it may mean that they are aware of the benefits of nets, and consider them a useful product.

In most urban and some rural areas of Sub-Saharan Africa the households use some form of prevention against mosquito bites (MacComarck and Snow, 1986, Desfontaines *et al.* 1990, Ziba *et al.* 1994, Ongore *et al.* 1989, Evans 1994, Lines 1996, Zimicki 1996). Shepard *et al.* (1991) assessed the economic costs of malaria in Africa. They divided the cost into direct costs (they applied the average costs of treatment and control activities) and indirect costs (assessed by multiplying adult output per day times the estimated productive time lost through both adult and childhood cases). According to them in 1987, a case of malaria cost US$9.84 ($1.83 in direct costs and $8.01 in indirect costs) (Shepard *et al.* 1991).

The malaria prevention methods used vary according to regional cultural preferences and beliefs, the availability of the preventive measures, the economic conditions of the population (MacCormack and Snow 1986) and the number of mosquito bites (Chavasse *et al.* 1996). Mosquito coils tend to be one of the most widely used methods of prevention (Ziba 1994, Evans 1994). In many parts of Africa, people also use traditional methods, such as burning leaves or herbs, or fire in the house (Ziba 1994).

In Malawi the household expenditure on malaria treatment did not vary with income; however, the low income group spent 32.1% of their income, while high income groups only spent 4.7%, but the low income group spent less on malaria prevention (Ettling *et al.* 1994).

Where the nets are available people do spend some amount of their income on bednets. However, the cost of the nets is the major constraint against buying a bednet (Carnevale and Cosemans, 1995). For example, in Cameroon (Louis *et al.* 1992b) a family spent on average US$47.50 on bednets per year, and in Malawi about US$11.32 (Ettling *et al.* 1994).

2.3.3. Household ability and willingness to pay for an ITN

Some studies have shown that when the bednets are available for sale, the most important factor limiting coverage is affordability (Stephens *et al.* 1995, Gyapong *et al.* 1996, Ziba *et al.* 1994). A problem therefore may arise in rural communities, where cash is normally most available in the harvest season (i.e. after the main malaria transmission season), and least available just before harvest when transmission is at its annual peak. In practice, however, projects have found that sales of nets are highest in the rainy season; i.e. they are correlated more closely to the degree of mosquito bites than to seasonal charges in the availability of disposable income (Schellenberg *et al.* 1999).

Cost and affordability can affect the demand and coverage of an ITN programme. Before embarking on a large-scale programme, planners will have to set an ITN price, and this price will in part determine whether the objectives of the programme can be achieved.

Economics often deals with the question of affordability in terms of willingness to pay (O'Brien and Viramontes 1994). Willingness to pay is an important aspect to be considered, because the responses of people to prices might influence the utilisation of the service (Russell 1995). Willingness to pay can be assessed in two ways, one is by observing past expenditure on utilisation of the service or product and responsiveness to prices, another is by asking people directly how much they would be willing to pay for a product or a service. Few studies have been conducted to look at willingness to pay for a bednet or for the insecticide. One such study was carried out in The Gambia, where people were asked how much they were willing to pay for the insecticide. The amount of money that people were willing to pay was less than the actual cost of the insecticide, and also differed from region to region (Mills *et al.* 1994). However, in Kinshasa, people were questioned about how much they were willing to pay for a bednet and the average amount reported was similar to the price of a bednet in the local market (Zandu *et al.* 1991). From these two examples it can be seen that people in different regions perceive the value of a product differently. Knowing how much people are willing to pay for an ITN would anticipate the impact of the price on demand and would make it possible to adjust the price of the product to a level which would not discourage demand.

2.3.4. Household benefits of using an ITN

In most places bednets are not supplied free of charge. Therefore, people will have to be convinced that ITNs are effective and necessary, in order to encourage households to prioritise ITN purchase above alternative purchases (Brinkmann and Brinkmann 1995).

Therefore, it is important to identify the benefits that a household would get from spending money on ITNs.

A hypothetical estimate of household benefits derived from using ITNs was conducted using data from Malawi and Cameroon (Brinkmann and Brinkmann 1995). In Malawi it was estimated that on average the cost of malaria would drop from US$47.72 to US$29.44 for each household using an ITN (Brinkmann and Brinkmann 1995). In Cameroon the economic impact of malaria would be reduced by 11.2% in Yaounde and by 9.3% in Douala (Brinkmann and Brinkmann 1995). From these data Brinkmann concluded that investing in ITNs would reduce the economic impact of malaria on the household. However, this study was based on assumptions which may not apply to different socio-economic environments.

A comprehensive study still needs to be done to evaluate the economic benefits of ITN use and to determine how much money a family would save on malaria prevention and malaria treatment by using an ITN. It is also important to estimate how long the family will have to wait to get the benefits of using an ITN, and why some households will not invest in ITNs.

2.4. Sustainability and equity of ITN programmes

2.4.1. The concept of sustainability and its implication for ITN projects

There is no clear definition of sustainability. La Fond (1995) defines it as "the capacity of the health system to function effectively over time with minimum external input". This definition assumes that many governments cannot run the health sector appropriately at the moment without some external support, and therefore it implicitly acknowledges that donors are needed for some time to come. La Fond assumes that sustainability is the capacity of the government to absorb responsibility for the project and to maintain the project's benefits, assuring continuity without external funds (Ibid).

La Fond also states that sustainability has different meanings for donor agencies and for governments. While for donor agencies sustainability means being able to continue with the activities after the donor's money is withdrawn, governments look at sustainability in terms of "organisational development and systematic growth, confidence building and improved efficiency in the use of resources" (Ibid). La Fond thus points out that donors pay more attention to outcomes during the life of the project, while governments look at the contribution of the project to the development of the health care system.

There are many studies reporting the sustainability of some health programmes. For example, a study was conducted in Bangkok to assess the economic cost of sexually transmitted disease (STD) treatment, and to identify the opportunities for sustaining the STD clinics (Forsythe *et al.* 1998). According to that study, the charge that was introduced allowed the clinics to recover between 11% and 22% of their recurrent cost. The authors concluded that although while some resources can be recovered, government support will continue to be required.

Another study looking at the sustainability of health programmes was conducted in Cameroon. According to Sauerborn (1995), a fund was created to finance drugs. The objective of that fund was to sustain the full coverage of both the costs of drug supply and the recurrent non-salary costs of the entire public health service in that province. The funds created covered 62% of the recurrent health care costs. The authors argue that the appropriate role of donor assistance is not only to finance investment but also to subsidise recurrent costs, until the fund has reached its projected size, thus realising economies of scale. They concluded that while the final word on sustainability can only be said years after the funds have reached their optimum size, the consistent trend towards full cost recovery was encouraging.

Amazigo *et al.* (1998) discussed cost-recovery for the treatment of onchocerciasis. They found that although large-scale treatments by mobile teams or community-based methods evidently achieve high and satisfactory rates of coverage, they also incurred high recurrent costs which have to be covered by external partners and are not sustainable by national health services. They concluded that cost-sharing is an important factor in a sustainable delivery system, and that a system in which the community shares the cost and ownership of local distribution and is empowered to design and implement it, is likely to be more cost-effective and sustainable.

In relation to ITNs, there are few examples in the literature where the concept of sustainability is discussed. One example was a study done in Kenya, where the continuity of bednet retreatment was investigated (Snow *et al.* 1999). It was found that bednet retreatment coverage was drastically reduced from 97% to 7% after the introduction of user fees. The main conclusion was that retreatment in that community was unsustainable. Another example of a failure in retreatment coverage was reported in The Gambia. In this study, when people were asked to pay for insecticide, the coverage dropped from more than 80% to about 30% (Cham *et al.* 1996).

In these two examples, the projects proved to be unsustainable in terms of the continuity of project coverage after the subsidy was withdrawn or reduced. Even less attention has been paid in the literature to the question of sustainability in terms of financial self-sufficiency: i.e., how projects can generate enough income to survive with little or no external financial support. This question is the crux of the present study.

The definition of sustainability that this thesis will adopt for ITN programmes in Mozambique is one that looks at the organisational development and systematic growth of the project, which must be able to secure adequate subsidies for the long-term maintenance of the programme.

Table 2.7 presents what is known about the availability of ITNs and the sustainability of ITN programmes

Table 2.7: What is known and what is not known about the availability of ITNs and the sustainability of ITN programmes

	What is known	What is not known	Comments
Availability of ITNs, sustainability of ITN programmes	-bednets are available in the majority of towns in Africa and less available in rural areas (Lines *et al.* 1996) -ITNs are well accepted as soon people realise the benefits (Lines *et al.* 1996, Binka *et al.* 1997 (Ghana) -bednets have been distributed by different sources: commercial (private sector), subsidised (public sector and NGOs) free of charge (public sector and NGOs) -there is very little availability of insecticide outside a few projects areas (Lines 1996, Chavasse *et al.* 1999). -bednet retreatment coverage drops when user fees are introduced (Winch *et al.* 1997, Snow *et al.* 1999, Muller *et al.* 1997) -many ITN programmes are not financially sustainable (Chavasse *et al.* 1999) -in areas where nets are well known, the net purchase is not income dependent (Chavasse *et al* 1999) -in areas where bednets are not very well known, ITN purchase is income dependent (Bortel *et al.* 1996) -the majority of the people buy nets to prevent mosquito bites and not malaria (Stephens *et al.* 1995, MacComack and Snow 1986) -household willingness to pay for an ITN can be influenced by promotional campaign	-what is the cost-effective way to sustain the delivery of (a) bednets and (b) insecticide? -what is the appropriate bednet price to cover a large enough population and get a public health impact? -can an ITN programme based in the PHC system be sustainable and at what price? -what is the price elasticity of demand of ITNs? -what is the income elasticity of demand of ITNs? -how ITNs can be available to persons who cannot afford them in a long run? -what are the appropriate roles of public and private sectors in distributing (a) bednets and (b) insecticide? -if ITNs have to be widely available who will pay for (a) bednets and (b) insecticide?	-demand and price elasticity are key question to answer in order to visualise the potential of a sustainable ITN programme -economic factors within the household are important factors to be identified in order to minimise the inequalities by charging for nets -factors associated with the net usage within the household, are important factors to be identified to verify who benefits more from the ITN within the household -nets have to be subsidised in order to increase coverage, however, subsidies affect the financial sustainability of ITN programmes

2.4.2. The concept of equity and its implication for ITN projects

In considering the sustainability of a programme, one needs to take into account how equitable the programme would be, because the two cannot easily be achieved together. The more self-sustainable it is, the less equitable it is likely to be.

Mooney (1992) defined equity for health care in two different perspectives: equality of use of health care and equality of access to health care. Equality of use can be defined in terms of individual need or demand. It is important to distinguish between need and demand. Need in this context is determined by a third person, usually a health care professional, while demand expresses the individual's preferences. The equality of use concept underlines that actual consumption does not only depend on demand, but also on supply. People may demand something but not get it because there is a deficiency in supply. Therefore, equal use for equal need, requires a sufficient supply of the goods or services to fulfil all the needs.

The element of equity based on access was considered by Gunning *et al.* (1999). They emphasised that very little attention has been paid to the issue of universal access to quality health care services. The equity of access concept is also discussed by Krasnik (1996). He stressed that health care researchers have a special responsibility towards the population at large to undertake qualified research on equity and to communicate the results to the general public.

Gunning *et al.* (1999) reported that in discussions about equity there is a tendency to focus on the inequalities in health status that appear to be the result of the tangible and intangible consequences of a low income or low social status in society. They added that despite the universal access to health care in western society, considerable differences in health continue to exist between socio-economic groups. These inequalities in health have been referred to in many countries as inequities, meaning that society finds them unjust and expects them to be 'avoidable' or amenable to policy programmes. The authors also added that research on the causal networks underlying the occurrence and the avoidability of inequalities in health remains sparse and studies seem to focus on policy measures that can be evaluated, but which will most likely have a limited impact on the inequalities measured at the population level. They concluded that the research community leaves policymakers with very little evidence on which to build policy initiatives that are nevertheless requested by many governments.

There have been some attempts to discuss the equity of health care programmes. Pereira (1990) discusses the equity of public health programmes in Portugal. The concept of equity accordingly to Pereira is discussed in terms of (a) access to health promoting commodities; (b) equal access to National Health Service care for equal needs; and (c) equal access to both public and private health care.

Pannarunothai and Mills (1997) explores the concept of equity for health services in a large urban area in Thailand. They found an inequitable pattern of out-of-pocket health expenditure by income quintile and per capita. According to their report, The underprivileged were more likely to pay out of their own pocket for their health problems, and to pay out of proportion to their household income when compared with more privileged groups. Furthermore, the underprivileged were least likely to be covered by government health benefit schemes, in contrast in particular to civil servants, who paid less out of pocket and did not contribute to their medical benefits fund. The paper suggests policy options for the short and long term to improve the equity of payment systems for health care.

There is very little published literature which discusses the equity of ITN programmes. However, from the studies already published it can be seen that equity was achieved during the scientific efficacy trials in Africa, because either ITNs or insecticide or both were distributed free of charge for the entire population under study (Binka *et al.* 1997, Alonso *et al.* 1991). However, as soon as charges were introduced not many people had access to insecticides (Snow *et al.* 1999). This situation suggests that at the moment a high level of equity can only be achieved if ITNs and insecticide are provided free of charge.

In conclusion, despite the general agreement that equity is part of the objective of a national ITN programme, there is little consensus on what is meant by equity in an ITN programme.

The definition of equity that this thesis will adopt is that of equal availability of the ITNs for equal need. This definition of equity is a function of both supply and demand. If access, a supply side phenomenon, is equalised, demand must be the same if utilisation is also to be equalised. In the other words, in order for there to be equity, people must have equal access to ITNs according to their need, whether they can afford to buy the ITNs or not, and the ITNs should always be available. Thus, the socio-economic level of the household should not be a barrier to owning an ITN, and the programme should have the capacity to provide a continuous supply of ITNs. This definition was chosen because in order to maximise the public impact of the ITN programme, the ITNs should be supplied on a regular basis, and the people who need them should have access to the ITNs. This is an expensive goal, but it can be argued that this is the only way to halve the malaria burden in Mozambique during the next ten years.

2.5. Conclusion

The literature review revealed that not many studies have so far been published in relation to the cost-evaluation of an ITN programme implemented throughout the primary health care system. Although there are some studies where the cost of implementing ITN programmes was evaluated, none of them sold both the bednet and insecticide.

According to the Feilden (1996) the financing and distribution can be undertaken by the public sector with households meeting some, or all of the costs. However, there is a lack of knowledge about how financially sustainable and equitable such a programme would be. In addition, there is lack of an evidence-base showing how the primary health care system in Mozambique can deliver ITNs.

A reduction in mortality has been observed under the trial conditions. There is a lack of an evidence-base on the reduction of impact indicators, such as mortality, under actual programme conditions (Lengeler and Snow 1996). The programme implementation usually faces more difficulties in delivering ITNs than the controlled trials because of the following reasons: a) inadequate training of the service provider; b) a poorly designed or implemented promotional campaign; c) "leakage" of supplies and equipment; d) insufficient financial resources, etc. (Ibid.).

PART II

This section will present background information about Mozambique, and the malaria situation in the country.

2.6. Socio-economic background of Mozambique

2.6.1. The Country: geography, population and economy

Mozambique is a country situated in southeastern Africa between parallel 10 degrees 27' North and 26 degrees 52' south, and between meridian 30 degrees 12' East and 40 degrees 51' west. It is bounded by the Indian Ocean to the east, Tanzania to the north, Malawi, Zimbabwe and South Africa to the west, and Swaziland and South Africa to the south (map 2.1). The total area of Mozambique is about 801,509 square kilometres. The northern and western regions are mainly mountainous and hilly. Parts of the central and the coastal region consist of large plains.

The climate is predominantly tropical, with three main sub-climates: a humid tropical climate in the northern, central and southern coastal areas; a dry tropical climate in the south and the Zambezi valley; and a high altitude tropical climate in the mountain regions in the interior. The country's flora is mainly open forest and savannah. The climate is characterised by two principal seasons, the rainy season, which lasts from October-November to April-May and the dry season, which lasts through the middle of the calendar year. Mozambique has an average annual rainfall of between 1,000 and 1,500 mm.

In 1997 the estimated population of Mozambique was 15,740,000 (Instituto Nacional de Estatistica, 1998). The density of the population was approximately 21 people/Km². Nearly 75% of the population live in rural areas. About 45.7% of the population consists of children below 15 years of age. The average household size is 4.6 persons. More than 70% of the households are headed by men. The total fertility rate was estimated to be 5.6, infant mortality is 135/1000 and under five mortality is 200/1000 (Instituto Nacional de

Estatistica, 1998). Longevity, measured as life expectancy at birth, was estimated at 46 years for the population as a whole.

Living conditions in Mozambique are poor. The majority of houses are without electricity and sanitation. Only about 6.5% of houses have access to electricity (25% of homes in urban areas and only 2% in the countryside) (Programa das Nações Unidas (1998). More than half of the male population is literate in contrast to little more than 20% literacy in the female population. Total gross national product (GNP) for 1997 in Mozambique was estimated to be approximately US$1.7 billion, and per capita GNP was US$143 (ibid).

The human development indicies (HDI) was calculated. The HDI is composed of three basic components of human development: longevity (life expectancy), knowledge (adult literacy and mean years of schooling) and standard of living (purchasing power based on real GDP per capita). An index lower than 0.500 is considered a low HDI, an indicies between 0.500 and 0.799 is a medium HDI and an index equal to or higher than 0.800 is a high HDI. The HDI for Mozambique has been calculated at 0.281, and thus, according to the international classification Mozambique is considered a country with "low human development". The country with the highest HDI is Canada (0.960), and the lowest is Sierra Leone (0.185) (Ibid).

About 60% of the Mozambican population has a monthly income equal to or lower than US$20; the national poverty line, adjusted for differences in the cost of living in various parts of the country is about $0.50 (fifty US cents) per person per day. At the national level the incidence of poverty is 69.7% (Ibid).

Administratively Mozambique is divided into eleven provinces, of which Maputo, the capital, is one. The provinces are divided into districts and the districts into administrative posts.

2.6.2. Health services in Mozambique

The health services were nationalised in 1975, the year of independence. In the late 1970's the National Health Service was created, and private medicine was nationalised. However, a government decree published in 1992 authorised the re-establishment of private medicine.

The National Health Service is managed at three levels: the Ministry of Health, and the Provincial health and District Health authorities. The Ministry of Health (MOH) is divided into five directorates, each consisting of between two and seven departments, divisions and sections. The main technical body is the National Directorate of Health, where the National Malaria Control Programme is located. Other directorates are: Human Resources, Planning and Co-operation, Administration and Financing and Supplies. Other institutions under the administration of the MOH are the National Institute of Health, Maputo Training Institute, Maintenance Centre, National Laboratories, etc.

The MOH is in charge of allocating resources to the provinces, inspecting their activities, establishing norms and fixing targets and goals. The Provincial Health Directorate, is one level below the MOH, and is largely modelled on the MOH. The District is where services are provided. It is managed by the district health directorate. Each district health directorate serves an average population of 100,000.

The health care system can be divided according to the type of assistance provided into four levels: primary, secondary, tertiary and quaternary. The primary level is composed of 277 health care centres, and 734 health care posts. The secondary level consists of four general hospitals and eleven rural hospitals, the tertiary of seven provincial hospitals, and the quaternary of four central hospitals and one specialised hospital (Ministerio da Saúde 1998 Unpublished). The health care system only covers 40% of the total population. However, mobile teams of the National Health Service deliver programmes such as immunisation into remote areas, therefore covering more than 40% of the total population. Traditional medicine is common in Mozambique, and traditional practitioners are all over the country.

Infectious diseases are the principal causes of morbidity and mortality. Malaria is responsible for most deaths in the country. About 40% of all hospital admissions are due to malaria. HIV prevalence is also another major health problem. The estimated prevalence of HIV in Mozambique in 1998 was 14.5% among the adult population (Direcção Nacional de Saúde, 1999).

2.6.3. Health care personnel

After independence (1975) there was a mass exodus of qualified personnel, which greatly depleted manpower resources, and which continues to affect the health services today. In 1997 the National Health Service had 15,500 personnel. Less than 2.7% of them have a higher education (university degree). The ratio of health care personnel per inhabitant is very low and is not equally distributed in the country. The ratio of health care personnel per inhabitant in 1997 was 1/2,311. However, the ratio of personnel with university degrees was 1/36,256 people, and with middle school degrees 1/11,048. Urban areas have a higher concentration of skilled personnel than rural areas. For example the ratio of personnel with university degrees in Maputo (the capital of the country) was 1/679.

2.6.4. Resource allocation

About 50% of the recurrent expenditure and about 90% of the capital expenditure of the National Health Service in Mozambique comes from the international community. Commitment and disbursement rates vary greatly, although total commitments may now surpass US$100 million. In 1997 some of the major contributors were the World Bank (US$20 million), the European Union (US$18 million), USAID (US$14 million), Swiss Co-operation (US$10 million), Dutch Co-operation (US$7.5 million), UNICEF (US$5.8 million) and others (Pavignani and Durão 1999).

The per capita expenditure on health care and health services was $8.84 (Beattie and Kraushaar 1999). The per capita expenditure according to financing source or agent in

1997 were: Government $1.97 (22% of total), International Agencies $2.92 (33%), (Government and International Agencies $4.89 (55%), Employers $0.57 (6%), NGOs and funding from local sources $1.68 (19%) and households $1.70 (19%) (Ibid).

The overall per capita expenditure in the health sector in Mozambique ($8.84) was less than the amount suggested by *Better Health for Africa* (World Bank 1994). In conclusion, this figure suggests that Mozambique is facing a shortage of funds for health sector requirements even for basic package of care. If care is to be expanded to all Mozambicans it is apparent that more resources will be required.

2.7. Malaria in Mozambique

Mozambique is a stable malaria area; endemicity is generally high varying between hyper to holo-endemic levels. Epidemics of malaria are very unlikely to occur, but a seasonal increase of malaria incidence is observed (towards the end of the rainy season). However, epidemics can occur in urban and high land areas. The most affected people by the disease are children and pregnant women.

2.7.1 The malaria problem

Malaria has always been the major disease reported in rural hospitals accounting for more than 44% of total admissions and 60% of admissions in paediatric wards. Malaria accounts for 29% of total hospital deaths (Gabinete de Epidemiologia 1998). In a study conducted in Maputo the main causes of death among the Maputo population were analysed. Malaria was the major diagnosed cause (Table 2.8) (Dgedge *et al.* 1999).

Table 2.8: The leading causes of registered death, Maputo city 1994

Disease	N	%
Peri-natal disorders	1618	19.9
Malaria	928	11.4
Diarrhoeal diseases	814	10.0
Tuberculosis	456	5.6
Lower respiratory infection	416	5.1
Road-traffic accidents	371	4.6
Cerebro-vascular diseases	269	3.3
Homicide	188	2.3
Bacterial Meningitis	178	2.2
Others	2876	35.4
Total	8114	100

Source: Dgedge *et al.* (1999)

2.7.2. History of the malaria programme in Mozambique

The malaria programme in Mozambique can be divided into two different stages: the malaria eradication programme, which started in the early 1960's and ended in the mid-1970's, and the post-malaria eradication programme.

The malaria eradication pilot campaign was initiated by the Portuguese government in agreement with the WHO. The area to be covered was situated in the southern part of the country, with an area of approximately 164,000 square km and a population of 1.5 million inhabitants. However the entire area was never totally covered. The programme mainly concentrated on intradomiciliary sprays with DDT, detection of positive slides through active and passive case detection, and mass drug administration with chloroquine were brought in as supplementary measures.

The objective of that project was to interrupt the transmission of malaria. However, twelve years later malaria transmission was not completely interrupted anywhere. Although the objectives were not successfully achieved, parasite rates had been brought down from an average of 50% to around 5% and in some areas even below 1% (Onori, 1982a). There is no information on mortality and morbidity, because they were not monitored. The reason for this failure can be explained as follows: firstly, the biting vector behaviour (partially exophagic), secondly, the people slept outdoors, and lastly parasite carriers came into the protected areas from other parts of the country.

In 1975 the strategy of the malaria programme was modified to be based on early diagnosis and treatment, and widespread prophylaxis with chloroquine, targeting all schools, communal villages and workers employed in some socio-economic development projects.

A few years later, a preliminary evaluation of the programme concluded that the campaign had failed (Onori, 1982a). The principal reasons for this failure was the poor usage of prophylaxis, irregularity of chloroquine supply at the points of distribution, lack of community participation, and start of chloroquine–resistance. All these factors led to the campaign being abandoned in the early 1980's (Onori, 1982a).

From the mid 1980's until the mid 1990's, the malaria programme was carried out with the co-operation of the former Soviet Union. The main activities were house spraying operations which resumed around the major cities, training of health care workers in diagnosis and treatment of resistant and complicated malaria, supervision of the laboratory network, quality control of blood slide results and epidemiological surveillance.

From mid-1999, the malaria control programme was enrolled in the WHO Roll Back Malaria Initiative (RBM). The Roll Back Malaria is an advocacy strategy for enhancing resource mobilisation and actions to control malaria. However, the technical programmes to address malaria have not changed. The RBM aims to reduce specific malaria mortality by 50% by the year 2010 through strengthening the health care system. The malaria control programme in Mozambique receives funds from the government and from international organisations, such as WHO, UNICEF, and international government agencies such as DANIDA (Denmark).

The current objectives of the malaria control programme in Mozambique are to reduce malaria morbidity and prevent and control malaria epidemics. Early diagnosis and effective treatment of malaria are defined as the first and fundamental elements required to achieve a reduction of morbidity and mortality.

Chloroquine is still the first-line drug, and sulfadoxine+pyremethamine is the second-line drug. Cases of severe malaria are treated with quinine.

Vector control with intradomiciliary spraying with Lambdacyalothrin is undertaken in some urban areas. In 1997, 366,840 houses were sprayed, protecting about 1,834,397 people (Malaria control programme report, 1998 not published). Some limitation of the widespread application of DDT in rural areas with low population density, social instability, and lack of community cooperation as a result of the poor economic situation of the country makes it impossible in practice to sustain a large spraying programme. Nothing relevant is currently applied for larval control, which anyway is not realistic outside some urban areas. The use of impregnated bednets is under study.

Resistance of *P. falciparum* to chloroquine is currently being monitored in Maputo and irregularly in other provinces. A better system for monitoring malaria resistance at the national level is under study.

Health education is carried out in collaboration with various sectors of the health service. It is one of the weaker areas of the malaria programme; it is mainly based on distribution of brochures and posters and occasionally on broadcasts on the local radio stations.

The National Malaria Control Programme was established in 1985 under the communicable diseases department. The staff of the malaria programme is made up of the head of the programme, the laboratory chief and a clinical assistant. Malaria control at the provincial and district level is under the responsibility of a technician (preventive) who is a member of the provincial or district health team.

The source of funding for the malaria control programme in 1996 were mainly the government of Mozambique, WHO (US$7,300) and UNICEF (US$424,000).

2.7.3. Coverage of ITNs in Mozambique

Bednets can only be found in some capital cities of Mozambique at a very high price. In Maputo a bednet costs between US$35 and US$75, and the majority of people are not familiar with bednets (Dgedge *et al.* 1994a). In almost all rural areas there are no bednets at all. One of the aims of the Ministry of Health is to introduce ITNs in the country. The present project is the first project introducing ITNs into the country. This objective has the support of UNICEF, which is subsidising some of the malaria control programmes in Mozambique. An experimental study using nylon-netting wall-curtains was conducted in Mozambique; however the results did not have any impact on malaria morbidity in children under five. The experiment was not continued, and no further actions were considered (Crook and Baptista 1995).

2.7.4. The malaria parasite

The results of a national parasitological survey performed in 1989 showed that the overall malaria prevalence of parasitaemia was 43%. The are three species of *Plasmodium*: *P. falciparum* accounting for about 90% all malaria infections, *P. malariae* accounting for about 9% and *P. ovale* accounting for less than 0.5% (Onori, 1982b). Resistance of *P. falciparum* to chloroquine was monitored in Mozambique from 1983 (Shapira and Schwalbach, 1988) up to the present (Dgedge *et al.* 1998). The clinical efficacy of chloroquine was about 60% in 1998 (Ibid), however the sensitivity of the parasites to chloroquine is much lower (less than 30% in many parts of the country).

2.7.5. The malaria vector

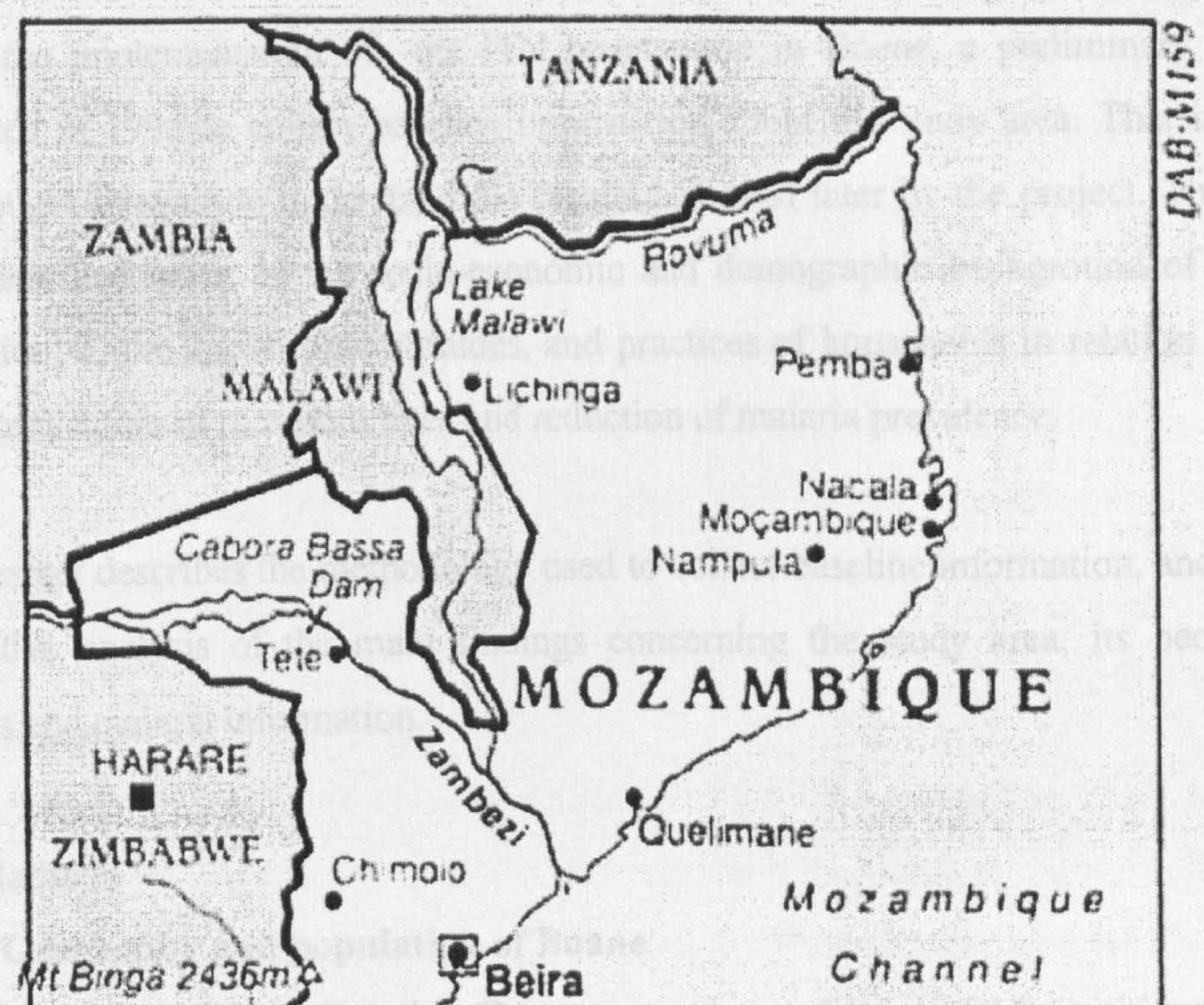
The principal malaria vectors in Mozambique are *A. gambiae s.l.* and *A. funestus*. The *A. gambiae* complex is distributed throughout the country as follows: *A. gambiae s.s.* predominating in the northern provinces. *A. merus*, predominating all along the littoral zones and *A. arabiensis*, mainly occupying the southern provinces. *Anopheles* mosquitoes are present throughout the year, with an increase in numbers during the rainy season (November to April).

2.7.6. Conclusion

In conclusion, malaria is endemic in Mozambique, a country with limited financial resources, and there currently is a limited availability of ITNs to control malaria.

Before introducing ITNs at a large-scale basis in Mozambique, there is a need to determine an appropriate policy, taking into consideration issues related to the financial sustainability and equity of an ITN programme.

Map 2.1: Map of Mozambique



CHAPTER 3: PRE-INTERVENTION BASELINE DATA COLLECTION

3.1. Introduction

Before the implementation of the ITN programme in Boane, a preliminary study was conducted in 1995 to collect baseline information about the study area. That information was thought relevant to understand the results achieved later by the project. The principal areas identified were: 1) the socio-economic and demographic background of the Boane population; 2) the knowledge, attitudes, and practices of households in relation to malaria; and 3) prevention of mosquito bites and reduction of malaria prevalence.

This chapter describes the methodology used to collect baseline information, and presents a descriptive analysis of the main findings concerning the study area, its people, health services and malaria information.

3.2. Methods

3.2.1. Geography and population of Boane

The ITN project was conducted in Boane, a southern district of Mozambique (map 3.1). Boane is one of the seven districts of Maputo province, and is situated at the southern end of the main road to Swaziland, 30km from Maputo (capital of Mozambique), in the basin of the Umbeluzi River. The Boane District area is divided into six administrative divisions: Boane town itself, (the headquarters of the district), and five small villages (map 3.2). The Boane town is divided into nine residential areas. The five villages and the nine residential areas where the study was located are as follows: Boane town ("Bairro 1", "Bairro 2", "Bairro 3", "Bairro 4", "Bairro 5", "Bairro 6", "Bairro 7", "Bairro Militar" and "Bairro I" and the villages "Massaca 1", Massaca 2", "Paulo Samuel Kankhomba", "Umpala" and "Radio Marconi". The distance between the villages and the town varies between 5km and 8km.

Boane has a tropical climate characterised by two principal seasons. The rainy season lasts from November to April, and the dry season through the middle of the calendar year. It has an average annual rainfall of between 1000mm and 1500mm. Temperatures are generally high all year round, the average monthly temperature being 22°C, in a range from 15°C to 38°C.

The total population in the study area was estimated in 1995 to be about 30,000. Nearly 18,000 live in Boane town and the remainder in the villages. The population of each village is between 1,500 and 3,000. There are about 6000 households.

The majority of people have a low level of education and live in poverty. Most of the houses are poorly constructed out of cane or mud and are without electricity or running water. The majority of houses are small, with two or three rooms. The average number of people sleeping in each household is about five.

3.2.2. Health profile of the study area

The health facilities in the study area consist of one health centre located in the town and two health posts, one located in Radio Marconi, and the other in Massaca II residential areas. The health centre has twenty-eight beds, eight of which belong to the maternity ward and, a small laboratory. The medical staff at the health centre is comprised of one doctor, and several midwives and nurses. There are no community health workers in the study area.

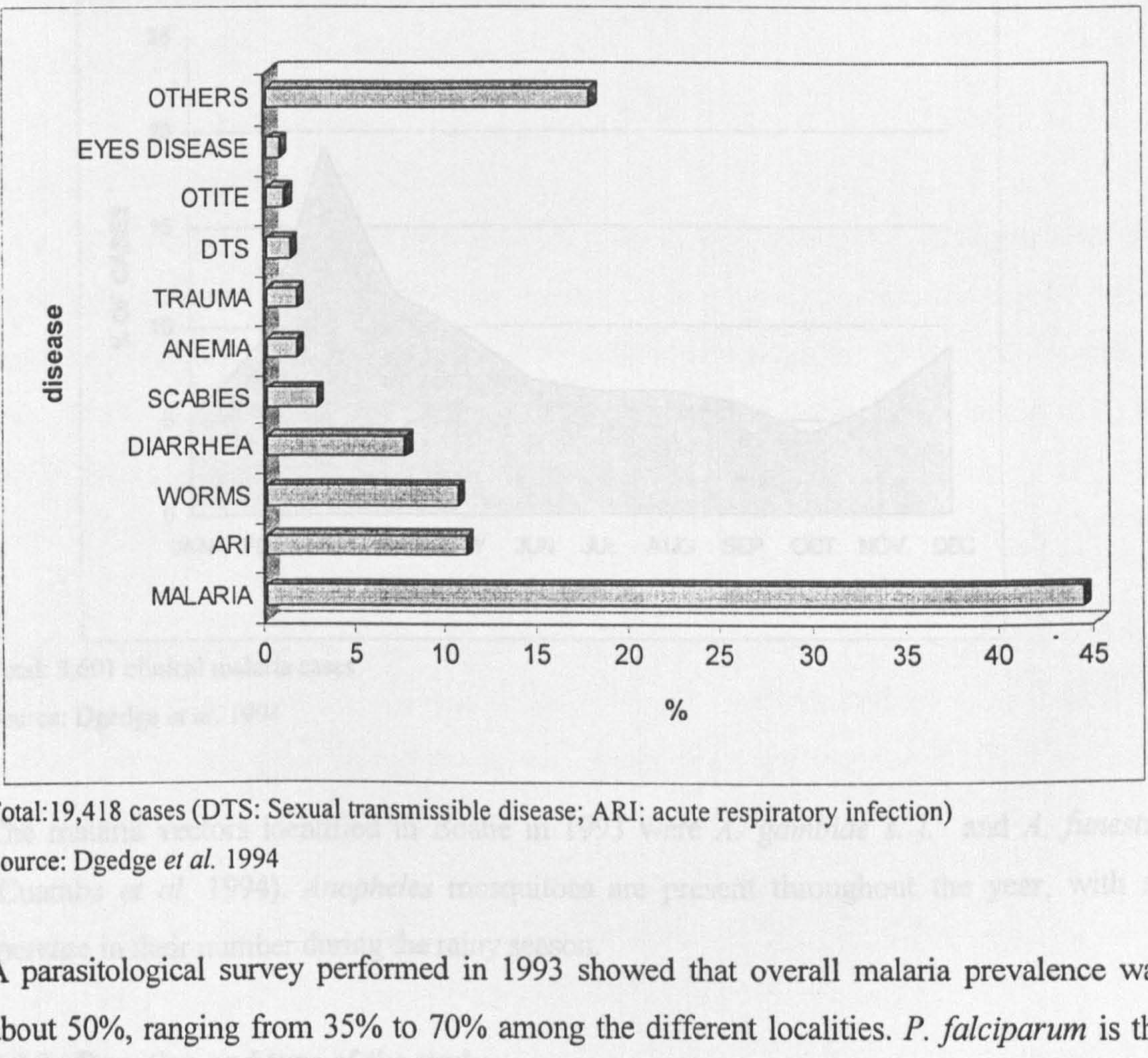
The health center provides health care for some severe conditions, such as cerebral malaria and severe anaemia, in addition to providing immunisations, prenatal care, and maternity care. There is no operating room. The two health posts only provide basic health care, immunisation and prenatal care.

Access from the study area to the health post can be considered good, since the residential areas are not more than 6-7 kms away, and the roads providing access are reasonably good.

There is no formal private medicine practice in Boane district. There are several traditional health practitioners, and traditional birth attendants. Traditional birth attendants benefit from close supervision by district midwife personnel.

There are on average about 1000 outpatients per month, with this number increasing during the rainy season. Malaria (diagnosed clinically) has always been the most important health problem in this area, accounting for about 45% of all outpatient visits to the Boane health Centre. Other principal causes of morbidity are acute respiratory infection accounting for more than 10% of the visits, and worms and diarrhoea, each accounting for more than 5% of visits (Figure 3.1).

Figure 3.1: Principal diseases reported in Boane outpatient health center-1993

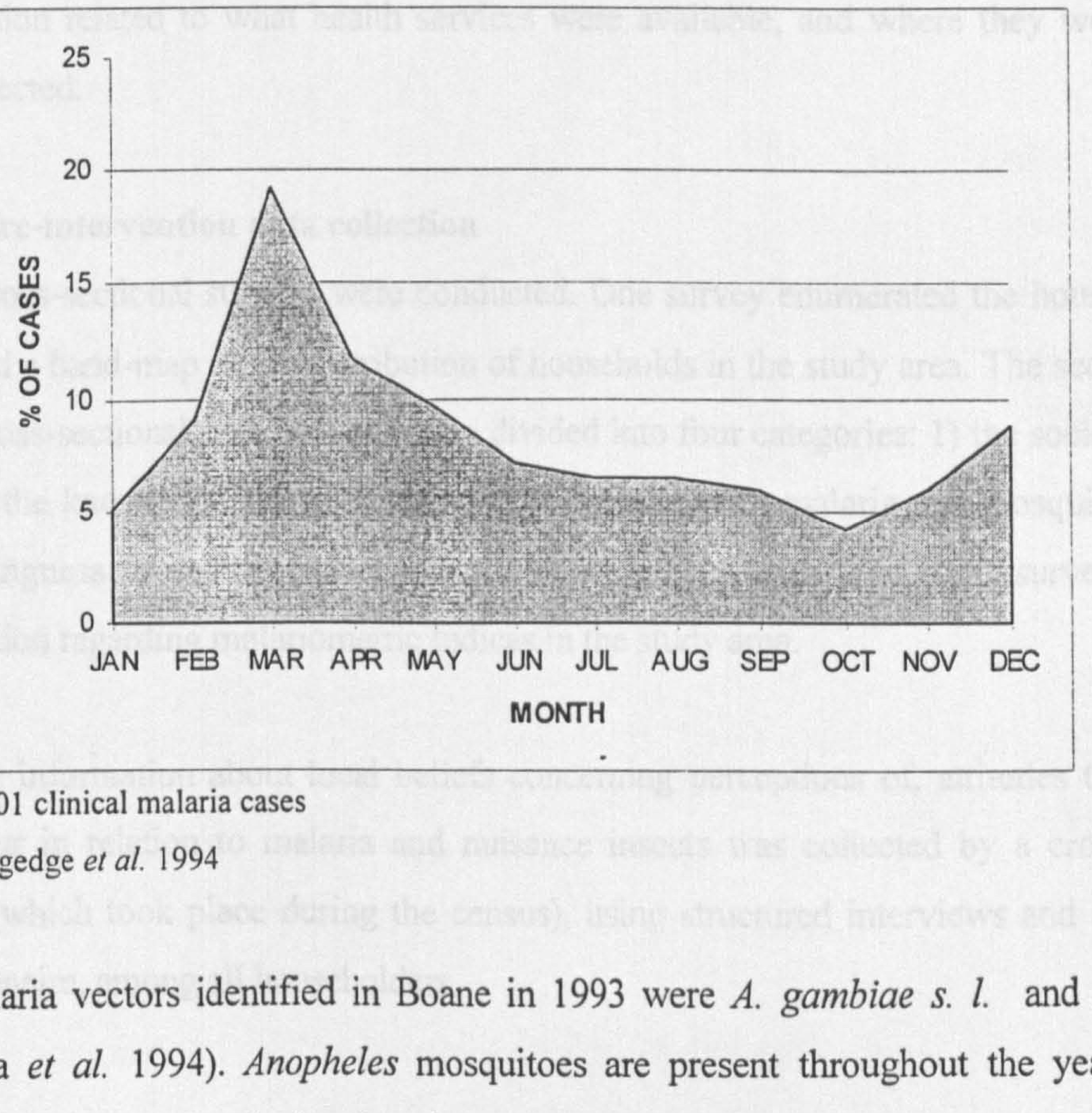


Total:19,418 cases (DTS: Sexual transmissible disease; ARI: acute respiratory infection)
Source: Dgedge *et al.* 1994

A parasitological survey performed in 1993 showed that overall malaria prevalence was about 50%, ranging from 35% to 70% among the different localities. *P. falciparum* is the most common *Plasmodium* species, accounting for more than 90% of the infections. Other species are *P. malariae P. ovale*. *In vivo* resistance of *P. falciparum* to chloroquine was monitored in 1994 (Dgedge *et al.* 1994b). About 40% of the infections were found to be resistant to chloroquine.

The number of malaria cases reaches a maximum towards the end of the rainy season (March/April). Figure 3.2 shows the number of malaria cases observed at the outpatient clinic in the health center. As can be seen, the number of cases increases during the later stage of the rainy season, which corresponds to the months of February, March and April. For example, in 1995 about 20% of all cases during the year were observed in March.

Figure 3.2: Seasonal variation in clinical malaria diagnoses at the Boane Heath Center (only outpatient clinical malaria cases) - 1994



Total: 8,601 clinical malaria cases
Source: Dgedge *et al.* 1994

The malaria vectors identified in Boane in 1993 were *A. gambiae s. l.* and *A. funestus* (Cuamba *et al.* 1994). *Anopheles* mosquitoes are present throughout the year, with an increase in their number during the rainy season.

3.2.3. Duration and type of the study

The study was conducted over two years and was divided into three phases. The first phase (pre-intervention) was a cross-sectional survey designed to generate baseline information on knowledge, attitudes and practices with regard to malaria, demographic and socio-economic data, and information about the willingness of people to pay for an ITN. The second phase consisted of the implementation of the ITN project, including the sale and retreatment of the ITNs. The last phase consisted of the financial and economic evaluation of the project.

3.2.4. Health and political organisation

Prior to the commencement of phase one, the formal co-operation of the Ministry of Health, in the form of a commitment to the project by the provision of local staff, was secured. Key community members able to assist were identified with the help of the political leader of the study area, and several meetings with these key community members took place. Information related to what health services were available, and where they were located, was collected.

3.2.5. Pre-intervention data collection

Three cross-sectional surveys were conducted. One survey enumerated the households and produced a hand-map of the distribution of households in the study area. The second survey was a cross-sectional survey, which was divided into four categories: 1) the socio-economic data; 2) the knowledge, attitudes and practices concerning malaria and mosquitoes; 3) the pre-willingness to pay for an ITN; and 4) the census data. The third survey collected information regarding malariometric indices in the study area.

Baseline information about local beliefs concerning perceptions of, attitudes towards and behaviour in relation to malaria and nuisance insects was collected by a cross-sectional survey (which took place during the census), using structured interviews and a pre-coded questionnaire, among all householders.

Table 3.1: Pre-intervention data collection. Each of the surveys was done separately. The questionnaire of Survey 2 was divided into four parts.

Survey	Objective	Time of the survey
Survey 1: Mapping and enumeration of Households	-To locate the households during the subsequent follow-ups -To facilitate sample size calculation for further surveys	July-November 1995
Survey 2: Socio-economic and demographic information		July-November 1995 (All of the information was collected at the time of the visit to each household.)
a) wealth data	-To determine the socio-economic level of the study population	
b) knowledge, attitudes and practice concerning malaria	-To ascertain the knowledge, attitudes and practices of the study population concerning malaria.	
c) census data	-To determine the size of the households and the sex and age distribution of the study population	
d) pre-implementation willingness to pay survey	-To determine the households' willingness to pay for ITNs prior to the implementation of the project	
Survey 3: Malariometric indexes	-To determine the prevalence of malaria in the study population, before the implementation of the ITN project	February 1996

All data collection tools were subjected to pre-tests in the field before the commencement of actual data collection. The questionnaire was administered in the language *Changana* (the local language) or in Portuguese, whichever the respondent preferred.

Key community members were invited to assist the field teams. Preliminary meetings with the local community took place in all the study areas. The objectives of the study, and the need for co-operation were explained to the community.

Interviewers were recruited from the National Institute of Health staff (a governmental research institution subordinated to the Ministry of Health) and from the local population. All interviewers had completed at least basic secondary school and also were fluent in the local language.

Field workers received training in the general aspects of the survey.

3.2.5.1. Survey 1: Mapping and enumeration of households

The objectives of mapping and enumeration were to facilitate the location of the households for subsequent follow-ups, and to facilitate sample-size calculation for further surveys.

A household was defined as a single home or a group of homes in which the residents were related and all shared the cooking facilities.

3.2.5.2. Survey 2: Socio-economic and demographic information (by categories)

Category a): Wealth data

The socio-economic data consisted of information such as the type of material used to build the house, whether the house had running water and electricity, and the level of household wealth, such as the possession of a radio, a refrigerator, and television (this is a crude wealth indicator, there was not collected the household income and expenditure data). Wealth possession was used as an indicator of socio-economic status by other authors.

For example in a study conducted in Malawi (Ettling et al. 1994) found a direct association between household income and house construction materials. Households living in houses made of mud were the poorest. It was suggested that household construction materials could be used to stratify communities by socio-economic level.

In addition, information about land ownership, farm production, possession of animals (cattle, goats, etc.) was collected.

Category b): Knowledge, attitudes and practices regarding malaria and the mosquito vector

The aim of this category was to gather quantitative data pertaining to household knowledge, beliefs and practices with regard to malaria.

Questions asked in the cross sectional survey were related to knowledge of malaria aetiology and its transmission, traditional beliefs about malaria aetiology, and the perceived efficacy of ITNs.

The questionnaire had two sections: the first section dealt with the respondent's perceptions concerning the principal diseases in the community and his/her perceptions of the seasonality of mosquitoes, what diseases mosquitoes transmitted and how household members protected themselves against mosquito bites. The second section dealt with information regarding bednets, whether the respondent had heard of bednets, about the utility of bednets and whether they had one at home. For those who had at least one net, a question about who was using it was asked. Before the interview ended a bednet was shown to the household members, and their colour preference was recorded.

Category c): Census data collection

Demographic data, such as household size, age and sex was collected by a census and an interview using a pre-coded questionnaire (Appendix 3.1). The census collected information about all members of a household, who had been in permanent residence during the previous six months. They were considered full-time residents. Household members were marked as present if they were living in the home at the time of the survey, "temporarily absent" if they had been away for a period of less than 48 hours, or absent if they had been away for more than six months. The reason for their absence was recorded. Visitors were not included in the census. If a household occupied more than one house in a compound belonging to another household, and was renting these houses, the members of that household were considered to be a separate household, and were interviewed separately. Houses that were empty at the time of the interview were revisited later; if the occupants still were still not found, they were revisited again later, during the period of the study. However, all households were enumerated, even in the absence of the household members. A household number was used to identify and locate the households, and each individual in each household was assigned a number, based on the household number. A map showing the distribution of households was hand-drawn (map 3.3).

The census data consisted of the following information from each household member: name, place of birth, date of birth, gender, mother language, marital status, number of children, level of education, employment status, and whether present or absent at the time of enumeration. If a household member could not remember their date of birth, a historical and local event calendar was used to approximately trace the date of birth.

Each individual permanently resident in the village was given a unique registration number, which was subsequently used for identification, for presentation to the study teams or to buy ITNs. Each household received an identification card containing information regarding the gender and age of all household members. The card was also used to record information about purchasing ITNs during the implementation process (Appendix 3.2).

Mortality data was collected during the census. Households were asked how many people had died during the previous year, the age and gender of the deceased person, as well as the place where death had occurred.

Category d): Pre-implementation willingness to pay survey

The aim of this survey was to determine how many people were willing to pay for one ITN, and to collect information about what price the people were willing to pay. Since the majority of households were not familiar with the bednets, and because bednets were not available in the market, it was assumed *a priori* that the results of the survey would not guide the choice of a price for the ITNs, but would provide useful information concerning future demand among the population.

The information related to willingness to pay was collected in an interview among households asking what was the maximum they would pay for an ITN. This information was collected during the census baseline cross-sectional survey, and all householders were interviewed. An open-ended question was used to collect the information related to willingness to pay.

3.2.5.3. Survey 3: Malariometric survey

A malariometric survey was carried out during the implementation of the ITN project in Boane. The objective of the survey was to collect baseline parasite prevalence and clinical malaria information about the study area, regarding parasite distribution by age, sex, and residential area, fever prevalence, spleen rate and anaemia prevalence.

One malaria parasitological survey was conducted before the implementation of the ITN project in Boane, in February 1996 (the high transmission season). The people studied ranged from less than one year old to seventy years old. Samples were collected from all age groups living in the study area (with about 50% of the samples collected from persons under ten years old). Mobile teams went from bairro to bairro to collect samples at a fixed point in the residential area. They invited everyone to attend at these points.

Children and adults were examined for spleen enlargement. The spleen was felt with the person lying down, and its enlargement was recorded in centimetres from the tip to the costal margin.

Blood was collected from a fingerprick. Packed cell volumes (PCVs or haematocrit) were measured with a microhaematocrit centrifuge using blood collected directly into heparinized capillary tubes, immediately after the blood collection. Thick films were made for parasitological examination, the films were stained with Giemsa's stain, and 100 high power fields were examined. For positive films, parasite density and species identification were recorded. Parasite density was calculated assuming a leukocyte count of 8000 white blood cells/µl of blood.

The axillary temperature of each person was taken using an electronic thermometer.

Febrile persons were referred to a health clinic, and free malaria treatment was provided during the surveys.

3.3. Data analysis

All questionnaires were coded and entered in a data file using the EPIINFO 6.0 package, and then exported to SPSS and STATA programs.

Categorical variables were analysed using χ^2 test. *Student's t-test* was used for normally distributed numerical variables. Variables not normally distributed were analysed by means of a non-parametric test.

3.4. Results

About 90% of all householders in the community were interviewed to collect demographic and socio-economic data.

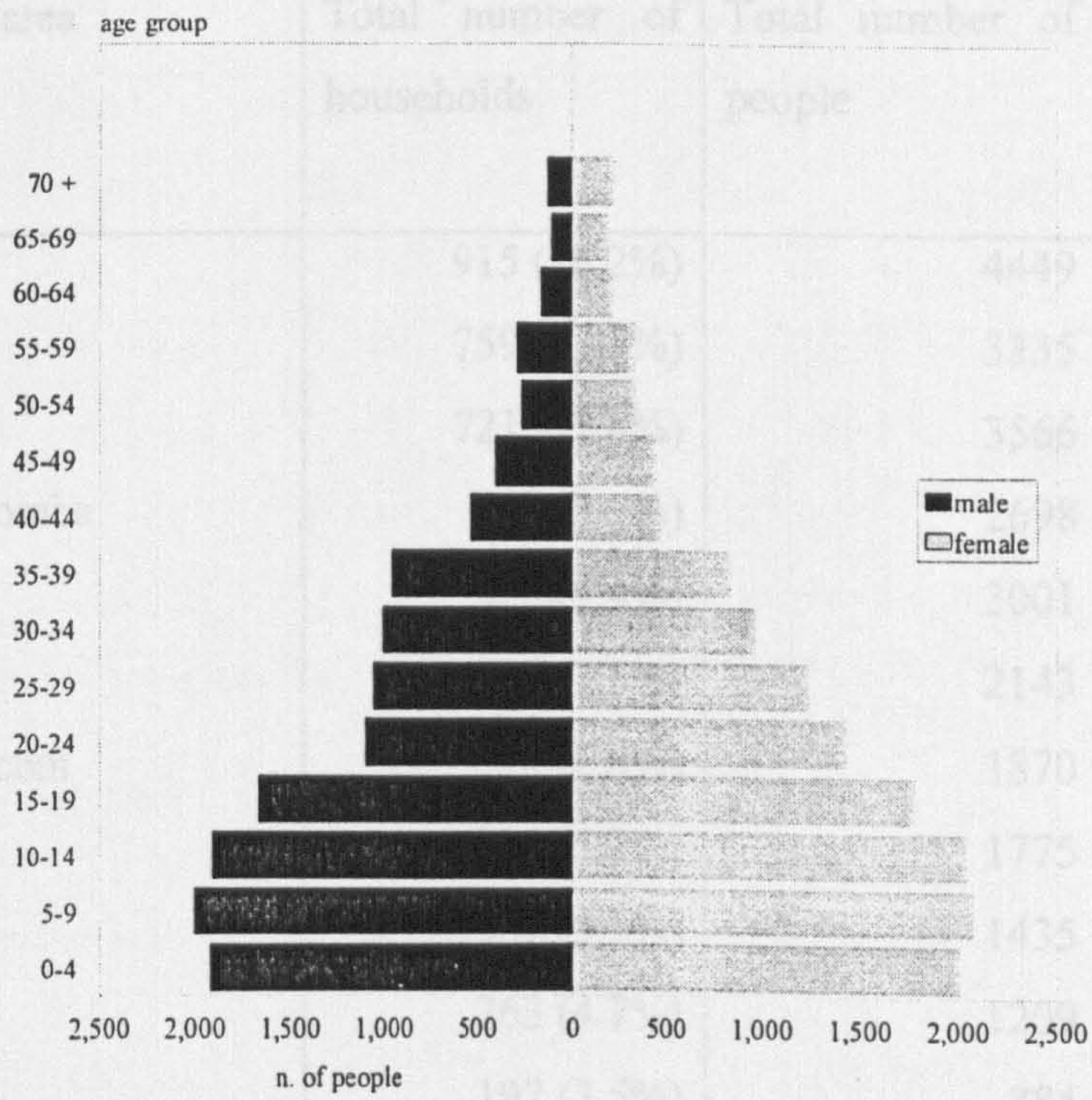
3.4.1. Mapping and enumeration of households, and demographic and socio-economic data

During the census survey, 5,640 households were counted, which corresponds to about 90% of all households. 27,938 persons were considered current residents. The age pyramid of the population is shown in figure 3.3. The configuration of the population pyramid is typical of those of developing countries, with a wide base made up of young age groups and then a sharp tapering off occurring after the age of around fifty. Children below age five and less than fifteen constituted 14% and 42.6%, respectively, of the population. Forty-eight percent of the total population was male. There were 6,670 women of reproductive age (between 15 and 49 years old), representing 23.8% of the population. The average household size was 4.9 persons.

Table 3.2 shows the population by residential area. Massaca 1 was the most heavily populated area with 915 inhabitants (16.2%). The least populated area was Bairro I with only 194 inhabitants; this is due to the fact that only people who work at a local agricultural school (and their families) live in Bairro 1.

With respect to the data on mortality, a total of 404 deaths were reported for the previous year (mortality rate = 14.4/1000). Two hundred and twenty six (55.9%) of these occurred among the male population. Table 3.3 shows the number of deaths per age group. As can be seen from the table, the majority of deaths occurred amongst children under five years of age (43.8%). Table 3.3. shows the place were the deaths occurred. The majority of deaths occurred at home (61%), and only 29% of the deaths occurred at a health unit (Table 3.4). Investigation into the possible cause of death was not included in this study.

Figure 3.3: Age-stratified pyramid of the Boane population - 1995



Source: Survey 2: census data (1995) Total: 27,938 people

Table 3.2: Pre-intervention baseline demographic profile of the study area (1995)

Residence area	Total number of households	Total number of people	Average number of people per household
Massaca 1	915 (16.2%)	4449	4.8
Bairro 7	759 (13.5%)	3335	4.4
Bairro 1	721 (12.8%)	3566	4.9
P.S.Kankhomba	537 (9.5%)	2698	5.0
Bairro 2	528 (9.4%)	3001	5.6
Bairro 4	421 (7.5%)	2143	5.1
Radio Marconi	374 (6.6%)	1870	5.0
Bairro 3	320 (5.7%)	1775	5.5
Umpala	301 (5.3%)	1435	4.7
Massaca 2	263 (4.7%)	1209	4.5
Bairro 5	197 (3.5%)	884	4.4
Bairro 6	182 (3.2%)	837	4.6
Bairro Militar	89 (1.6%)	412	4.6
Bairro I	33 (0.6%)	194	5.8
Total	5640 (100%)	27808	4.9

Source: Survey 2: census data (1995)

Table 3.3: Number of deaths in Boane during one year (January-December 1994)

Age group	MALE		FEMALE		TOTAL POPULATION		
	Total Male	N. of deaths	Total Female	N. of deaths	TOTAL POPULA-TION	Number of deaths	Mortality rate/1000/ Year
0-4	1920	97	1995	80	3915	177	45.2
5-14	3920	32	4099	31	8019	63	8
>=15	7678	97	8371	67	16,049	164	10
TOTAL	13,518	226	14,465	178	27,983	404	14

Source: Survey 2: Census data (1995)

Table 3.4: Place where the deaths occurred (January-December 94)

Place	% of deaths (N=404)
Home	61%
Health Unit	29%
Street	3%
Without information	7%

Source: Survey 2: census data (1995)

3.4.2. Socio-economic situation

Three socio-economic levels were used to categorise households in Boane. The criteria were based on the material used to build the house, whether the house had running water and electricity, and whether the household possessed a radio, refrigerator and television. Households with a house made of concrete, with electricity and running water and with a radio, television and refrigerator were classified as the high-income group; households with some of those items were classified as the middle-income group and households with none of these items were classified as the poor group.

The most common type of house was made of mud (71%). Only 11% and 10% of the houses had running water and electricity, respectively. Concrete houses with both electricity and running water accounted for only 7% of the total. While 37% of all households had a radio, only 5% and 5% respectively had a television and a refrigerator (Table 3.5).

The majority of households were in the poor group (55%), and only 2% were in the high-income group (Table 3.6).

Table 3.5: Socio-economic background of Boane - 1995

Description	N= 5640 (100%)
Type of wall of the house	
Hut	71%
Concrete	20%
Others	9%
Houses with Electricity	
Yes	10%
Houses with running water	
Yes	11%
Houses with a radio	
Yes	37%
Houses with a refrigerator	
Yes	5%
Houses with a television	
Yes	5%
Houses with concrete wall, electricity and running water	
Yes	7%

Source: Survey 2: wealth data (1995)

Table 3.6: The socio-economic level distribution of the households

Socio-economic level	N= 5640 (100%)
Poor	55%
Middle-income	43%
High-income	2%

Criteria: houses with concrete walls, electricity, piped water, radio, refrigerator and television

Poor: none of the items listed above

Middle-income: at least one of the items listed above, but not all of them

High-income: all items listed above

(Source: survey 2: wealth data (1995)

About 16% of the heads of households were female (Table 3.7). The majority of these heads of household were engaged in some kind of activity to earn money for their families. Most of them were engaged in farming or in their own business of selling food and other items at the local market or near their residence.

The majority of households (61%) were engaged in farming, but 96% of this was subsistence farming (Table 3.7). Maize was the predominant crop produced in Boane. Among other crops produced were beans, cassava, and vegetables such as tomatoes and onions. Cereals were grown predominantly during the rainy season and vegetables at the end of the rainy season.

About 6% (347) of households kept cattle, goats or pigs. The total number of goats reported in Boane was 1260 and among households that kept goats the average number kept was 11. Cattle were the third most frequently reported animals; 74 households had cattle. The total number of households that reported having animals and the average number of animals per household can be seen in Table 3.7. The study did not collect information about other small animals such as chickens, ducks and pigeons, because almost all households kept a relatively small number of them, mainly for household consumption.

The survey collected information about religious faith (Table 3.7). Christianity had the majority of adherents (76%); among these, the Zion faith (a Christian evangelist denomination) was the most commonly reported faith followed by Catholicism. 23% of the people who were interviewed did not declare any religious faith.

3.4.3. Knowledge, attitudes and practices concerning malaria and the mosquito vector

When households were asked about their health problems, 4,983 out of 5,640 respondents (88%) identified malaria as one of the principal diseases in Boane. This was followed by diarrhoea. It was interesting to note that scabies was one of the 10 main health problems. The distribution of diseases is summarised in Table 3.8.

Awareness of mosquito bites appeared to be universal. Nearly three quarters of the respondents (73%) said that they received too many mosquito bites (Table 3.8). When the respondents were asked what disease a mosquito transmits, 61% mentioned malaria and symptoms associated with malaria such as headache, body weakness and fever. Less than 50 respondents (under 1%) thought that mosquitoes cause skin diseases, such as body rash and pruritis, and similarly, few thought that mosquitoes cause diarrhoea.

When they were asked about the breeding sites of mosquitoes, over half of the respondents identified water as the breeding site of mosquitoes (54%) (Table 3.8). Other mosquito breeding sites reported were dust (16%) and latrine pits (less than 2%).

Household mosquito protection was investigated. In general all households protected themselves against mosquito bites. Naturally available products such as burning leaves (especially *Eucalyptus spp* leaves), and animal dung (especially cow-dung) were used the most often (35.6%). A small proportion of people (less than 2%) reported burning rubber, old sisal bags and other materials. More than 45% of the households reported the use of products that they had purchased. Among these users, 35% reported the use of mosquito coils, 10% the use of insecticide in cans and only 0.4% the use of bednets (Table 3.8).

Table 3.7: Background socio-economic information about the Boane community

	N=5640
The heads of household	
Male	73%
Female	16%
No information	10%
Farm ownership	
YES	61%
Type of farming	
Subsistence	96%
Cash crops	4%
Animals	
Yes	6%
Goat	4%
Cattle	1%
Pig	1%
Total animals kept	11
Goat (mean per household)	11
Pig	7
Cattle	
Religion	
Zion	30%
Catholic	12%
Twelve Apostles	9%
God Assembly	4%
Muslim	2%
Other Christian	20%
No Religion	23%

Source: survey 2: knowledge, attitudes and practice concerning malaria (1995)

Table 3.8: Knowledge, attitudes and practice regarding malaria

	N=5640
Five principal diseases perceived by households	
Malaria	88%
Diarrhoea	40%
Respiratory infection	23%
Scabies	5%
Asthma	4%
Perception of mosquito bites	
Too many	73%
Not many	20%
Few	6%
Knowledge of what disease mosquitoes transmit	
Malaria	61%
Knowledge about mosquito breading sites	
Water	54%
Dust	16%
Pit latrines	2%
Protection against mosquito bites	
Burning herbs, animal dung	36%
Mosquito coils	35%
Insecticide in cans	10%
Bednets	0.4%

Source: survey 2: knowledge, attitudes and practice concerning malaria (1995)

3.4.4. Knowledge, attitudes and practice regarding bednets, and willingness to pay for an ITN

More than half of the households interviewed said that they had heard about bednets before (62%). The main purpose of using a bednet was investigated. The majority of respondents (60%) reported that the principal reason for using a bednet was to protect themselves against mosquito bites. Very few (1%) associated the use of bednets with malaria prevention, and 40% of the respondents did not have an opinion about the importance of using bednets (Table 3.9).

Less than 0.5% (21) of the households had a bednet at home (at the time of the interview). However, only seven of the twenty-one households had slept under a bednet during the night immediately before the interview. Among those who had slept under bednets the previous night, in four households the parents had used the bednets, in two the children had used them, and in one both parents and children had used them (Table 3.9). The reason that the people who owned bednets had not slept under them was not recorded during this survey.

Before the end of the interview information regarding the importance of ITNs was provided to the households, and a net was shown to them. A question about colour preference was asked. A choice of three colours - white, green and brown - was offered. Green was the most preferred colour (44%), followed by brown (Table 3.9). This information was used later to import bednets according to the colour preference.

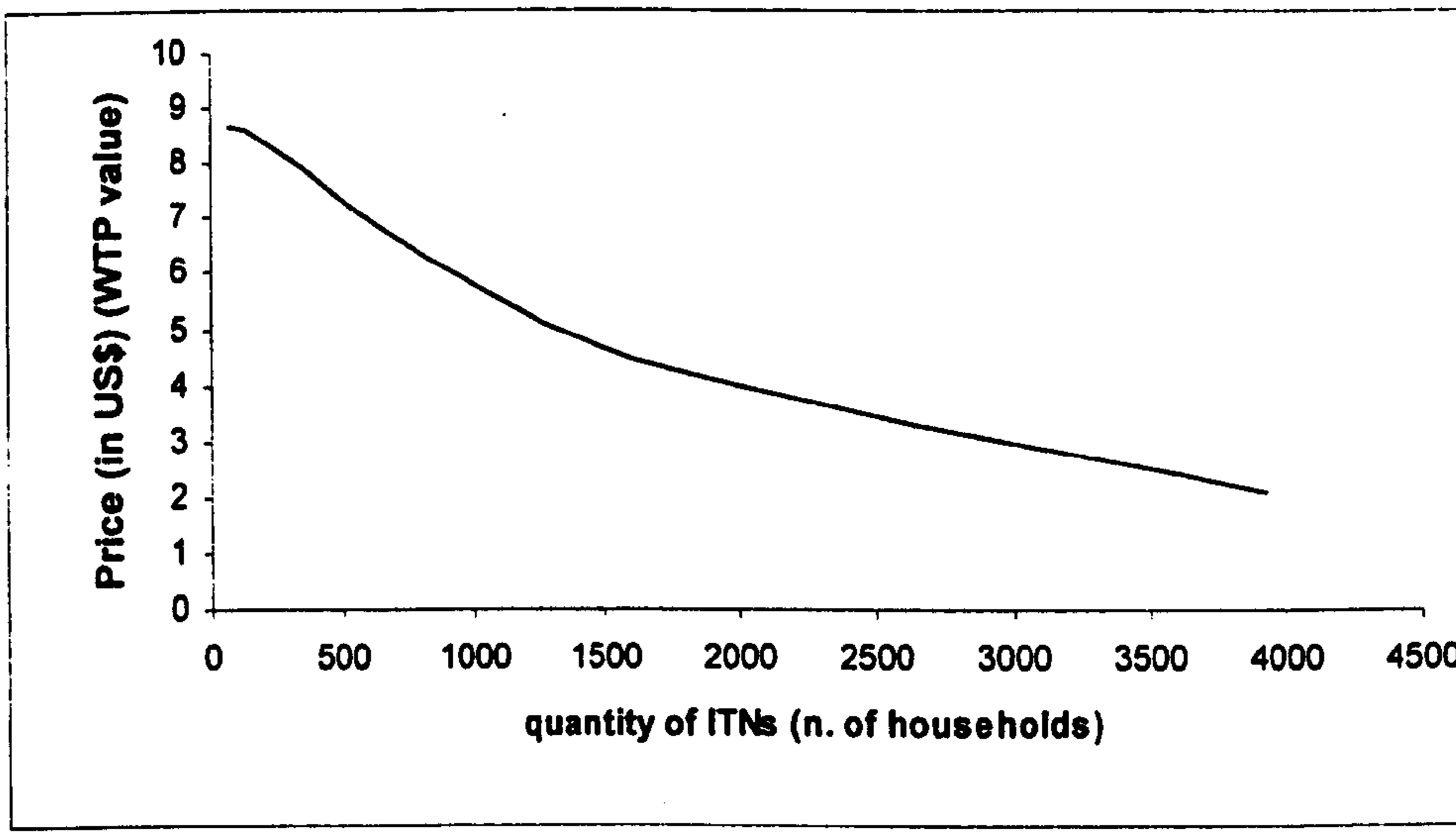
Households were all asked if they would be interested in buying ITNs if they were made available. Almost all of them (99.3%) responded affirmatively. An open question about how much they were willing to pay for one ITN was asked. Figure 3.4 shows a hypothetical demand curve of bednet purchase based on the households' willingness to pay for one ITN (it does not explore the WTP for more than one ITN). The X axis is the number of households, which is equivalent to the number of bednets and the Y axis is the willingness to pay, in terms of the price of bednets. As can be seen in Figure 3.4, the majority of households were willing to pay no more than $2.10. The mean willingness to pay was $1.80 and the median $1.30. Very few households were willing to pay $9 or more for an ITN.

Table 3.9: Background information about Bednets

	N=5640
Have heard about bednets before	
Yes	62%
What is the purpose of using a bednet	
Protect against mosquito bites	60%
Protect against malaria	1%
No idea	40%
Number of households with at least one bednet at home	
Yes	0.4%)
Number of households who used the net during the previous night	(33.3%) (7/21)
Who slept under the bednet	
Parents only	4
Children	2
Parents and children	1
Colour preference of Insecticide treated net	
Green	44%
Brown	35%
White	20%

Source: survey 2: knowledge, attitudes and practice concerning malaria (1995)

Figure 3.4: Hypothetical demand curve based on the results of WTP for an ITN before the implementation of the ITN project in Boane – 1995.



Total households=5640. The X axis represents the number of households, which is equivalent to the number of bednets (each household is equivalent to one bednet; the Y axis represents the willingness to pay price that the household was willing to pay.

Source: survey 2: pre-implementation willingness to pay survey (1995)

3.4.5. Malariometric indices

During the pre-intervention parasitological survey, 3514 persons were examined in February 1996. The malaria parasite rate in February was 72.3%. Of the 2542 positives, 2189 showed one species, and 353 showed two species. It was observed that *P. falciparum* infection accounted for 69.6% of total slides, and 96% of total positive slides (Table 3.10).

Table 3.10: Malaria parasite prevalence in Boane (February of 1996)

	February N=3514
Malaria parasite rate	
Negative	972 (27.7%)
Positives	2542 (72.3%)
1 species	2189 (62.3%)
2 species	353 (10%)
Malaria parasite Prevalence by species (N=3514)	
P. falciparum	2444 (69.6%)
P. malariae	425 (12.1%)
P. ovale	26 (0.7%)

Source: survey 3: malariometric indexes (1996)

Table 3.11 shows the malaria *P. falciparum* prevalence in the residential areas. The overall *P. falciparum* prevalence in February was 69.6%. As can be seen from the Table, in February it varies from 57.8% in Bairro 3 to 79.7% in Massaca 2 (χ^2= 52.9; p<0.001).

Table 3.11: Prevalence of *P. falciparum* by residence area in Boane - February 1996

Residence area	Positives	TOTAL (N)
Massaca 2	80%	207
Radio Marconi	74%	532
P.S.Kankhomba	74%	300
Umpala	73%	304
Massaca 1	71%	308
Bairro1	70%	239
Bairro 4	69%	263
Bairro 5	68%	166
Bairro 2	68%	284
Bairro 7	67%	383
Bairro 6	60%	232
Bairro 3	59%	296
Total	70%	3514

Source: survey 3: malariometric indexes (1996)

Because in endemic areas malaria immunity is an important risk factor, and is related to the age of the person, the population under study was stratified according to age in five different age groups: 0-1 year, 2-4 years, 5-9 years, 10-14 years and 15 or more years old. The highest parasite rates were observed among the 5-9 year old age group (81%). The lowest parasite rate was observed in those fifteen years old or more (55%). There was a significant difference in parasite rates among the age groups (χ^2=222, p<0.0001) (Table 3.12). There were no differences between males and females with regard to malaria parasite prevalence (data not shown). The geometric mean of *P.* falciparum density was 835/µl. A progressive decrease of geometric *P. falciparum* density was observed with the increase of age (Table 3.12). About 9% (306/3514) of the population were gametocyte carriers. The gametocyte prevalence decreased with the increase of age: 17% of children below 1 years old had gametocytes compared to 5% of adults (Table 3.12).

Table 3.12: Prevalence of *P. falciparum* by age group in Boane (February 1996)

Age group (years)	Total	% of Positives	*P. falciparum* Asexual density Density (95% CI)	*P. falciparum* gametocytaemia (%)
0-1	262	61%	2,604.5 (403-16,317)	17%
2-4	566	76%	1,941.0 (445-9,897)	12%
5-9	808	81%	1,230.2 (298-5,431)	11%
10-14	819	76%	633.9 (148-2,208)	6%
>=15	1059	55%	285.7 (81-897)	5%
total	3514	70%	835 (181-3,641)	9%

Source: survey 3: malariometric indexes (1996)

The spleens of 2,299 persons were examined. There were 486 (21%) people with splenomegaly. The prevalence of splenomegaly was highest at age 2-4 years (31%), and lowest in adults (9.3%) (χ^2=67.36; p<0.001) (Table 3.13). A cross tabulation analysis between *P. falciparum* positives and splenomegaly was undertaken. There was a higher prevalence of splenomegaly among the people infected with *P. falciparum* (χ^2=14.95, p<0.001) (Table 3.14).

Table 3.13: Spleen rate by age group in Boane, February 1996

	% of Positives	Total
Age group (years)		
0-1	21%	196
2-4	31%	424
5-9	24%	619
10-14	21%	576
>=15	9%	489
total	21%	2299

χ^2=67.36; degrees of freedom=4; p<<0.001

Source: survey 3: malariometric indexes (1996)

Table 3.14: *P. falciparum* and splenomegaly

P. falciparum	Splenomegaly		Total
	Negative	Positive	
Negative	533	100 (15.8%)	633
Positive	1280	386 (23.2%)	1666
Total	1813	486 (21.1%)	2299

χ^2=14.95 p<0.0001. Source: survey 3: malariometric indexes (1996)

Blood samples for a haematocrit examination were collected from 1,377 persons. The mean of haematocrit was 33.4% (SD=5.1%) and the median 34%. The distribution of haematocrit was used to estimate anaemia levels in the study population. All people with haematocrit equal to or higher than 30% were considered normal, while those below this point were considered anaemic (Bouvier *et al.* 1997). Table 3.15 summarises the haematocrit data by age group. The level of anaemia prevalence decreased steadily with the increase in age. Children below five years old had the highest anaemia prevalence (42%) while adults had the lowest prevalence (7%) (χ^2=95.9, p<0.001).

Table 3.15: Proportion of anaemia by age group in Boane, February 1996

	Haematocrit <30	Total
Age group (years)		
0-1	42%	114
2-4	28%	230
5-9	23%	388
10-14	11%	368
>=15	7%	277
total	19%	1377

χ^2=95.9; degrees of freedom=4; p<0.001

Source: survey 3: malariometric indexes (1996)

People infected with *P. falciparum* had a higher prevalence of anaemia (21%), than those who were parasite free (14%) (χ^2=11.26 p<0.001) (Table 3.16).

Table 3.16: *P. falciparum* and anaemia

P. falciparum	Haematocrit		total
	<30%	>=30%	
Negative	356	56 (14%)	412
Positive	759	206 (21%)	965
Total	1115	262 (19%)	1377

χ^2=11.26 p<0.001

Source: survey 3: malariometric indexes (1996)

Axillary temperature was collected from 3514 people studied; 656 (18.7%) had a measurable fever (axillary temperature >=37.5°C) at the time of examination. The youngest age group had a greater fever prevalence (28.6% of children below one year old) than the children (12.3%) age fifteen years or more (χ^2=56.7, p<0.0001) (Table 3.17). Fever was associated with *P. falciparum*; 75.3% of the people with fever were infected (494/656), and 68.2% of people without fever (1950/2858) (χ^2=12.6, p=0.0003).

Table 3.17: Prevalence of fever in Boane (February 1996)

	N	% of Positives
Fever by age group (years)		
0-1	262	29%
2-4	566	22%
5-9	808	22%
10-14	819	18%
>=15	1059	12%
total	**3514**	**19%**

Source: survey 3: malariometric indexes (1996)

3.5. Discussion

3.5.1. Demographic information

The characteristics of the population in Boane revealed by the present study are similar to those enumerated in the most recent census (Instituto Nacional de Estatistica, 1997a).

The population, age and gender distribution are similar to those in other developing countries. The household economy of Boane rests largely on subsistence farming, although a few households also keep animals. The majority of people live in huts, and therefore most of them can be considered to be poor. This finding has a tremendous implication for future strategies to be adopted in Boane, if ITNs are to be sold.

3.5.2. Knowledge, attitudes and practice regarding malaria

In Boane malaria was recognised by most households as a principal health problem. This conforms with the hospital data, which also suggests that malaria is the principal disease in Boane.

In Boane, more than half of the households interviewed considered mosquitoes to be a cause of malaria, and less than 2% associated mosquitoes with other diseases such as scabies. Aikins (1994) reported that in Ghana, Guinea-Bissau and Sierra Leone nearly half of the respondents also associated malaria with mosquitoes. Similar findings were also observed in Baringo (Kenya), where 58.5% of the respondents believed that malaria is caused by the mosquito (Munguti, 1998).

In Boane the majority of households mentioned the use of a number of mechanisms to avoid mosquito bites. More than 35% of households burnt some form of local leaves and animal dung to produce smoke and to drive mosquitoes out of the room. Similar findings were observed in a study conducted in Maputo where burning substances was one of the most frequently used methods of avoiding mosquito bites (Dgedge *et al.* 1994a). The use of burning substances as a mosquito repellent is common in Africa. Many authors have reported similar practices in other areas (Aikins *et al.* 1993; Aikins *et al.* 1994, Ongore *et al.* 1989; Ziba, *et al.* 1994, Stephens *et al.* 1995).

Mosquito coils were the product most often purchased for repelling mosquitoes and were widely used in Boane. Very few households purchased insecticide in cans and almost no households had bednets at the time of the interview. Thus, the Boane population had almost no experience of sleeping under bednets.

Proper education about the importance of ITNs needs to be developed, because less than 1% of the people thought that ITNs would protect them from malaria, although about 60% thought that bednets would protect them from mosquito bites. Assessment of the few bednet-owning households identified at the time of the interview, showed that adults were more likely to sleep under a net than children, but that only 38% of the nets were actually in use. However, the interview was conducted during the dry season, when there is a large reduction in the number of mosquito bites, which may explain the relatively low usage. Similar findings were observed in The Gambia (Aikins *et al.* 1993).

Studies on knowledge, attitudes and practice indicate the potential methods to be used to generate practical ways of promoting and improving malaria prevention and control at individual and community level (Klein *et al.* 1995). The present study identified some of the important areas of misconception, as well as lack of knowledge and patterns of behaviour that interfere with efforts to control malaria. In this study it was found that malaria is perceived by the community as one of their principal health problems; however, it was also found that the tools that the community are using are not sufficient for the control of malaria.

To succeed in implementing malaria control measures, such as ITNs and adequate promotional campaigns, it was thought that local experiences and concerns should be taken into consideration, such as building awareness and reinforcing the desire of the people to use adequate tools (such as ITNs) to protect themselves from the already perceived problem of mosquito bites.

It has been said that the success of malaria control relies on community participation (Carnevale and Coosemans 1995, Service 1993, Sexton 1994, Marsh *et al.* 1996). This study showed that to make communities aware of the steps necessary for the control of the disease in their area, information, education and communication of malaria-related problems and control measures, need to be addressed. Reinforcing the knowledge that some members of the community already have, and providing information to those who do not know that malaria is transmitted by mosquitoes, will be important in order to get community support for vector control by using ITNs. This information was used to design the promotional campaign (see Chapter 4).

An important result of the Boane study was the information that the households' mean willingness to pay was less than $2. This price is lower than the factory cost of a bednet.

Chapter 5 will discuss the influence that the households' willingness to pay had on the demand for ITNs before the implementation of the project.

3.5.3. Malariometric indices

Malaria prevalence can be considered high in Boane. More than 70% of the people living in Boane had parasites in their blood. The malariometric indices observed in Boane, as expected, showed little difference from other regions with a similar malaria epidemiology background.

In this preliminary data collection it was observed that *P. falciparum* infection is associated with anaemia. Many previous studies have found a similar association (Hedberg *et al.* 1993, Abdalla *et al.* 1980, Woodruff *et al.* 1979).

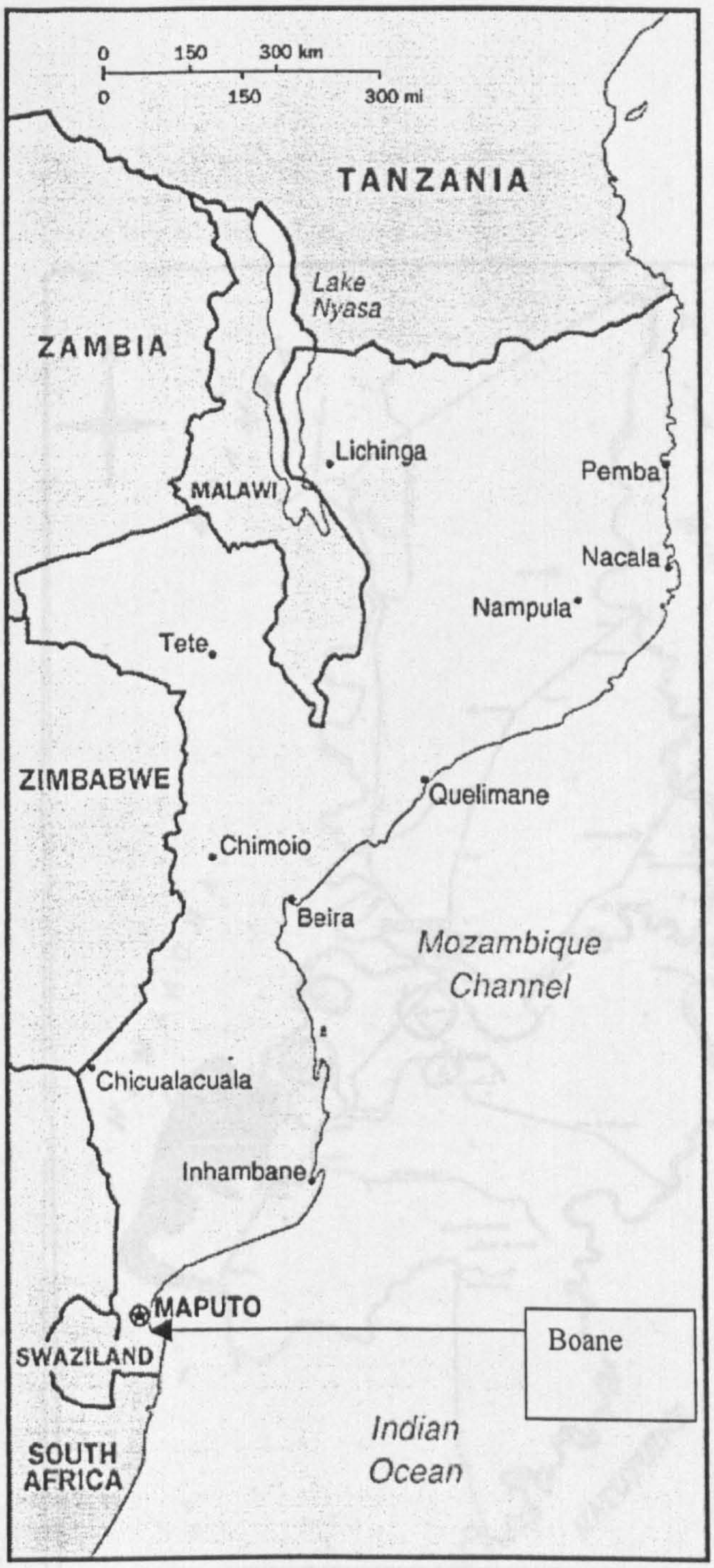
The results of the study showed that the great majority of people were clinically asymptomatic at the time of testing. Such findings are observed in areas of endemic malaria. Similar results were observed in Liberia (Jackson (1985). This result suggests that reliance on parasitological data is insufficient for a valid diagnosis of clinical malaria. In areas where malaria is endemic, with considerable levels of acquired immunity, asymptomatic malaria is common and fever due to other diseases may occur concomitant with *P. falciparum* infection (McGuinness *et al.* 1998). Thus the diagnosis of malaria based on malaria parasites and fever may lead to over-diagnosis.

3.6. Conclusion

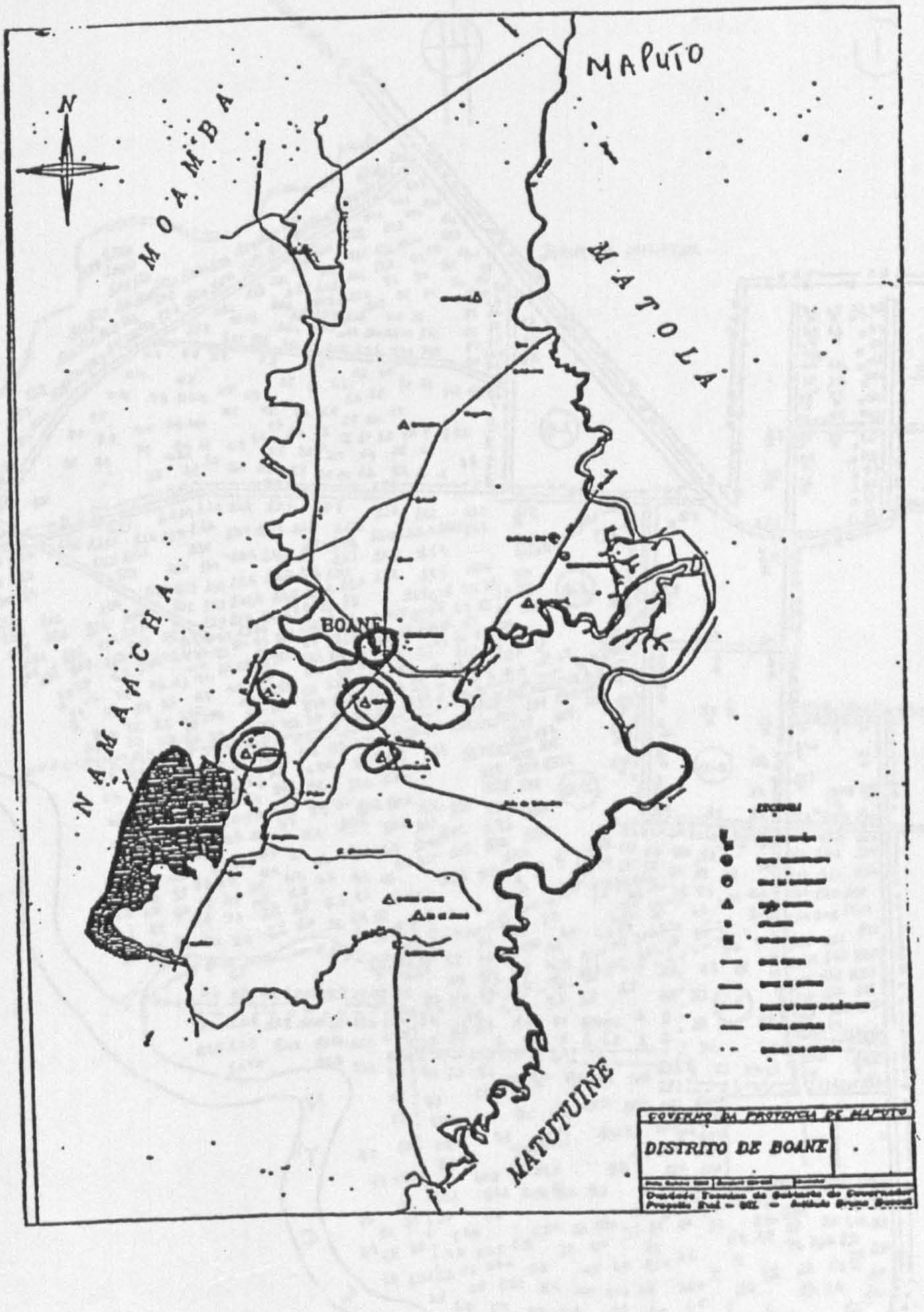
From the data collected in this study it was seen that the majority of the population live in poor economic conditions. This information will be useful in analyses of the issues of the sustainability and equity of ITN programmes based on the Boane study. The information about the availability of ITNs in Boane and about the knowledge, attitudes and practices of the people in relation to malaria will guide the promotional strategies which need to be developed in Boane. Although the majority of households would like to buy an ITN, the median price they were willing to pay for an ITN was less than $2. The high prevalence of malaria will call attention to the need to introduce malaria control measures. Thus, the introduction of an ITN programme in Boane seems to be appropriate.

Chapter 4 will describe the implementation of the ITN project in Boane and the factors associated with the demand.

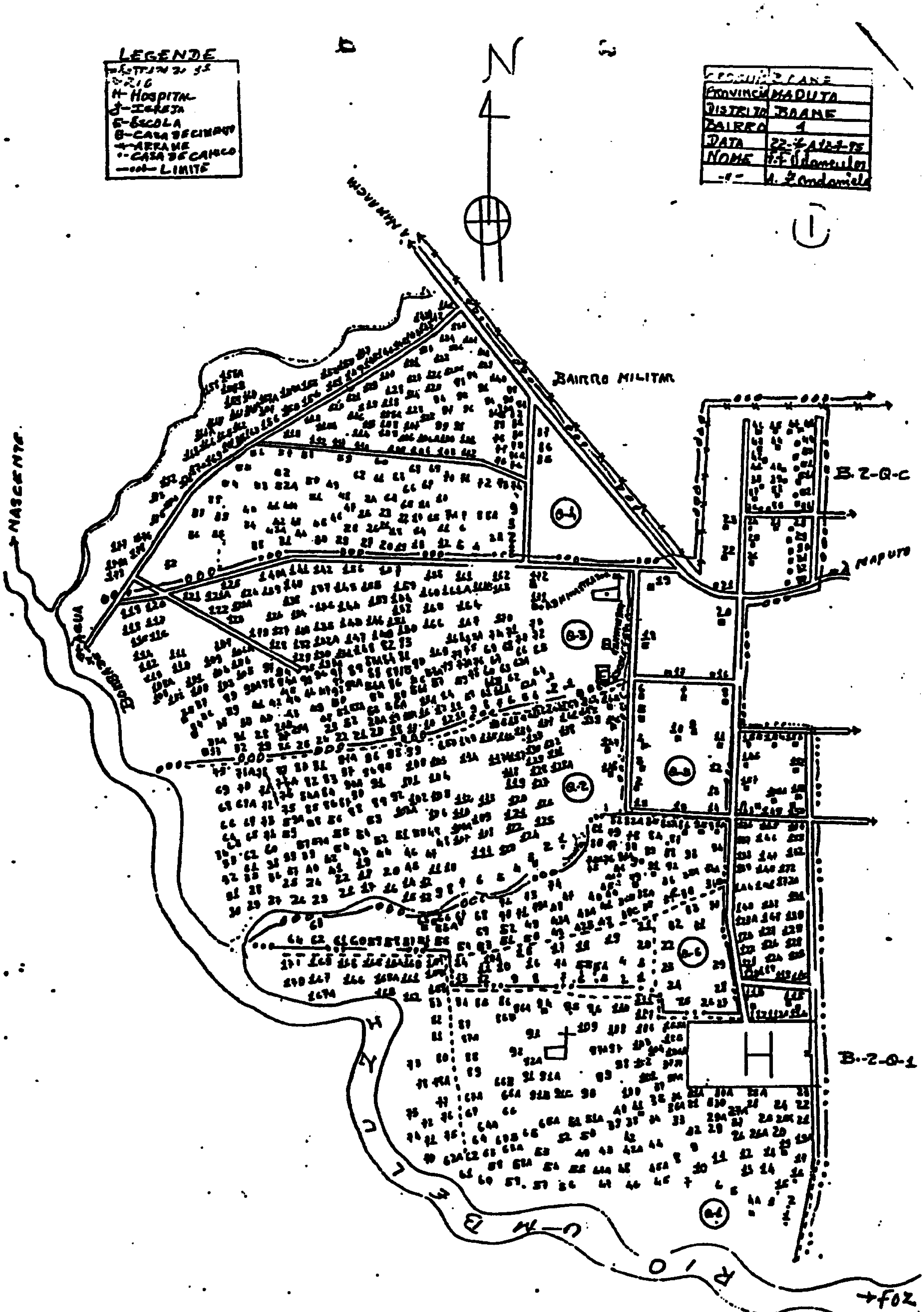
Map 3.1: Location of the study area



Map 3.2: The Boane study area



Map 3.3: Hand Map of one of the "bairros" of the study area



CHAPTER 4: DEMAND, COVERAGE AND ACCEPTABILITY OF ITNs AND RETREATMENT IN BOANE

4.1. Introduction

The baseline information of the study area described in Chapter 3 showed that there were not only no insecticide-treated bednets, but almost no untreated bednets in Boane before the implementation of the ITN project. This chapter will present the results of the implementation of that project in the primary health care system of Boane district.

The use of ITNs has proved to be an effective tool for the control of malaria (Alonso *et al.* 1991, Binka *et al.* 1996, Goodman *et al.* 1999), a tool which can be incorporated into primary health care (Chavasse *et al.* 1999). However, in Mozambique ITNs have never been used before, and thus the people in Boane may not perceive the need for ITNs. For that reason, simply making ITNs available and accessible will not necessarily bring about their use in Boane or elsewhere in Mozambique.

Plans for large-scale implementation have been considered in Mozambique, and some international agencies such as UNICEF and WHO are willing to support the introduction and expansion of ITN programmes all over the country. However, many ITN projects have taken place under trial conditions, and therefore it is still not well understood how the results of efficacy trials can be translated into the national control programme activities (Lengeler and Snow 1996). Thus, before incorporating the use of ITNs into the malaria control programme in Mozambique, the question of how to achieve widespread publicity and coverage among the population most at risk needed to be addressed.

The objectives of this chapter are as follows:

-To determine the socio-economic factors associated with the demand for ITNs,

-To determine the malaria epidemiological factors associated with the use of ITNs,

-To determine the feasibility of implementing the ITN project throughout the primary health care system.

A pilot ITN study was implemented through the primary health care system in Boane District, Mozambique from 1996 until 1998. This chapter will examine the ITN implementation process, activities of the project, the response of the community as to demand, the coverage which was achieved, and the acceptability of ITNs in relation to socio-economic factors and malaria epidemiology. This information will guide the discussion about the policy issues related to a large-scale implementation of the ITN programme in Mozambique, particularly with regard to the equity of the distribution of ITNs among socio-economic groups, which will be discussed in chapter 8.

4.2. Methodology

Chapter 3 provided information regarding the availability of bednets in the community, and the socio-economic background of the households. This information will be important to understand the demand for ITNs and the coverage which was achieved in Boane.

This section describes the supply and promotion of ITNs, bednet treatment and retreatment, and the monitoring of ITN demand and acceptability as well as the socio-economic factors of malaria epidemiology associated with demand and coverage.

4.2.1. Supply and delivery of ITNs

Bednets were purchased from the Siamdutch Company in Thailand. The netting was made of knitted 100% polyester; all the bednets were 100 denier (this describes the strength of the yarn). About 2,000 bednets were purchased during the first year of the project. They came in two sizes (single and double) and three colours (white, green and brown). An additional 2000 ITNs were purchased at beginning of the second year of the project. They came in two sizes (single and double) and two colours (white and green).

The ITNs ordered by the project were sent to Maputo. Nets and insecticide were stored at the National Institute of Health (INS), a research institute, in Maputo. From Maputo, the nets and insecticide were delivered to the Boane District Health Centre. An agreement between the project and the Provincial and District directorate of health was secured for the use of the district pharmacy of Boane to store the nets and the insecticide as well for the involvement of their personnel.

The supply of bednets and insecticide were sufficient to meet the demand in Boane until November of 1996 when a shortage of bednets developed. Regular supplies of bednets and insecticide were only received again in Boane from June 1997 onwards. Transport from the INS was used to deliver the nets and insecticide to Boane. The distance between these two areas is about 30km. At the health centre adequate space was found to store the nets and insecticide. The district health authority appointed a person to be responsible for the storage and delivery of the nets to the health posts.

Forms for recording stocks and delivery of nets at each level (INS and district) were designed and filled out by the administrative staff of the INS and the Boane health centre. Reports of nets in stock and deliveries were prepared monthly.

4.2.2. Bednet treatment process

Nets were treated with Lambdacyalothrin (*Icon*®). The insecticide for treatment and retreatment was donated by *ZENECA* (the company that produces the insecticide). Three people treated the bednets regularly at the health centre. One came from the National Institute of Health (INS), another from the health centre and the third from the community. The treatment dosage was $15 mg/m^2$ of netting. The concentrate was added to water in a plastic container of 20/l. The people treating bednets were protected with rubber gloves and glasses to minimise the side effects, such as eye and skin irritations..

Bednets for treatment were kept in the storage room in the Boane Health Centre. The head of the pharmacy regularly sent an adequate quantity of bednets for treatment according to the demand and the stock of nets already treated.

The treatment took place in the laundry room of the health centre. The bednets were dried in a vertical position under the roof of the laundry. The bednets were treated on a weekly basis, or as needed. About 50 nets were treated at one time.

Only nets already treated were available for sale.

4.2.3. Establishment of the ITN price

The price at which the ITNs would be sold to consumers was established based on the factory and delivery (to Maputo) cost of the nets and insecticide. The selling price was equivalent to US$4.70 for the single size and US$5.50 for the double size (the exchange rate in 1996 was: US$1=11,800MT, Mozambican currency).

4.2.4. Sale of the ITNs and financial management of the receipts

The pharmacy at the health centre and two health posts were chosen as the points of sale. At the health centre a full-time person was employed by the project to sell the ITNs, and to update the files concerning the selling process. At the health post, the nurses heading the health post were responsible for selling the ITNs. These persons worked closely with the head of the pharmacy, who was responsible for the entire selling process.

At the beginning of the second year of the implementation of the project, eight activists were selected by community members, according to their residence area, to promote and sell the ITNs. All of them attended a short course organised to introduce them to the activities. Each of them had the responsibility to increase the demand for ITNs, to promote the use of ITNs among children and to remind people to come back for retreatment as soon they washed their nets. Each activist received 10-15 ITNs (already treated) from the clinic to sell in their communities. As soon they finished and accounted for this initial allocation, they received more ITNs. Activists who failed to account for the ITNs they had received were fired. All the activists received one week of training and an ITN manual for consultation (Appendix 4.1). The manual was specifically written for the Boane project, and was tested for understandability before it was distributed. All activists received a monthly subsidy.

Only people living in the study area were allowed to buy ITNs. People had to bring the card given to them during the last census in order to buy ITNs. It was expected that not more than 3 nets per family would be allowed; however, the actual number was adjusted according to the size of the household checked on the card.

The people in charge of selling ITNs at the health units, as well as the activists, recorded the number of ITNs sold, the colour and size, and the number of the residence area of the buyer, as shown on their census card. This form was used to check how many people were buying ITNs, to facilitate the identification of these people in future surveys, to verify their use of the ITNs and to collect further data.

During the first year around 2,000 nets were available and the same number during the second year.

Residents were instructed on how to use the ITNs at the time that they bought them. They were advised to always use the ITNs while sleeping. Residents were told that they must not wash the ITNs before the retreatment period, and that if they did, they should come to the health centre for retreatment.

The management of the money collected was under the responsibility of the District Health Director. The head of the pharmacy collected the money from the different selling points and reported to the financial administrator of the health centre. The financial administrator had a book in which to record all the money received and he reported to the District Health Director. The money collected from the sales was banked in an account in the name of the health centre. The funds were used to order more nets and to pay for services related to the sale process. The book of accounts was kept in the administrative section of the district health centre. The treasurer of the district was responsible for depositing and withdrawing money. In order to withdraw money from the bank a cheque had to be signed by the District Director and by one or two staff members of the health centre, in accordance with the health centre regulations.

4.2.5. Promotion process

MUXIQUITELA (Muxiquitela means a weeding veil) was the brand name chosen and used for the dissemination of information and for the promotion of the ITNs. This name was obtained by means of consulting the local people (in focus group discussions), and after a preliminary test to see if that brand name was attractive to the people. Because of the similarities between the bednet and the veil, people in Boane used to call MUXIQUITELA (the veil) the bednet brought to Boane by the miners working in South Africa.

The ITN sale process was promoted by means of information, education and communication. These activities included using theatre, posters (Appendix 4.2) and a health education campaign. Posters, T-shirts and hats with a logo were produced and distributed. A book (pre-tested) for health workers (Appendix 4.3) was produced, which they used for consultation. A booklet (pre-tested) (Appendix 4.4) to accompany the ITNs which were sold was also produced.

Demonstrations of how to use ITNs were conducted in the community. A car with megaphones was used to disseminate the information throughout the study area.

House-to-house visits were also used to encourage the sale of the ITNs. People were invited to meetings, to share their own experiences in using the ITNs, and to discuss the constraints against the use of ITNs including the price.

There were demonstrations of how to use bednets at the selling points, at the health centre, and at village meetings. Key community leaders and staff of the project conducted the marketing process.

The reasons for using ITNs were emphasised, stressing how they protect the user from malaria and from the mosquito nuisance and how they can reduce the number of many other types of insects. The message about the use of ITNs to avoid malaria was used in order to encourage people to continue sleeping under an ITN even when there were not many mosquitoes. Messages were designed to encourage people to prioritise the purchase of ITNs, in order to persuade people to rank them in importance along with such pleasures as alcohol. The message was to encourage people to spend money on acquiring bednets even at times when cash was short.

A theatre group already existing in Boane was invited to present a play. The principal messages incorporated in the play were the reasons for using and buying ITNs, the responsibility for maintaining the ITNs properly, the importance of using ITNs every night throughout the year, the repair of the nets, the importance of washing the nets only before retreatment, and the need for annual retreatment, by January and February. The play was specifically written for the Boane project (Appendix 4.5). Performances began 6 months after the project started. The group performed in different places, such as schools, residential areas and health centre.

Methods of communication such as radio, newspaper and television were avoided in order to prevent people in other areas from learning about the ITNs as they might come to buy them.

4.2.6. Data collection

Different surveys were undertaken to collect data. Table 4.1 presents the results of these surveys, their objectives and information about when the survey was done.

Table 4.1: Surveys conducted to collect data during the intervention

Survey	Objective	Time
1: Demand for ITNs	To quantify the number of ITNs purchased	May 1996 to May 1998
2: Malaria epidemiological factors		
a) mosquito collection	To quantify the mosquito density and the demand for ITNs	May 1996 to May 1998
b) cross-sectional parasitological surveys	To measure the impact of ITNs in some malaria epidemiological factors	September 1996 February 1997 September 1997 February 1998
3: Retreatment	To determine the retreatment rate	February 97 February 98
4: Focus Group discussion	To determine the household's priorities To determine the sleeping patterns	June 1997
5: Cross sectional acceptability and usage of ITNs survey	To determine the acceptability and usage of ITNs	March 1998
6: Mapping ITNs distribution	To map the ITNs geographically	June 1997 to May 1998

4.2.6.1. Survey 1: Monitoring demand and coverage

A) Monitoring demand

Almost all the individuals coming to buy ITNs had to provide information that was requested in a sales questionnaire. The information that was collected consisted of data related to the place of the sale, the responsibility for the sale, the name, sex and residence of the buyer, the number of ITNs bought according to colour and size, and the amount of money paid (Appendix 4.6).

Data about the demand for ITNs was collected from the sale forms. Every month all the people involved in selling the ITNs (the head of the pharmacy, the nurses at the health posts, the activists) sent their forms to the INS for data processing.

B) Monitoring coverage

In order to determine the coverage of the ITN project, the files containing information about the ITN purchases, and the census files, were merged. Statistics concerning the coverage achieved with the ITNs were generated from the merged file. The coverage was calculated according to household and residential area, total population, number of children under five years of age, and socio-economic level.

The census undertaken during the pre-intervention data collection was updated in order to allow people who did not receive their cards during the first census to get one.

4.2.6.2. Survey 2: Monitoring ITN demand and use, and malaria epidemiological factors

A) Monitoring demand and mosquito density

i: Mosquito data collection

The true extent of the nuisance caused by mosquitoes was studied. The objective of the entomological survey was to assess the number of mosquito bites per month and the demand for ITNs.

Mosquitoes were collected twice a month from May 1996 to May 1998, using human-biting catches (WHO, 1975). Each collection consisted of simultaneous indoor and outdoor captures with two mosquito collectors stationed inside and two stationed outside the houses, working alternate 3 hour shifts from 18.00 to 06.00 hours. Only households without ITNs were selected for the collection of mosquitoes.

The collected mosquitoes were transported to the INS laboratory and all *Anopheles* mosquitoes caught were identified morphologically according to the keys provided by Gilles and Coetzee (1987).

Man-biting rates were calculated as the number of mosquito bites (*A. gambiae sl., funestus* or *culicines*) per human bite per night. Biting rates were used to study the mosquito bite specifics and also the total nuisance bites due to all mosquitoes. Biting rates were used to analyse the influence of mosquitoes on the sale of ITNs over time.

ii: Meteorological Data

Meteorological data was obtained from the National Institute of Meteorology. This data was collected from the time that the ITNs began to be sold, and consisted of rainfall data, maximum and minimum temperatures each week, and the average monthly temperature. The meteorological data was used to ascertain the influence of temperature and rainfall on the sale and use of ITNs in the area.

B) Monitoring the impact of ITNs on malaria epidemiological factors by cross-sectional surveys

Baseline information on the malaria parasite prevalence was collected and monitored during the study, to detect differences in parasitological rates between people with ITNs and without.

Four community-based cross-sectional malaria parasitological surveys were conducted throughout the end and the beginning of the rainy season, during September 1996, February 1997, September 1997 and finally in February 1998. The methodology used to collect this data was similar to that described in chapter 3, during the parasitological pre-programme data collection.

The cross-sectional survey collected data related to parasite prevalence, axillary body temperature, sex, age and local residence of the person, as well as information regarding whether he/she had an ITN and had slept under the ITN during the night before the survey. Mobile teams went to the residence areas at a fixed time to collect the samples. More than 2,000 people were sampled per survey. Community leaders and research staff went to the residence areas and asked people to participate on a voluntary basis in the survey.

Blood was collected to measure haematocrit during the cross-sectional surveys conducted in September 1996 and February 1997.

During the cross-sectional surveys people were asked if they had ITNs, and if the answer was yes, if they had slept under the ITN the night before the interview.

4.2.6.3. Survey 3: Retreatment

Once a year, for a period of one month before the malaria transmission season, people were invited to bring their ITNs to the health centre or to other central points for retreatment. Before retreatment people were asked to wash their ITNs so as to bring them in clean.

The percentage of people that returned to retreat their ITNs was recorded. Those who did not come voluntarily, were visited by a team at their home, to explain the benefits of retreatment and to advise them to go for retreatment. People attending the retreatment were interviewed to find out why they were coming for retreatment.

The retreatment was charged at the price of $0.40 (40 US cents). The cost was estimated hypothetically, based on the basic cost of the Lambdacyalothrin needed to treat one net.

4.2.6.4. Survey 4: Monitoring the acceptability and usage of ITNs

A) Cross-sectional survey

A survey was conducted at the end of the study, to collect information regarding the acceptability of ITNs. The objective of this survey was to collect information related to the factors associated with the acceptability of ITNs and the coverage in Boane. About 3,800 households (about 60% of the total households in the study area) were interviewed regardless of whether they had bought an ITN.

A prepared questionnaire was used in the interview to collect the information (Appendix 4.7). The interview was conducted with the head, or a senior representative of the household. The questionnaire was pre-tested in the field before the final presentation. The questionnaires were administered by a field assistant of the INS, and interviewers were recruited from an agricultural school in the study area.

The questionnaire contained various questions such as:

a) Why the household did or did not buy an ITN, the household use of the ITNs and household priorities in the use of the ITNs.

b) The person in the household making decision to purchase an ITN

c) Financial resources used to purchase the ITN

d) Number of ITNs bought, presence of ITNs in the home, examination for cleanliness and damage, observation of whether the ITN was unfolded and used during the previous night or not, who used it during the previous night.

e) Colour and size preference

f) Complaints about sleeping under an ITN

g) Satisfaction with the use of an ITN.

4.2.6.5. Focus group discussions

The questionnaire was complemented by 6 focus group discussions among people who did buy and did not buy the ITNs. Each group discussion was between 6 to 8 people with homogeneous backgrounds in terms of education, age, marital status, sex, etc. A facilitator, who was assisted by a notetaker who recorded the proceedings, guided the groups. Also, a tape recorder was used in order not to miss any information. The discussion was conducted using a predetermined format developed by the investigator. The principal issues discussed concerned ITNs as a priority among other household commodities, such as dishes, furniture, the roof, etc. Questions as to who has priority as to sleeping under the ITN, sleeping arrangements, why people buy or do not buy ITNs, how malaria is transmitted, etc., were also discussed. Finally, a general discussion was held about the ways that people received messages about ITNs.

4.2.6.6. Survey 5: Geographical Distribution of ITNs

A digital map of the study area was drawn using two hand-held navigation systems (GPS 100SRVY II; Garmin International, Lenrxa, KS). The Boane district map was obtained from the National Geography Direction in Maputo (scale 1:10,000). The digital map of the district was digitised using MapInfo (MapInfo 4.0 1996; MapInfo Corporation, Troy, NY) software. The digital map provided a graphic representation of the locations of the households, the points of sale of the ITNs (health units and the houses of the activists), the breeding sites of the mosquitoes, the river, the roads and the railway. A database containing information about household ITN ownership and household socio-economic status was used to represent graphically the distribution of ITNs in the study area.

4.3. Results

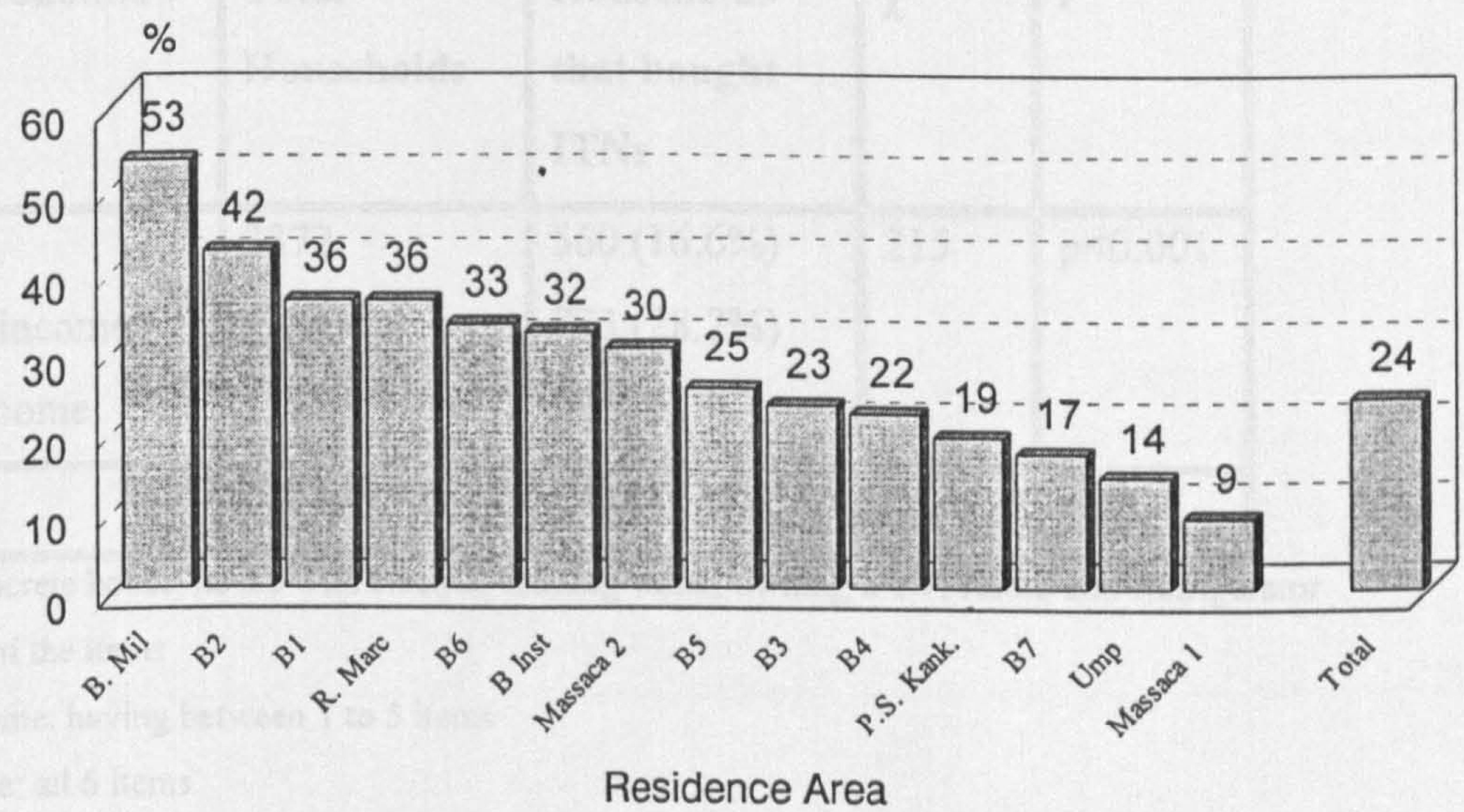
The results of this chapter will be presented in three different sections: a) demand for and coverage of ITNs and how they are associated with socio-economic and malaria epidemiological factors; b) the impact of ITNs on malaria epidemiological factors; and c) acceptability and usage of ITNs.

4.3.1. Demand and coverage of ITNs according to socio-economic factors

In 1995, before the introduction of the ITN programme in Boane, 5,829 households (93% of all households) were interviewed. Only 21 households reported having a bednet, and the coverage was 0.4% (21/5829). The total number of households that received the card during the census and the updated census, and therefore were eligible to buy ITNs, was 6,337. Two years after the introduction of the ITN programme, 3,785 ITNs had been sold. The total number of households who had at least one ITN was 1,536 out of 6,337 households. The coverage (as bednet/household) had increased from 0.4% to 24%.

Figure 4.1 presents the ITN coverage by residential area. In 1995 there were almost no bednets in Boane. After the introduction of ITNs in Boane, some residential areas achieved household coverage of more than 30% (only two were higher than 40%) (Fig 4.1).

Figure 4.1: Coverage of ITNs after the implementation of the ITN project in Boane (1998)



Source: survey 1: demand of ITNs (1996-1998)

In order to collect information on ITN coverage by socio-economic level, the census file and the sales file were merged. From the total of 6337 households that received the identification card and were eligible to buy ITNs, 6218 provided wealth information during the census. Out of the total of 1536 households that bought ITNs, 1416 provided wealth information. The new file was used to analyse the ITN coverage by socio-economic level and the ITN ratio of persons and households with ITNs.

Based on wealth, three socio-economic strata were identified. Household possession of radio, television, refrigerator, electricity, running water and houses with concrete walls were the criteria used to measure socio-economic status. Households with all of these criteria were ranked as high-income (2.4%), households with at least one, but not all of them were ranked as middle-income (43.3%), and households without any of these items were ranked as poor (54.2%). The coverage of ITNs was associated with socio-economic groups. It was observed that the higher socio-economic groups had a coverage of 55% and the lower group a coverage of only 16.6% (χ^2= 215; p<0.0001) (Table 4.2).

Table 4.2: Household ITN coverage by socio-economic group

Socio-economic Groups	**Total Households**	**Households that bought ITNs**	χ^2	***P***
Poor	3372	560 (16.6%)	215	p<0.001
Middle-income	2695	773 (28.7%)		
High-income	151	83 (55.0%)		
Total	6218	1416 (23%)		

Criteria: concrete house, house with electric, running water, owning a TV, Radio and Refrigerator

Poor: none of the items

Middle-income: having between 1 to 5 items

High-income: all 6 items

Source: survey 1: demand of ITNs (1996-1998)

Table 4.3 shows the ratio of households that had ITNs according to socio-economic groups. It can be seen that on average the households that bought ITNs bought at least two ITNs. The high-income group bought almost 3 ITNs per household.

Table 4.3: Ratio of ITN per households with at least one ITN

Socio-economic Groups	Total ITNs	Total Households with an ITN	Mean Number of ITNs per Household with an ITN
Poor	1160	560	2.07
Middle-income	1756	773	2.27
High-income	227	83	2.73
Total	**3143**	**1416**	**2.2**

Source: survey 1: demand of ITNs (1996-1998)

The ratio of the average number of people living in a household with at least one ITN was investigated. There were no differences observed across the socio-economic groups in terms of the average number of people in buying bednets per household. In other words, the fact that the richer households bought more ITNs per household was not attributable to there being more people in these households (table 4.4).

Table 4.4: Ratio of ITN per people living in a household with at least one ITN

Socio-economic Groups	Total ITNs	Total number of persons living in a house with an ITN	Mean number of persons per household with an ITN
Poor	1160	2642	2.3
Middle-income	1756	4376	2.4
High-income	227	527	2.3
Total	**3143**	**7545**	**2.4**

Source: survey 1: demand of ITNs (1996-1998)

4.3.2. Demand for ITNs by geographical location of households

Four digital maps were developed. The maps only represent the Boane village area (from Bairro 1 to Bairro7, see chapter 3). The first map contains information about ITN distribution among households in the whole study area, information related to the distribution of households with at least one ITN in relation to the points of sale of the

ITNs and the breeding sites of the mosquitoes (map 4.1). Maps 4.2 contain information related to the distribution of households with ITNs and their socio-economic status and breeding sites. Maps 4.3 and 4.4 contain information regarding the distance between the houses and the selling point or breeding site. The distance between the first ten contour lines represents 100m. From these maps it can be seen that a higher proportion of households in the high-income group had ITNs compared with the others. The maps also showed that ITNs were distributed all over the study area.

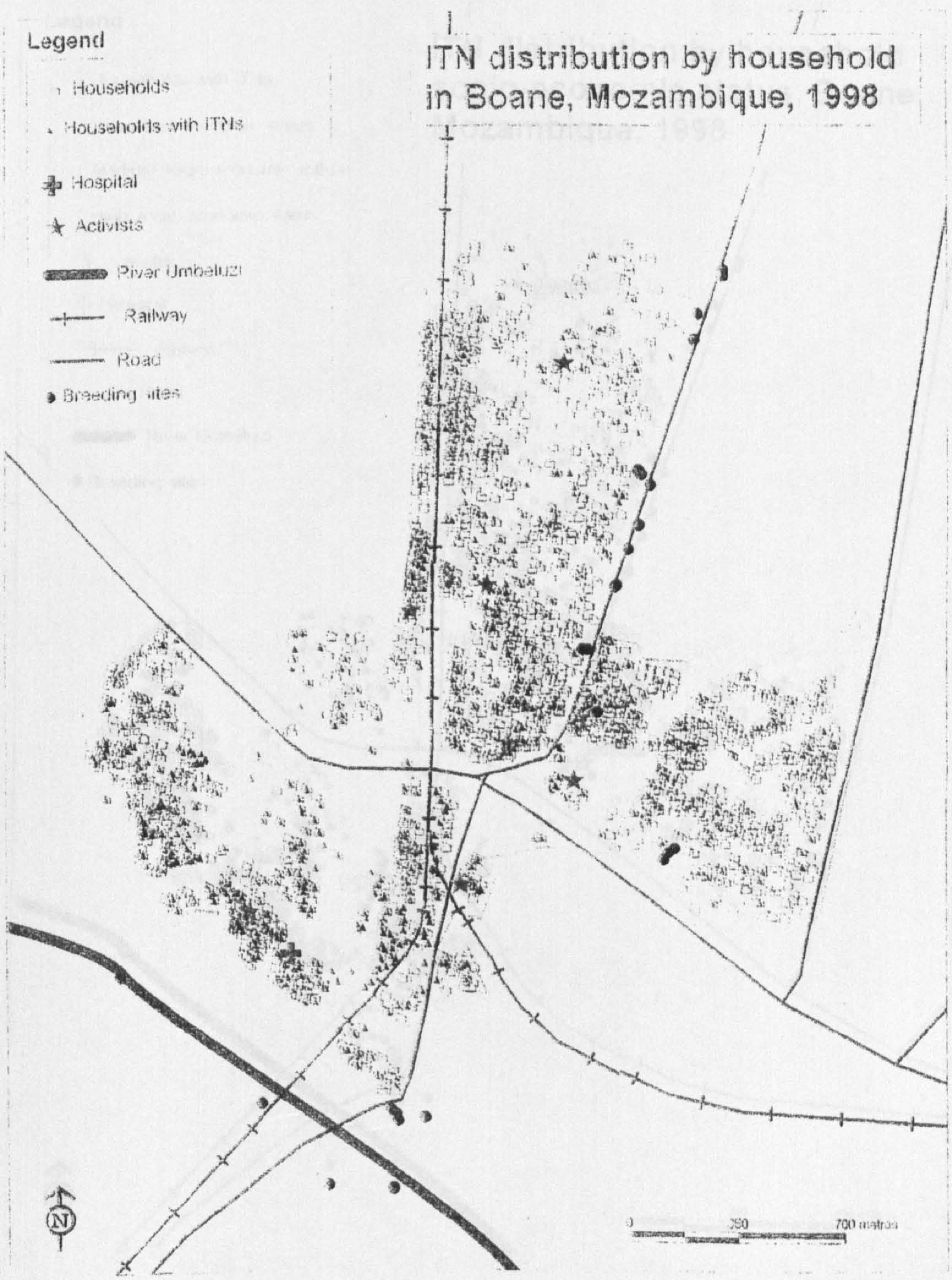
Table 4.5 shows the distances between the households and the selling points, and between the households and the breeding sites according to whether or not the households had ITNs. It can be seen that the households placed 100m or less from the selling points had a higher coverage than the households located at a greater distance (χ^2=26.9 p<0.001). However, no association was observed between the distance of households and the breeding site.

Table 4.5: Number of households according to the distance between households and selling points, and between households and breeding sites, and the number having ITNs

	Selling Points		Breeding sites	
	N. Households		N. Households	
	Total	With ITN	Total	With ITN
0-100	184	77 (42%)	166	35 (21%)
101-500	1739	458 (26%)	1566	422 (27%)
501-1000	480	106 (22%)	677	184 (27%)
Total	2403	641 (27%)	2409	641 (27%)
	χ^2=26.9 p<0.001		χ^2=2.8 p=0.2	

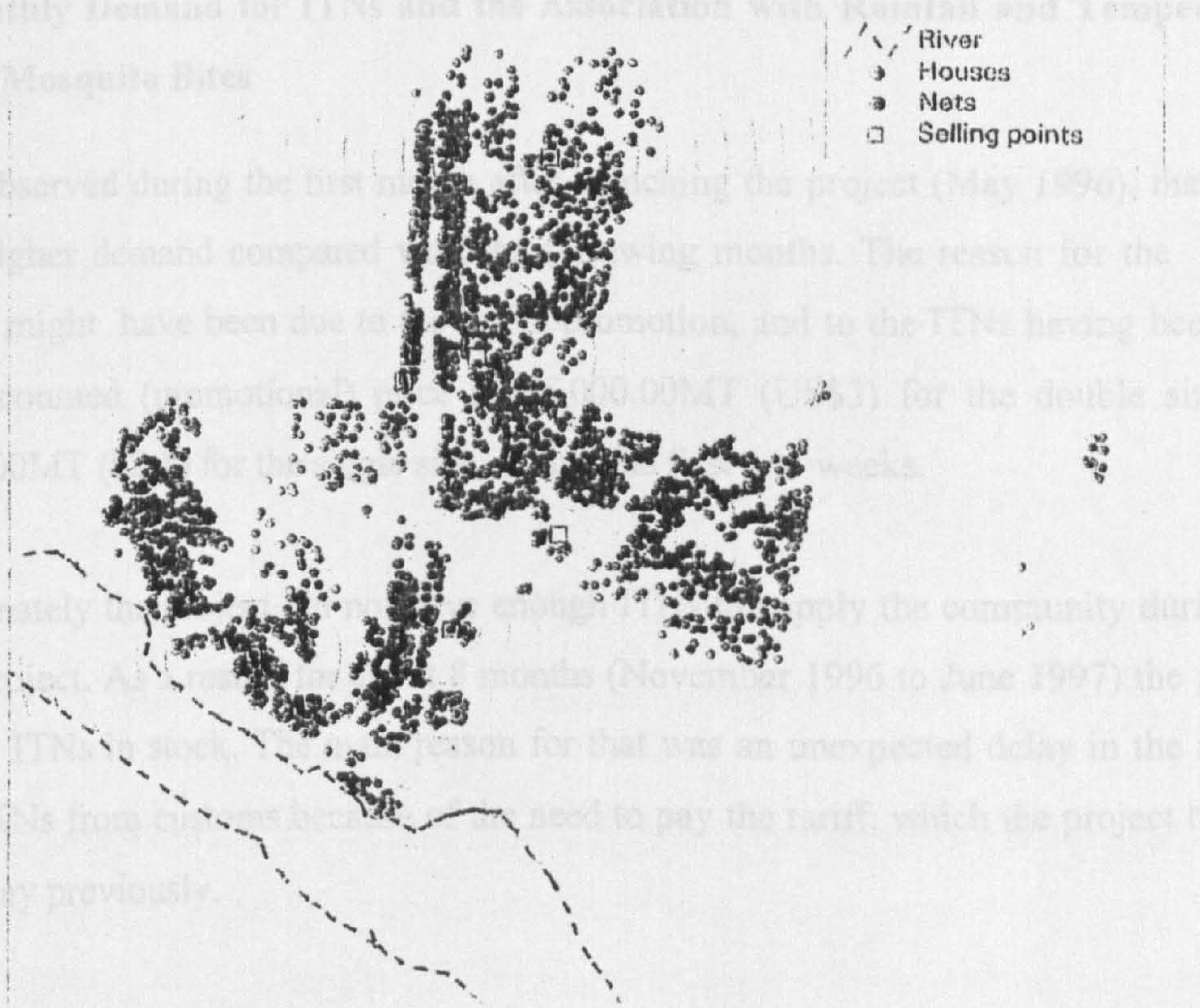
Source: survey 5: GIS map and demand of ITNs (1996-1998)

Map 4.1: Digital Map of ITN Distribution in Boane, Mozambique, 1998

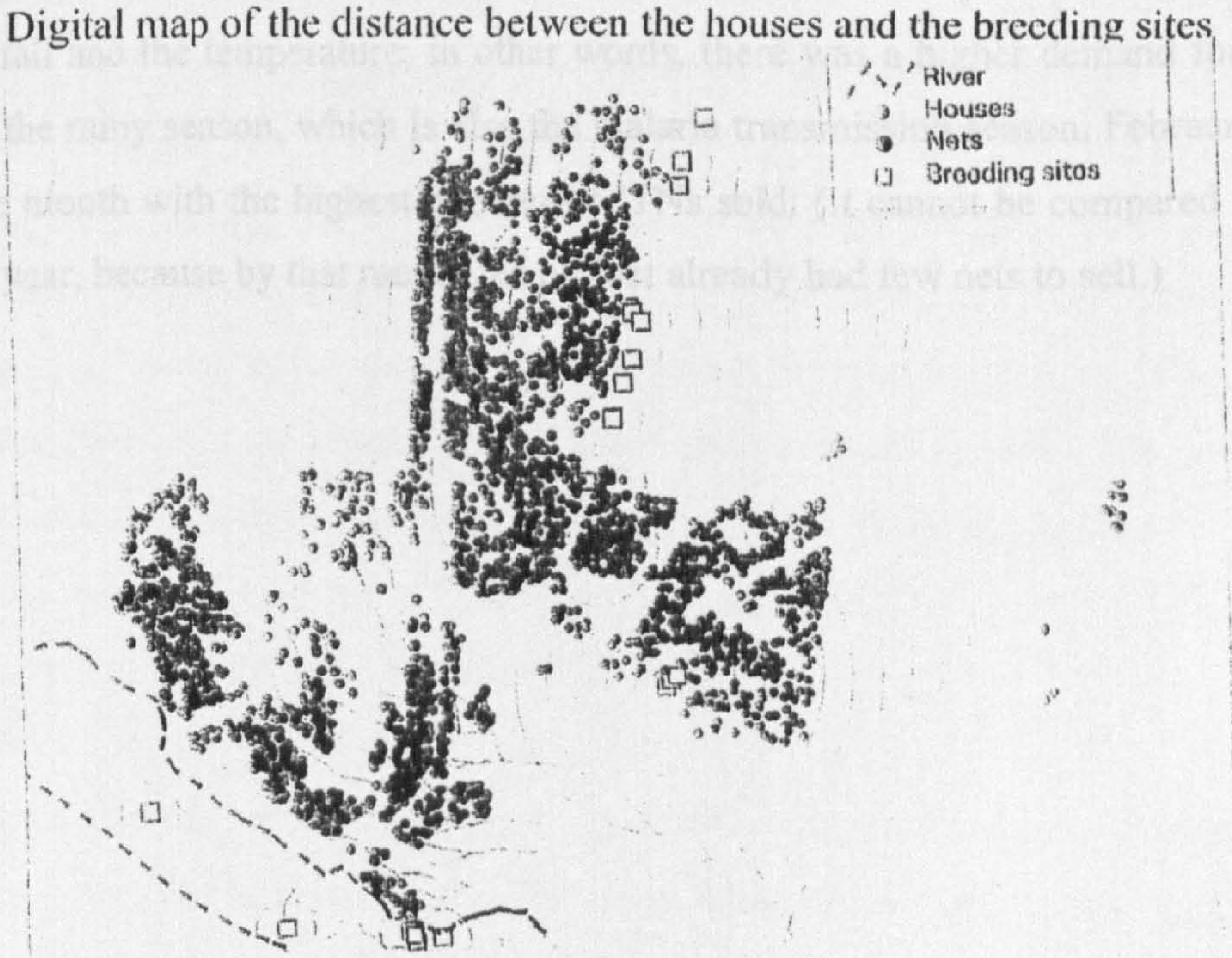


Map 4.2: Digital map of ITN distribution by household socio-economic status

Map 4.3: Digital map of the distance between the houses and the ITN selling points.



Map 4.4: Digital map of the distance between the houses and the breeding sites



Note: The distance between the first ten contour lines represents 100m

4.3.3. Demand for ITNs according to mosquito density and rainfall

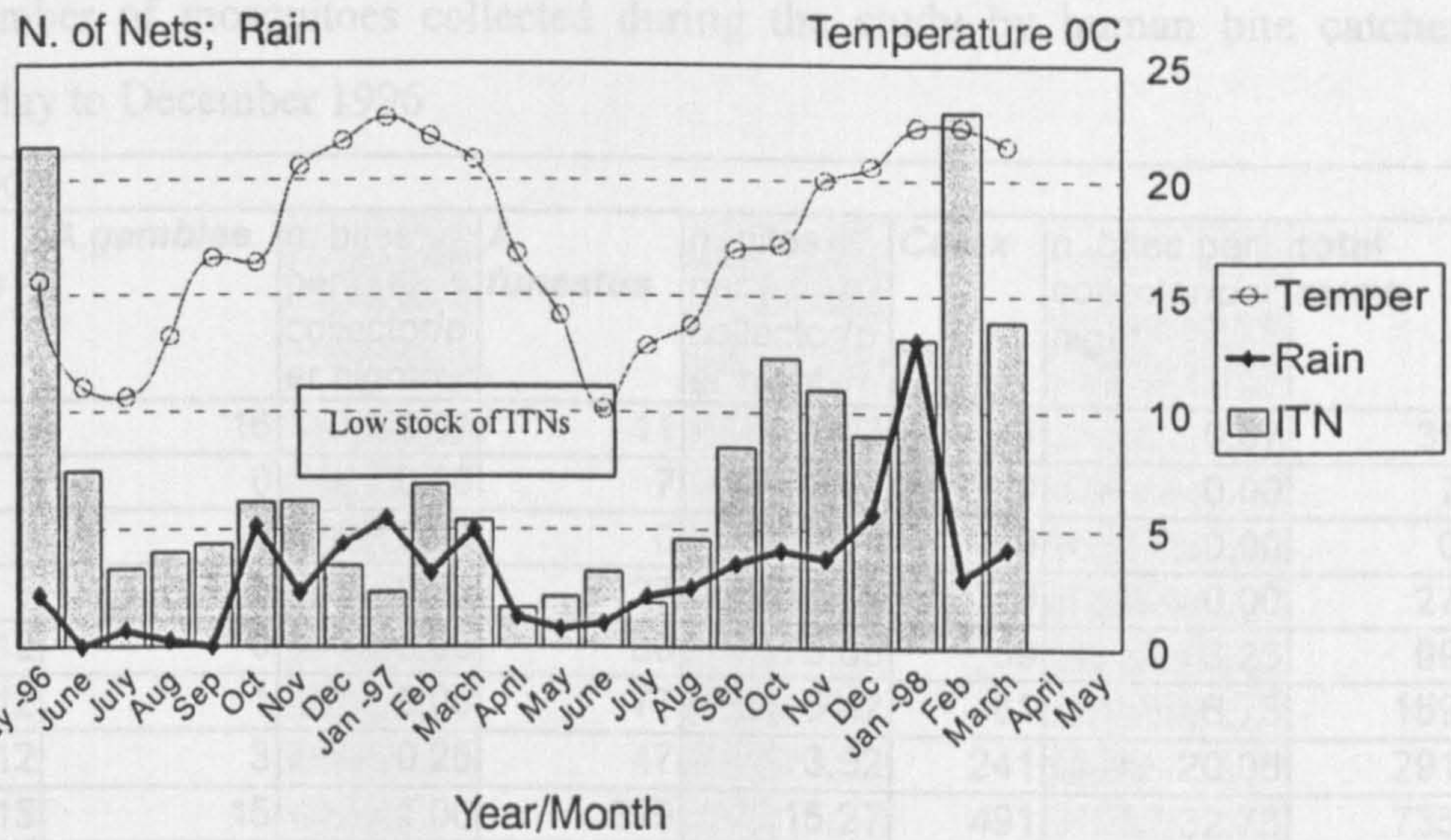
A) Monthly Demand for ITNs and the Association with Rainfall and Temperature and Mosquito Bites

It was observed during the first month after launching the project (May 1996), that there was a higher demand compared with the following months. The reason for the higher demand might have been due to the initial promotion, and to the ITNs having been sold at a discounted (promotional) price of 35,000.00MT (US$3) for the double size and 25,000.00MT ($2.1) for the single size, during the first two weeks.

Unfortunately the project did not have enough ITNs to supply the community during the entire project. As a result, for about 8 months (November 1996 to June 1997) the project had few ITNs in stock. The main reason for that was an unexpected delay in the release of the ITNs from customs because of the need to pay the tariff, which the project had not had to pay previously.

Nevertheless, it can be seen from Figure 4.2 that the number of ITNs purchased increased with the rainfall and the temperature; in other words, there was a higher demand for the ITNs during the rainy season, which is also the malaria transmission season. February of 1998 was the month with the highest number of ITNs sold. (It cannot be compared with the previous year, because by that month the project already had few nets to sell.)

Figure 4.2: Demand for ITNs by month, rainfall and monthly average temperature –1996-1998



Source: survey 1: demand of ITNs and survey 2: mosquito collection (1996-1998)

Tables 4.6 and 4.7 show the number of mosquitoes collected during the study of human-biting catches (HBC) indoors and outdoors from May 1996 to May 1998. As can be seen from the table, *Culex* mosquitoes followed by *Anopheles funestus* mosquitoes were the predominant mosquitoes caught during the indoor HBC. The average number of mosquitoes collected per person per night from May to December 1996 was 12.06 for *Culex*, 6.94 for *Anopheles funestus* and 0.58 for *Anopheles gambiae s.l.*. Higher mosquito densities were found during the last three months of the year, reaching their peak in December. The outdoor HBC caught more mosquitoes than the indoor HBC. *Culex* and *Anopheles funestus* were again the most predominant mosquitoes caught. The total number of mosquitoes caught from May to December 1996 was 2,066. The average number of mosquitoes collected per person per night was 24.54 for *Culex*, 3.08 for *Anopheles funestus*, and 1.48 for *A. gambiae*. The peak of the outdoors HBC was similarly observed during the last 3 months of the year.

In 1997 and 1998 *Culex* mosquitoes were again the most predominant followed by *Anopheles funestus*. The maximum densities were observed at the beginning of the calendar year, which coincides with the rainy season.

Table 4.6: Number of mosquitoes collected during the study by human bite catches indoors from May to December 1996

Human bite indoors

Month 1996	n. collectors	A.gambiae	n. bites per collector/per night	A. funestus	n. bites per collector/per night	Culex	n. bites per collector/per night	total mosq	n. bites per collector/per night
May	6	16	2.67	11	1.83	4	0.67	31	5.17
Jun	3	0	0.00	7	2.33	0	0.00	7	2.33
Jul	3	0	0.00	0	0.00	0	0.00	0	0.00
Aug	3	0	0.00	27	9.00	0	0.00	27	9.00
Sept	12	0	0.00	60	5.00	39	3.25	99	8.25
Out	12	1	0.08	77	6.42	81	6.75	159	13.25
Nov	12	3	0.25	47	3.92	241	20.08	291	24.25
Dec	15	15	1.00	229	15.27	491	32.73	735	49.00
Tot	**71**	**41**	**0.58**	**493**	**6.94**	**856**	**12.06**	**1390**	**19.58**

Source: survey 1: demand of ITNs and survey 2: mosquito collection (1996-1998)

Table 4.7: Number of Mosquitoes collected during the study by human bite night catches outdoors from May to December 1996

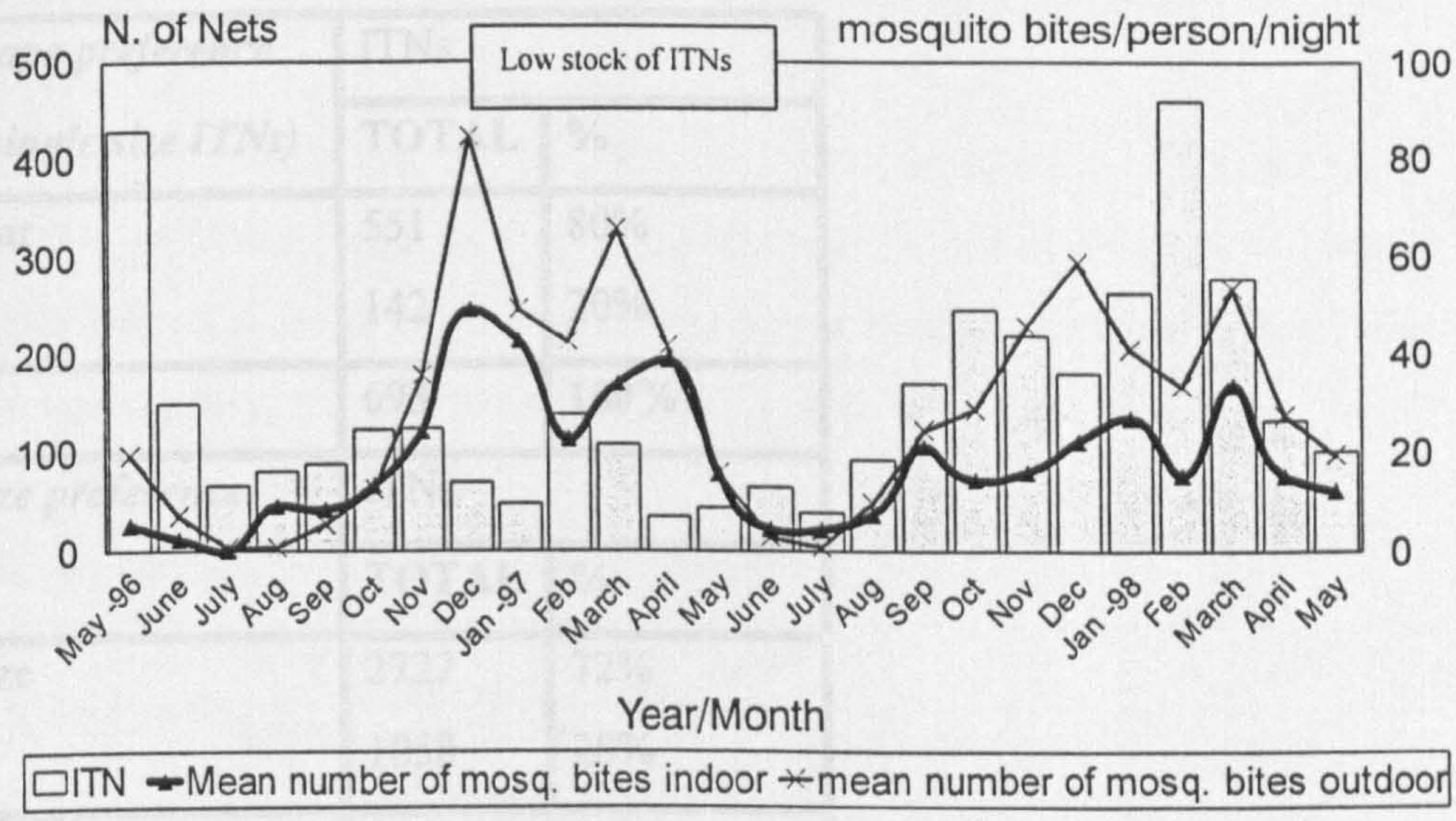
Human bite outdoors

Month 1996	n. of collector	A.gambiae	n. bites per collector/per night	A. funestus	n. bites per collector/per night	Culex	n. bites per collector/per night	total mosq	n. bites per collector/per night
May	6	70	11.67	9	1.50	36	6.00	115	19.17
Jun	3	4	1.33	17	5.67	0	0.00	21	7.00
Jul	3	2	0.67	0	0.00	0	0.00	2	0.67
Aug	3	0	0.00	2	0.67	0	0.00	2	0.67
Sept	12	0	0.00	41	3.42	22	1.83	63	5.25
Out	12	1	0.08	5	0.42	142	11.83	148	12.33
Nov	12	10	0.83	36	3.00	380	31.67	426	35.50
Dec	15	13	0.87	94	6.27	1162	77.47	1269	84.60
Tot	**71**	**105**	**1.48**	**219**	**3.08**	**1742**	**24.54**	**2066**	**29.10**

Source: survey 1: demand of ITNs and survey 2: mosquito collection (1996-1998)

Fig 4.3 shows the association between demand for ITNs and rainfall and human mosquito bites. As can be seen, during the rainy season the number of mosquito bites increased, as well as the demand for ITNs.

Figure 4.3: Monthly demand for ITNs by number of mosquito bites, indoors and outdoors



Source: survey 1: demand of ITNs and survey 2: mosquito collection (1996-1998)

4.3.4. Demand for ITNs by shape, size and colour, and by the gender of the buyer

Information on the colour, shape and size of the ITNs sold was collected from the sales files, There were two different ITN shapes, one rectangular and another conical. The conical nets came only in single size nets. The analysis of shape preference among single size nets, showed that the people in Boane preferred the rectangular shape. Among a sample of 693 single ITNs sold, only 20% were conical (table 4.8).

The analysis of size preference showed that 72% bought double size ITNs, and only 28% bought the single size (table 4.5). The analysis of the gender of the people who purchased ITNs, revealed that females purchased about 43% (1600/3761) of the total ITNs sold.

The first ITN sold in Boane came in 3 different colours: white, green and brown. The second batch came only in two colours, white and green. Because brown nets were not among the second batch, the colour preference was only analysed using the data collected from the ITNs sold excluding the second batch. A survey of the ITNs that were sold showed that 44% (635/1433) of the ITNs sold were green, followed by brown 35% (507/1433) and lastly white 20% (291/1433) (Table 4.8).

Table 4.8: Number of ITNs bought by colour, shape, and size preference and by the gender of the buyer.

Bednet shape preference (only for single size ITNs)	ITNs	
	TOTAL	**%**
Rectangular	551	80%
Conical	142	20%
Total	**693**	**100%**
Bednet Size preference	ITNs	
	TOTAL	**%**
Double size	2727	72%
Single	1058	28%
Total	**3785**	**100%**
Gender of Bednet Buyers	ITNs	
	TOTAL	**%**
Male	2161	57%
Female	1600	42.4%
No information	24	0.6%
Total	**3785**	**100%**
Bednet colour preference (only during the first year)	ITNs	
	TOTAL	**%**
Green	635	44.3%
Brown	507	35.4%
White	291	20.3%
Total	**1433**	**100%**

Source: survey 1: demand of ITNs (1996-1998)

4.3.5. Section II: Impact of ITNs on malaria epidemiological factors

B) Monitoring the impact of ITNs on malaria epidemiological factors by cross-sectional surveys

The prevalence of the malaria parasite was between 55% (September 1997) and 63.8% (February 1998). More than 5% of the slides showed 2 different malaria parasite infections. Only 2 slides showed 3 different malaria parasite infections (September 1996). *P. falciparum* was the most frequent malaria parasite (Table 4.9).

Table 4.9: Malaria parasite prevalence in Boane (September 1996 – February 1998)

	1996	1997		1998
	September N=2,845	February N=2,928	September N=2,789	February N=2,007
Malaria parasite rate				
Negative	1109 (39.0%)	1226 (41.9%)	1255 (45.0%)	726 (36.2%)
Positives	1736 (61.0%)	1702 (58.1%)	1534 (55.0%)	1281 (63.8%)
1 species	1452(51.0%)	1467 (50.1%)	1363 (48.9%)	1176 (58.6%)
2 species	282(9.9%)	235 (8.0%)	171 (6.1%)	105 (5.2%)
3 species	2(0.1%)	0	0	0
Malaria parasite Prevalence by species	(N=2,845)	(N=2,928)	(N=2,789)	(N=2,007)
P. falciparum	1181 (41.5%)	1673 (57.1%)	1501 (53.8%)	1256 (62.6%)
P. malariae	339 (11.9%)	244 (8.3%)	201 (7.2%)	123 (6.1%)
P. ovale	19 (0.7%)	20 (0.7%)	3 (0.1%)	7 (0.3%)

Source: survey 2: cross-sectional parasitological surveys (1996-1998)

Table 4.10 shows the *P. falciparum* distribution by age group. During the four surveys a higher parasite rate was observed among the age group 5-9 years old (72% in February 1997), and a lower rate among adults (age 15 years or more) (37.1% in February 1997).

Table 4.10: Prevalence of *P. falciparum* by age group in Boane (September 1996 - February 1998)

	1996	1997		1998
Age group (years)	September N=2,845	February N=2,928	September N=2,789	February N=2,007
0-1	45.1%(73/162)	46.9% (106/226)	51.9% (97/187)	58.6% (99/169)
2-4	65.4% (280/428)	59.3% (306/516)	63.5% (310/488)	73.9% (258/349)
5-9	74.6% (573/768)	72.0% (532/739)	66.9% (464/694)	75.8% (366/483)
10-14	65.8% (450/684)	66.9% (431/644)	61.6% (397/645)	71.3% (256/359)
>=15	35.9% (288/803)	37.1% (298/803)	30.1% (233/775)	42.8% (277/647)
Total	58.5% (1664/2845)	57.1% (1673/2928)	53.8% (1501/2789)	62.6% (1256/2007)

Source: survey 2: cross-sectional parasitological surveys (1996-1998)

An analysis of the association between the individuals' ownership of the ITNs and *P. falciparum* parasite was done. The study showed no statistical difference between ownership of ITNs and *P. falciparum* parasite infection during the cross-sectional study undertaken 3 months after the implementation of the ITN project, in September 1996. Later surveys undertaken in 1997 and 1998 demonstrated that owners of ITNs were less likely to be *P. falciparum* carriers. For example, in February 1997 the prevalence of *P. falciparum* infection was 60.2% among people without ITNs compared to 46.6% among people with ITNs (χ^2=30.03, p<0.0001) (Table 4.11). For this and the following analysis, people were classified as "ITN owners" if they lived in a household with at least one ITN, and not according to their own individual usage of an ITN. The analysis of the association between the individuals' ownership of the ITNs and their mean age, showed that there was no statistical difference between owners and non-owners of ITNs during the surveys conducted in September 1996 (p=0.5), September 1997 (p=0.8) and February 1998 (0.8). Only during the survey conducted in February 1997 was a statistical difference observed, in which the owners of ITNs had a lower age (mean=11.8 years) than non-owners (mean=14.6) (p=0.0004).

Table 4.11: Prevalence of *P. falciparum* among those having and not having an ITN in Boane (September 1996 - February 1998)

	Ownership of ITNs	*P. falciparum*				**Stratified analysis* Mantel-Haenszel
September–1996 (N=2,812) (low transmission)		**Positives**	**Negatives**	**Odds Ratio (95% C.I)**	***P***	**Odds Ratio And (95% C.I)**
	Yes	76	68	0.78	0.1	0.78
	No	1569	1099	(0.55-1.11)		0.49-1.02
February 1997 (N=2,922) (high transmission)	**Ownership of ITNs**	***P. falciparum***				
		Positives	**Negatives**	**Odds Ratio (95% C.I)**	***P***	**Odds Ratio and (95% C.I)**
	Yes	298	342	0.58	<0.001	0.52
	No	1374	908	(0.48-0.69)		0.43-0.62
September–1997 (N=2,789) (low transmission)	**Ownership of ITNs**	***P. falciparum***				
		Positives	**Negatives**	**Odds Ratio (95% C.I)**	***p***	**Odds Ratio and (95% C.I)**
	Yes	277	287	0.79	0.012	0.79
	No	1224	1001	(0.65-0.96)		0.64-0.96
February-1998 (N=2,007) (high transmission)	**Ownership of ITNs**	***P. falciparum***				
		Positives	**Negatives**	**Odds Ratio (95% C.I)**	***p***	**Odds Ratio and (95% C.I)**
	Yes	328	271	0.63	<0.001	0.60
	No	928	480	(0.51-0.77)		0.49-0.74

Source: survey 2: cross-sectional parasitological surveys (1996-1998)

**Stratified analysis* Mantel-Haenszel adjusted by age groups

The impact of ITNs on haematocrit levels was analysed. The definition of anaemia was identical to that used in chapter 3: *i.e.* haematocrit below 30%. The proportion of anaemia was not significantly different between that reported for ITN owners and non-owners (Table 4.12). In September 1996 the results of the mean PCV in owners was 35.1g/dl and in non-owners was 35.7g/dl (p=0.23). There was no statistical difference observed when the analysis of the mean PCV in owners and in non-owners was adjusted by age group. In February 1997 the results of the mean PCV in owners (33.7g/dl) again showed no statistically significant difference from the non-owners (33.09g/dl) (p=0.1) and no statistically significant difference was observed when the analysis was adjusted by age.

Table 4.12: Prevalence of anaemia* among those having and not having an ITN in Boane in September 1996 and February 1997

	ITN ownership	ITN non-ownership	Odds Ratio (95% C.I)	P	* *Stratified analysis* Mantel-Haenszel Odds Ratio And (95% C.I)
September 1996 (N=908)	10.2% (6/59)	9.1% (72/849)	1.14 (0.42-2.88)	0.77	1.44 (0.68-3.06)
February 1997 (N=612)	15.3% (18/118)	14.0% (69/494)	1.1 (0.60-0.2.02)	0.7	1.28 (0.78-2.08)

Anaemia*: Haematocrit < 30%

Source: survey 2: cross-sectional parasitological surveys (1996-1997)

**Stratified analysis* by age groups

C) Reported ITN usage during the cross sectional parasitological surveys

Four surveys (as part of the cross-sectional survey) were conducted to see how many households that bought an ITN had slept under the ITN the night before the interview. Two surveys were conducted during the rainy season (February 1997 and February 1998) and the remaining two during the dry season (September 1996 and September 1997). The results are presented in table 4.13.

In September (dry season) 1996 usage was at its lowest level, with only 23.6% (34/144) of the people interviewed having declared that they had slept under an ITN the previous night.

The proportion of declared usage increased to 69.2% (443/640) during the following wet season in February 1997 and it was even higher in February 1998, reaching 85.6% (513/599).

Table 4.13: Number of Households owning an ITN that reported sleeping under the ITN the previous night

	1996	1997		1998
	September 1996 N=144	February 1997 N=640	September 1997 N=564	February 1998 N=599
Yes	34 (23.6%)	443 (69.2%)	367 (65.1%)	513 (85.6%)

Source: survey 2: cross-sectional parasitological surveys (1996-1998)

Section III: Retreatment of ITNs

4.3.6. Retreatment coverage

Two yearly rounds of ITN retreatment took place, one in 1997 and the second in 1998. ITN retreatments were undertaken during January and February, at the beginning of the high transmission season. The retreatment took place in each village. The INS team spent 2 or 3 days in each of the residential areas. Since sachets for individual retreatment were not yet commercially available, the project selected the communal retreatment approach. Each householder was asked to bring all the ITNs that they had at home for retreatment on a specific day. The retreatment sessions took place at the community meeting places. Community leaders and a car from the project were used to advertise the day of retreatment as well the benefits of retreatment. In this report only the results of the ITN retreatment undertaken in 1998 will be presented.

There were 476 bednets retreated in 1998. 319 households brought their ITNs for retreatment. The total number of ITNs that those households had at home by the time of retreatment was 585. Among the households that brought their ITNs in for retreatment the coverage of ITNs retreated was 81.3% (319/585).

It was not easy to find a proper denominator for the assessment of the overall retreatment rates, because the ITNs were sold continuously and the households were told that the insecticide in their nets would last one year if the nets were not washed. The best estimate would probably be to use the total number of ITNs sold up to 01/02/97, six months before the retreatments started. Using that date, the retreatment rate was then 30.4%. The main reason that people came to retreat their ITNs was that they were told to come (table 4.14).

Table 4.14: ITN Retreatment coverage in 1998

Number of ITNs bought Per period	**Total ITNs Bought**	**Total ITNs retreated**	
	TOTAL	N	%
Until 01/07/97	1563	476	30.4%

Source: survey 3: Retreatment (1998)

Households that came to retreat their ITNs were asked what financial source they were using to pay for the retreatment. Nearly 85% declared that they were using money from their salary (399/476), and the remainder said that they were paying with money coming from selling their farm crops or from selling other products such as traditional drinks.

Section IV: Acceptability and usage of ITNs

4.3.7. Acceptability and usage of ITNs

A questionnaire interview was undertaken in 1998 to monitor the acceptability and usage of the ITNs (survey 5, see table 4.1). A total of 3,784 households were visited and among them 841 (22.2%) households had ITNs. During this survey information regarding acceptability and usage of ITNs among those owning ITNs was collected. The reasons for not purchasing ITNs were collected from households that did not buy ITNs. The survey had the following components: a) reasons for colour preference; b) observed ITN usage; c) methods used by households for mosquito bite prevention; d) household's decision to buy ITNs; e) financial resources used to buy ITNs; and f) acceptability of the ITNs.

A) Reasons for colour preference

The majority of households that preferred green and brown nets said that the main reason was that the ITNs looked less dirty. More than 77% (135/175) of households preferring the white nets said that the main reason was that white is a more pleasant colour (Table 4.15). It was noted that the higher socio-economic groups preferred white nets.

Table 4.15: Reasons presented for colour preference

	Reason			
Colour	Looked less dirty	It is more pleasant	Others	Total
Green	55.5%	37.8%	6.7%	63.8%
White	-	77.1%	22.9%	21.2%
Brown	79%	15.3%	5.6%	15%
Total	**390**	**353**	**52**	**825***

***84 households did not reply to the question**
Source: survey 4: cross-sectional acceptability and usage of ITNs survey (1998)

B) Observed ITN usage

A visit to a sample of households who bought an ITN took place to confirm whether the ITN, which had been purchased was still there and had been used during the previous night. Eight hundred and forty-one households were visited. Almost all households managed to show their ITN to the interviewer (96%, 810/841). About 54% (452) of the ITNs had apparently been used during the previous night; the interviewer could see the ITN hanging over the sleeping place. About 43% of households (358) had not been use the ITN during the previous night; however, when they were asked to show the ITN, they did so. The remaining 55 households (4%) could not show their ITNs. The main reasons were that the ITNs had been stolen, or given as a gift, or that the person who bought the ITN had left the house, and had taken the ITN with him/her.

The main reason for not using ITNs during the dry season was the absence of mosquitoes while the main reason for sleeping under an ITN during the wet season was to avoid mosquito bites.

C) Methods used by households for mosquito biting prevention

Information regarding methods (purchased) of prevention used during the previous night was collected among households regardless of whether they bought an ITN. Out of the 3,784 households interviewed, 2,779 (73%) reported having used a method to prevent mosquito bites. Among them, mosquito coils were the most frequently used method (74%), followed by ITNs (27%). Insecticide in aerosol sprays was used the least. A diagram was drawn to show how many households had used the different methods simultaneously during the previous night. In figure 4.4 it can be seen that 2% of households reported having used all three methods during the previous night. The two methods most often associated were mosquito coils and insecticide in aerosol spray. The usage of ITNs among those households with ITNs (841) was 88.9% (748).

D) Household decision to buy ITNs

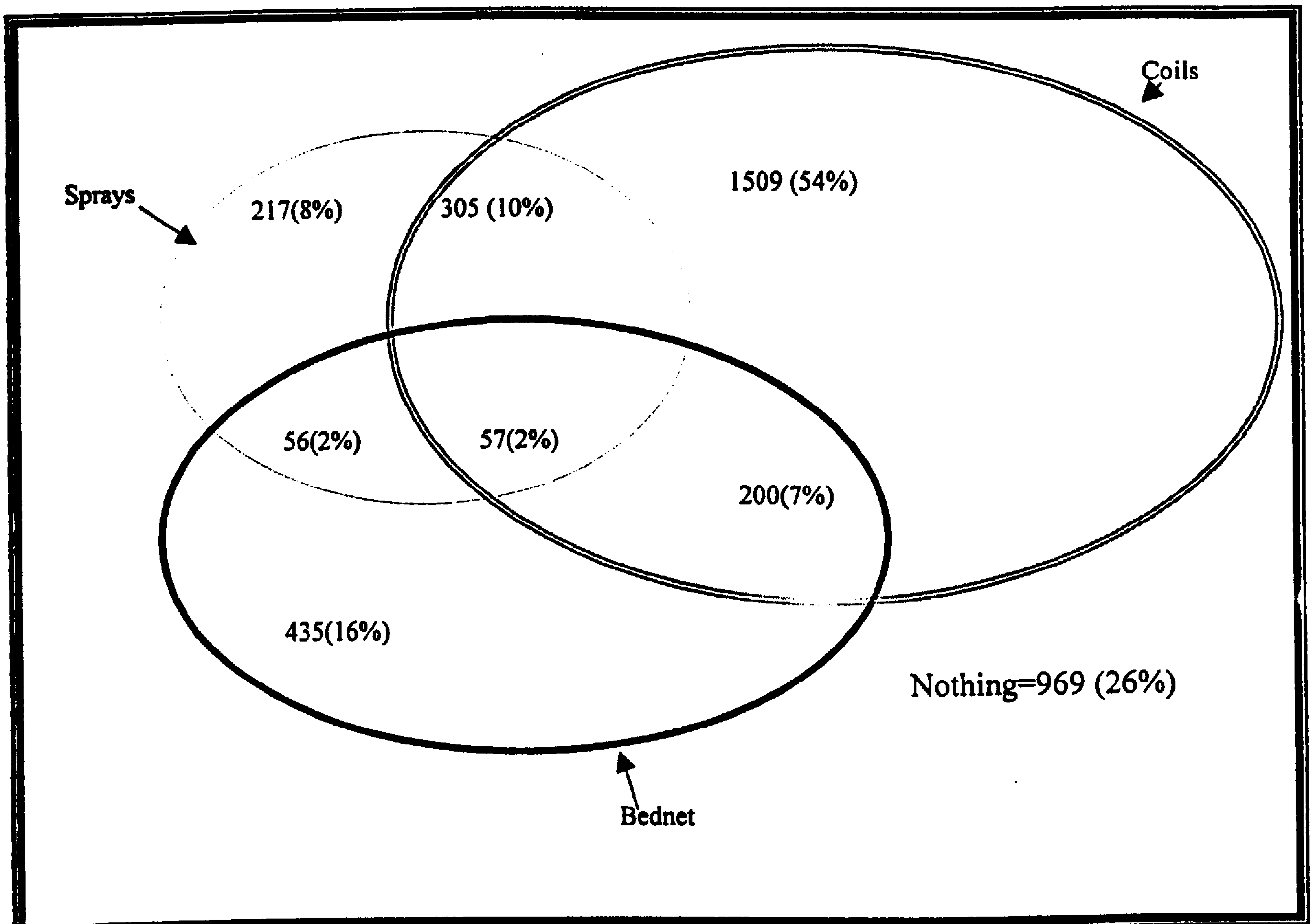
The analysis of the gender of the people, who purchased an ITN, revealed that females purchased about 43% (1600/3761) of the total ITNs. To understand who makes the decision and the initial decision to buy an ITN within the household, the survey collected information among households who owned ITNs. Table 4.16 shows that although about half of the ITNs were bought by a female, the wives did not play an important role in the decision to buy the ITN; only in 27.4 % of the cases (194/708) was the decision taken by the wife.

Table 4.16: Household decision-making by gender: in bednet-buying households, who (husband or wife) suggested buying the ITN, who decided to buy it, and who made the purchase

	Husband bought the ITN		Wife bought the ITN		Total
Decision	Suggestion		Suggestion		
	Husband	Wife	Husband	wife	
Husband	341	14	137	22	514 (72.6%)
Wife	8	2	35	149	194 (27.4%)
Total	**349**	**16**	**172**	**171**	**708***

*133 households are missing .Source: survey 4: cross-sectional acceptability and usage of ITNs survey (1998)

Figure 4.4: Diagram of the overlap of the use of the three mosquitoes prevention tools: ITNs, mosquito coils and insecticide in aerosol spray by households in Boane - 1998



Total=3,748; Number that used methods to prevent mosquito bites = 2,779
Source: survey 4: cross-sectional acceptability and usage of ITNs survey (1998)

E) Financial resources used to buy ITNs

The financial sources used by householders to purchase an ITN were investigated and can be seen in table 4.17. The majority of households used their salaries as the means to buy an ITN.

Table 4.17: Source of financing used to buy the ITN

Source	n	%
Monthly salary	568	67.5%
Selling crops	187	22.2%
Selling products at local market	41	4.9%
Others	45	5.4%
Total	841	100%

(Others: occasional work, family present, selling traditional beer)
Source: survey 4: cross-sectional acceptability and usage of ITNs survey (1998)

F) ITN acceptability

The reasons for buying ITNs were investigated among households who had purchased at least one (Table 4.18). About three-quarter of the households said that the main reason was that the ITN kills mosquitoes.

Table 4.18: Why households decided to buy the ITN

	N=742* (%)
Because ITNs kills mosquitoes	74%
Because ITNs repels mosquitoes	18%
To avoid malaria	7%
Because ITNs provides a good sleep	1%
Total	100%

*99 did not respond the question
Source: survey 4: cross-sectional acceptability and usage of ITNs survey (1998)

When the households were asked whether they would like to buy more ITNs, 98% of them (3715/3784) gave a positive response. The average number of ITNs was 1.5 (sd=0.79) per household. Although 98% of the households were interested in buying ITNs, they did not all buy them.

Households without ITNs, who said that they were interested in buying an ITN, were asked why they had not bought at least one ITN. The lack of money and the high price are some of the reasons. The main reason given was lack of money (79.2%). Resistance to the high price of the ITNs was the second reason given, 13.4% of households responded that the ITN was very expensive for them. The remaining 188 households gave different reasons (table 4.19). The most important factor was related to the lack of a census card (60/188; 32%). Without that card, households were not allowed to buy any ITNs. Other households declared that they were not aware of the existence of ITNs in Boane, or they did not find an ITN when they went to buy one.

Table 4.19: Reasons why households did not buy ITNs

Reason	**n**	**%**
Lack of money	2028	79.2%
Resistance to high price	343	13.4%
Others	188	7.4%
Total	2559	100%

(Others: lack of census cards, lack of information)
Source: survey 4: cross-sectional acceptability and usage of ITNs survey (1998)

G) ITN Side effects

About 20% of household owners complained about the side-effects of the insecticide. The side-effect most often reported was coughing 9.8%, followed by headache. Sore eyes and sore throat were also mentioned. Other side effects reported, such as itching and general discomfort were also reported (Table 4.20). However, these side-effects should be interpreted with caution because there was not a control group to compare with.

Table 4.20: Principal side effects perceived by households who did sleep under an ITN

	N = 841 (%)
No report of side effects	81.8%
Coughing	9.8%
Headache	3.9%
Sore eyes	1.8%
Sore throat	1.4%
Others	1.3%
Total	100%

(Others: skin allergy, irritation, discomforts breathing)
Source: survey 4: cross-sectional acceptability and usage of ITNs survey (1998)

H) How households would like to pay for ITNs

Households were asked how they would like to pay for their ITNs. The majority of households (61%, 2309/3784) declared that they would prefer to pay with money from their salaries. About 24% (887/3784) said that a credit scheme would be more suitable for them, if one was available. Nearly 6% (210/3784) of households declared that they would prefer to use money saved from "Xitique", which is a community association based in small group of persons where each of them contributes a certain amount of money and receives the funds raised on a rotating basis. The remaining 70 households (2%) declared that they would prefer to use the money earned from selling farm crops and traditional drinks to purchase an ITN.

Many villages surrounding the study area requested to buy ITNs from the project, but, since the project had a limited supply of ITNs available, it was not possible to extend the project to neighbouring areas.

I) The priority of sleeping under ITNs within Households and the sleeping arrangements

ITNs were not the first priority item among the householders; among all FGD ITNs ranked between third to sixth positions. The first priorities were the roof of houses and the furniture. It was noted during the FGD that young couples still slept in the same bed when the wife was pregnant. After delivery they slept separately until the baby was 6-9 months old. The husband slept alone and the wife with the baby. Children of both sexes below 5-6 years old shared the same sleeping place, but from age 7 on were separated.

Almost all households knew by the time of the FGD that mosquitoes transmit malaria, and that the purpose for the ITNs were to prevent mosquito bites and malaria. This is one achievement of the promotion campaign developed in the study area.

People who did not have an ITN said that if they had only one, they would give it to their children. However, people who had already bought only one ITN, said that the ITN was used by the head of the family. They said that the main reason for that, was that the head of the household needed to have good health in order to feed the family; "if I got sick, who would take care of the family?", a man asked.

During the FGD, the people said that the main reasons for not coming to retreat their ITNs was lack of money, or that the ITNs still were effective against mosquitoes (they said that they could see dead mosquitoes on top of the ITNs).

All the households said that they received information about the ITNs from different sources, such as community meetings, health centres (all the beds at the health centre had an ITN), the theatre group, house- to- house visits, etc.

4.4. DISCUSSION

4.4.1. Demand and coverage of ITNs

This was the first ITN project undertaken in Mozambique. The study used the primary health care system to introduce and promote ITNs in a semi-rural community. The overall coverage of households purchasing at least one ITN was 24%. A coverage difference was noticed between socio-economic groups, which varied from 16% to 55%. Lack of money was the main factor for low coverage. This project was not equitable (in terms of equal coverage of ITN by socio-economic groups). Similar findings were identified by other projects (Bortel *et al.* 1996).

In addition, the interruption in the supply of ITNs also affected the coverage, since many people were willing to buy ITNs, but the ITNs were not available.

There was also observed a significantly higher coverage among households living near to the selling points. Making ITNs available near to the residence areas might increase the demand. However, there was no relation observed between proximity to breeding sites and purchase of ITNs. One explanation, might be related to the presence of mosquitoes all over Boane, almost all households reported that the presence of mosquitoes in their houses (see chapter 3). In a study conducted in The Gambia, Thompson *et al.* (1996) found that the bednet usage were associated with the distance from the River Gambia, where they found higher density of mosquitoes.

The average number of ITNs per household who bought ITNs in Boane was 2.2, with a variation from 2.07 in the low socio-economic groups to 2.73 in the higher socio-economic groups. This finding shows that the majority of households which decide to buy ITN, buy more than one. This result is comparable to one from a study conducted in Tanzania (Evans, 1994). In this study the bednet average per household with at least one bednet was between 1.82 to 2.49.

The average number of people per ITN among households with at least one ITN was 2.4. No differences were observed among socio-economic groups in terms of the number of persons per ITN. This suggests that not all people in the house do not sleep under an ITN.

The question regarding what should be the optimal coverage is relevant when the aim is to cover as many persons as possible. Due to economic constraints it is not affordable for the majority of households to provide individual ITNs for each member of the household. Sharing an ITN is more practical. The average number of people in Boane is about five persons per household. Thus, if households can have at least two ITNs, it is possible to cover the majority of people living in the house, assuming that they share the same sleeping space.

The results of the project show an attempt at the creation of a market for ITN, which will need further support not only from the private sector, but also from other organisations, such as NGOs, in order to secure the supply of nets for people who want to buy them. Although there was observed an irregular supply and a low coverage (the primary health care was not responsible for purchasing bednets), it can be concluded that the primary health care system succeeded to implement the ITN project.

4.4.2. Acceptability and Usage of ITNs

Usage of ITN was seasonal. Higher usage was found during the rainy season. Other authors found similar patterns (Makemba *et al.* 1995, Kroeger *et al.* 1997, Aikins *et al.* 1994). For example in a study conducted in Ghana, it was observed that usage during the rainy season was 99%, but in the dry season it was only 20% (Binka and Adongo 1997). In Boane as well in Ghana the main reason for not sleeping under an ITN was reported to be the absence of mosquitoes or low mosquito density. This leads again to the question of how to best promote best ITN usage. It seems that although people understand that they should always sleep under an ITN they do not always do so. Therefore, it is important to find out why people do not always sleep under an ITN. It will take some time for people to perceive the need for using an ITN even when they do not see mosquitoes. Messages such as "always sleep under an ITN" should be placed in all the most important public places, such as health care units, the local market, the community meeting place.

The results of the Boane project demonstrated that the main reason why people bought ITNs was to prevent mosquito bites. More than 90% of the households declared that they bought an ITN because the ITN killed or repelled mosquitoes. During the focus groups many householders commented that they used to see dead mosquitoes on top of their ITNs, and that other mosquitoes were repelled. In addition during the promotional and educational activities it was emphasised that ITNs killed and repelled mosquitoes. The observation of dead mosquitoes and the promotional activities which were developed may explain why so many people stated that their major reason for wanting of ITNs was that killed mosquitoes. The observation of dead mosquitoes by the community was also reported in a study conducted in Tanzania where villagers enthusiastically reported the death of mosquitoes near ITNs and the disappearance of other insect pests, including bedbugs, fleas and cockroaches (Njunwa *et al.* 1991. In a study conducted in The Gambia it was found that the main reason people bought an ITN was to protect themselves from mosquito bites (MacComack and Snow 1987), and some communities used ITNs to keep warm during cold and rainy season as well for privacy and protection for against dust. In another study conducted in Cameroon about 90% of the respondents declared that they used ITNs to protect themselves from mosquito bites (Louis *et al.* 1992b). These studies show that protection against mosquito bites has been the main reason to buy ITNs.

Finding out what is the main reason for people to buy an ITN is very important in order to develop proper and adequate promotional messages. It is still not very clear what should be the major emphasis of the promotional messages: should it be to avoid mosquito bites? Or to prevent malaria? It has been found that *Culex* mosquitoes develop resistance to the insecticide (Kang *et al.* 1995), and therefore the ITNs become useless to prevent mosquito bites by *Culex* mosquitoes. Thus, messages which emphasise that the ITN will prevent mosquito bites may not be appropriate, particularly if the message emphasises that the ITN will avoid any mosquito bite.

Some projects try to teach people about the differences between *Anopheles* and *Culex* mosquitoes, but that it is not feasible and nor understandable in poor communities with a low level of literacy. In addition ITNs do not give 100% protection against malaria and thus, some people sleeping under ITN will still get malaria. This situation may discourage people from buying ITNs if they or their relatives, sleeping under an ITN, get malaria. During informal conversations with households in Boane, some of them (not many) said that they knew a neighbour who had bought an ITN, but that children in that house had still got malaria, and therefore they were not motivated to buy an ITN. These two examples illustrate the difficulty of finding adequate messages to educate people about the benefits of ITNs. In the Boane study the option was to deliver two main messages: the first was to avoid mosquito bites, and the second was to prevent malaria, but the results showed that most people purchased ITNs to avoid mosquito bites, and that very few took into consideration the possibility that the ITN might prevent them from getting malaria. This demonstrates the need for education.

Data from the study demonstrated that although households may have ITNs they still purchase mosquito coils or aerosol sprays. Mosquito coils contain an active pesticide, traditionally pyrethrum, in a spiral with a slow-burning base. The smoke acts mainly as an excito-repellent and drives the mosquitoes away, but it has little effect on killing mosquitoes. Mosquito coils can decrease mosquito bites (Charlwood and Jolly 1984), and are relatively affordable for many households; they are widely used in some regions of Africa (Evans 1994). The Boane study revealed that some households that had purchased an ITN were still buying mosquito coils and sprays, and that some of them used all three together at the same time. Similar findings were observed in a study conducted in Tanzania, where 44% of households with ITNs also used mosquito coils, 30% used sprays and 13% all three together (Evans 1994). The Boane study took place during the low transmission season, when there are not many mosquitoes. This may explain the differences observed between the two studies in terms of the proportion of users. The Boane study did not ask households why they were using ITNs and other methods simultaneously, but from the Tanzania study it was found that people used mosquito coils before they went to bed; therefore ITNs were not a complete substitute for mosquito coils or sprays.

Side effects of *pyrethroid* have been reported by other authors, particularly after the bednet was treated with insecticide. The symptoms reported are sneezing, cold-like symptoms (running noses, etc.), running eyes (Njunwa *et al.* 1991), or skin reactions (Gyapong *et al.* 1996). These symptoms tended to disappear after some days. In a controlled study conducted in The Gambia (Snow *et al. 1987*) no statistical difference was observed of side effects of pyrethroid among children sleeping under ITNs and children sleeping under bednets treated with a placebo. Since the Boane study did not have a control group, it is probable that the side effects reported could be by chance.

ITNs were accepted very well and this is shown in the study, where it can be seen that people are keen to buy more ITNs, and that the average is about 1.5 ITN per household. The fact that the majority of ITNs bought by householders remain in the house also emphasises that ITNs are well accepted. Many projects have found that as soon as ITNs are introduced they are accepted very well (Jamjoom *et al.* 1994, Kroeger *et al.* 1995, Gyapong *et al.* 1996, Richards *et al.* 1993). However the major problems concerns the households ability to buy ITNs. The question is how to make the ITNs affordable for those people that need more of them?

From the Boane project it was learnt that people preferred coloured ITNs, in double sizes and in a rectangular shape. This is very important information, which could prevent future mistakes, such as importing only white, single and conical nets. Green was the colour most often selected. The main reason given was that coloured bednets do not look dirty very quickly. Colour preference apparently varies from region to region. Coloured bednets were found more appropriate in regions where bednets can very quickly get dirty for different reasons, such as the bednet being tucked under the mats on the floor (Gyapong *et al.* 1996). In The Gambia about 90% of the adults interviewed preferred white bednets, and they washed the bednet two or three times a month to get the clean white appearance (MacComark and Snow (1986).

It was interesting to note that women played a very important role in purchasing ITNs, however their role were less important regarding the decision to buy one ITN. That information should be considered when a promotion campaign is developed.

The FGD provided relevant information about household priorities, and about sleeping arrangements regarding the ITNs. Although the head of the households understood that children get malaria more often, they are reluctant to give the children priority for sleeping under an ITN. Therefore, it may be a better approach, to push the households to buy enough ITNs to cover all the family. However, that raises the question of lack of money. Thus, further studies need to be done in order to assure that the children will be covered by ITNs. It is also clear from the FGD, that more than one ITN will be needed to cover all the children since from the age of seven they sleep separated by sex. It was also noted, that pregnant woman can be protected until they deliver, but as soon as they come home they may not sleep under an ITN until the baby is six-nine months old. Therefore, one can conclude that the optimal and maybe the minimal number of ITNs for a household with five members will be three ITNs. In Boane households that bought ITNs usually bought about two ITNs. This number is still not enough to cover all the family. However, it is an encouraging number, and more efforts should be made to increase the ITN coverage among all household members.

4.4.3. Impact of ITNs on malaria epidemiology factors

The analysis of data on malaria and on the ownership of ITNs demonstrated that the ITNs had an impact in reducing prevalence of *P. falciparum* after above one year of the implementation of the ITN programme. However, no impact was observed on clinical malaria and anaemia. The number of malaria cases and the number of households with ITNs were small which makes it difficult to reach conclusions about the lack of impact of the ITNs on the prevalence of clinical malaria. In a study conducted in The Gambia (Snow *et al.* 1987) they observed that at the end of the rainy season, permethrin treated nets did not have any impact on the prevalence of the malaria parasite and on the haematocrit. Lengeler (1998) in his review found that ITNs have little impact on mild episodes of malaria, and only one trial demonstrated a substantial impact on severe malaria disease. In the same review, Lengeler found that in areas of stable levels of malaria, the ITNs had little impact on malaria prevalence, less than 10% (in randomised trials) and less than 21% when randomised and non-randomised trials were analysed together. The review also found that ITNs had little impact on increasing the mean PCV values in children sleeping under an ITN.

An appropriate study has to be designed and developed in Mozambique in order to measure the impact of ITNs (particularly the impact of ITNs in low coverage areas) on malaria morbidity and malaria mortality, such as longitudinal (Binka *et al.* 1996) or case control studies (D'Alessandro *et al.* 1997).

4.4.4. Retreatment coverage of ITNs

The coverage of retreatment achieved at the Boane project was 30.4% in 1998. People had to pay to get their nets retreated. This coverage was higher than that observed by other authors in the Gambia, where the introduction of fees dropped the coverage from 80% to 16% (Mills *et al.* 1994). The use of fees has been considered to be one of the main constraints against the achievement of a high retreatment coverage, particularly in areas where it started free of charge like in a study conducted in Tanzania (Winch *et al.* 1997). However, not only the price is important, the availability throughout the year of the retreatment service is also important.

It is still not very clear if in fact people do not retreat their ITNs because of the fee, since the price has always been under one U.S. dollar (Winch *et al.* 1997). However, a relatively high coverage of ITN retreatment was found in some places, when the retreatment was free of charge. For example, in a study conducted in Ecuador the ITN retreatment was free of charge and the coverage was between 63% to 80.4% (Kroeger *et al.* 1997).

In Boane only 32% of the people declared that they did not come to retreat their ITNs because of lack of money. The majority said that the insecticide in the ITNs was still effective enough to repel or kill mosquitoes or that they had bought their ITNs less than one year before the time of retreatment. Since the communal retreatment only took place once a year, many householders had bought ITNs during the previous year, and they had not had the ITN for one year after treatment. Therefore, many householders said that they did not come for retreatment because they had had the ITN for less than one year and the insecticide was still effective.

In future it is recommended to have at least two semi-annual sessions of retreatment, but the ideal would be to have it done three or four times per year. A project undertaken in

Ifakara district (Tanzania) recommends four retreatments per year to all households who buy their ITN (Schellemberg *et al.* 1999). The argument for frequent retreatment during the year is made in a study undertaken in Dar es Salaam, where it was found that people washed their nets after about twelve weeks, which leads to a decrease in insecticide concentration and in the effectiveness of the net to kill or repel mosquitoes (Miller *et al.* 1999).

If sachets are available for commercialisation (they are becoming more available now), then the health centre can sell the sachet with the ITN. Also, ways of reminding households of the time of retreatment should be developed. During the focus group discussions, some householders with ITNs said that they had noticed that from for some time mosquitoes had not been found on top of the ITNs, and that the ITNs were not killing mosquitoes anymore. This perception of the effect of the insecticide in the ITNs is very important and should be emphasised to persuade households to come with their ITNs to retreatment, and to buy sachets, if they are available. It has already been observed that a higher coverage of ITN retreatment is found where insecticide is sold in individual packages (Muller *et al.* 1997).

Another important point for discussion is whether the insecticide for retreatment should be sold or distributed free of charge. When a fee is introduced the levels of usage with retreatment are not satisfactory; from the public health point of view. The study conducted in Kilifi, Kenya demonstrated that high retreatment coverage depends on whether a charge is introduced or not, and on whether the payment was introduced after being free. The coverage of retreatment before the introduction of fees was more than 95%, however it dropped to 7% when people were asked to pay for the retreatment (Snow *et al.* 1999). If the insecticide is distributed free of charge, using appropriate channels (such as maternal and health care services) the coverage can reach very high levels (Muller *et al.* 1997). This is a subject that needs more studies and more discussion.

4.5. Conclusion

- **Implementation: The primary health care system can implement an ITN project**

  The results of the present study demonstrated that ITNs could be implemented through the primary health care system, although the supply issue should be considered with more attention. Without a proper system, the stock of bednets and insecticide can run out, and the replacement delay will affect the coverage. The inability to provide all of the ITNs on time was one of the major constraints, which could jeopardise the entire project. The lesson that was learnt, was that before an ITN project is introduced, it is very important to find the means with which to provide ITNs as they are needed and not to wait until the stock runs out. The provision of ITNs has to take into account the entire bureaucratic process of importing nets and insecticide, if the country does not produce its own nets and insecticide.

- **Policy: An ITN project implemented within the primary health care could be more equitable**

  Demand for ITNs was created, however the socio-economic level of households influenced the coverage, the demand for ITNs among poor socio-economic groups was lower than in the richer groups. The experience of the Boane project showed that the price was one of the principal constraints against selling the nets and insecticide. Although the ITNs were not sold for profit the coverage was not very high, for either the ITNs or the retreatment. This has been found in several studies (Winch *et al.* 1997). The problematic and even contradictory objectives of having programme which is both equitable and sustainable, shows the need for further studies in order to determine how the price of ITNs should be established and what would be the gains in terms of public health.

- **Research: Future research on the impact of ITNs on malaria morbidity and mortality under low coverage**

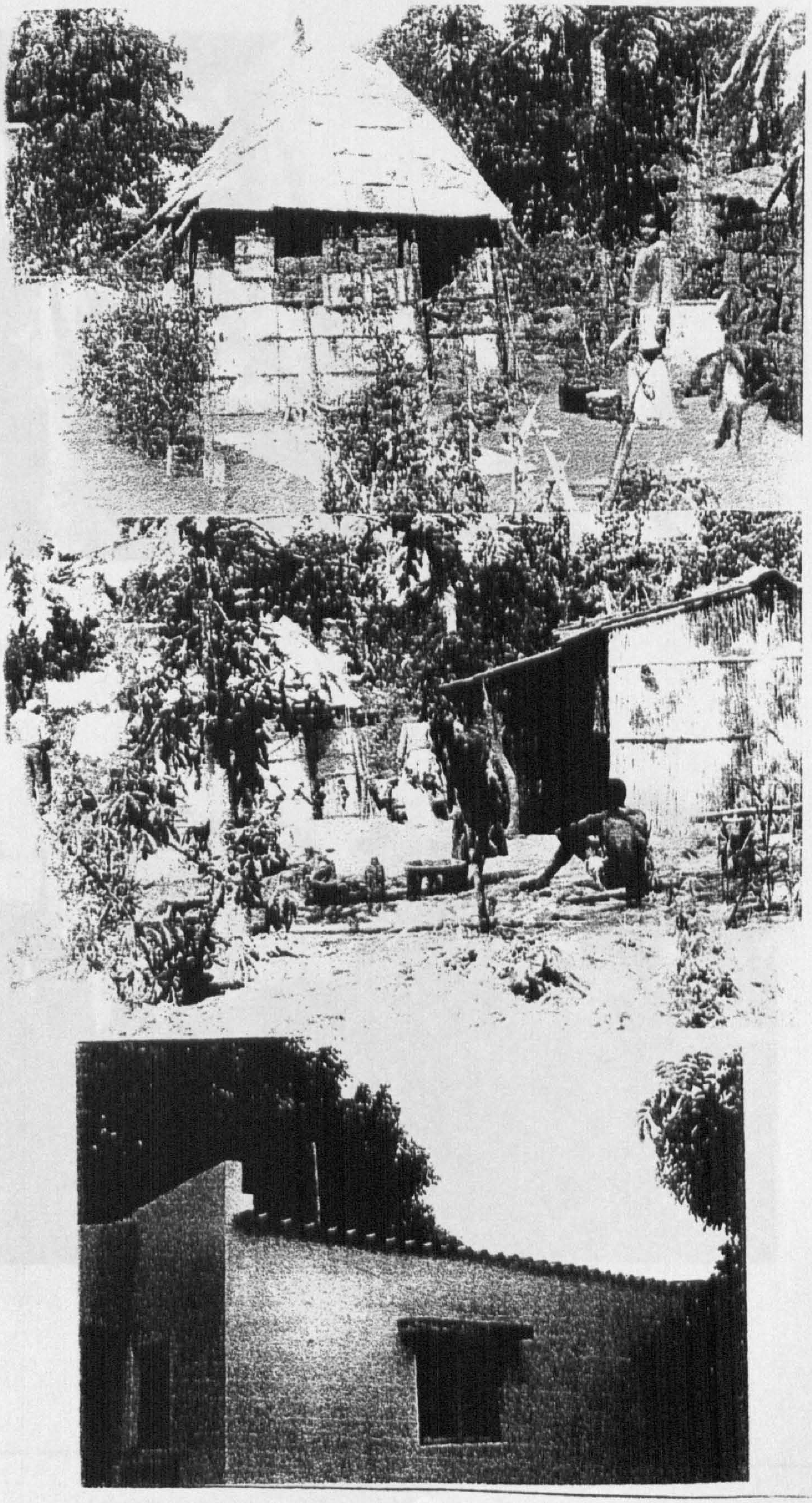
  There is a need to address the question whether or not ITNs will decrease the malaria morbidity and mortality if the coverage is low.

In conclusion it can be said that the primary health care system can deliver an ITN project in a semi-rural setting, and the recruitment and training of local community members can contribute to increasing the coverage. Socio-economic factors, including the price of ITNs, are the main factors, which affect the ITN household coverage. Based on that evidence, it is important to look at how much people are willing and able to pay for ITNs and how their willingness to pay is associated with the demand for ITNs. This question will be addressed in the following chapter 5.

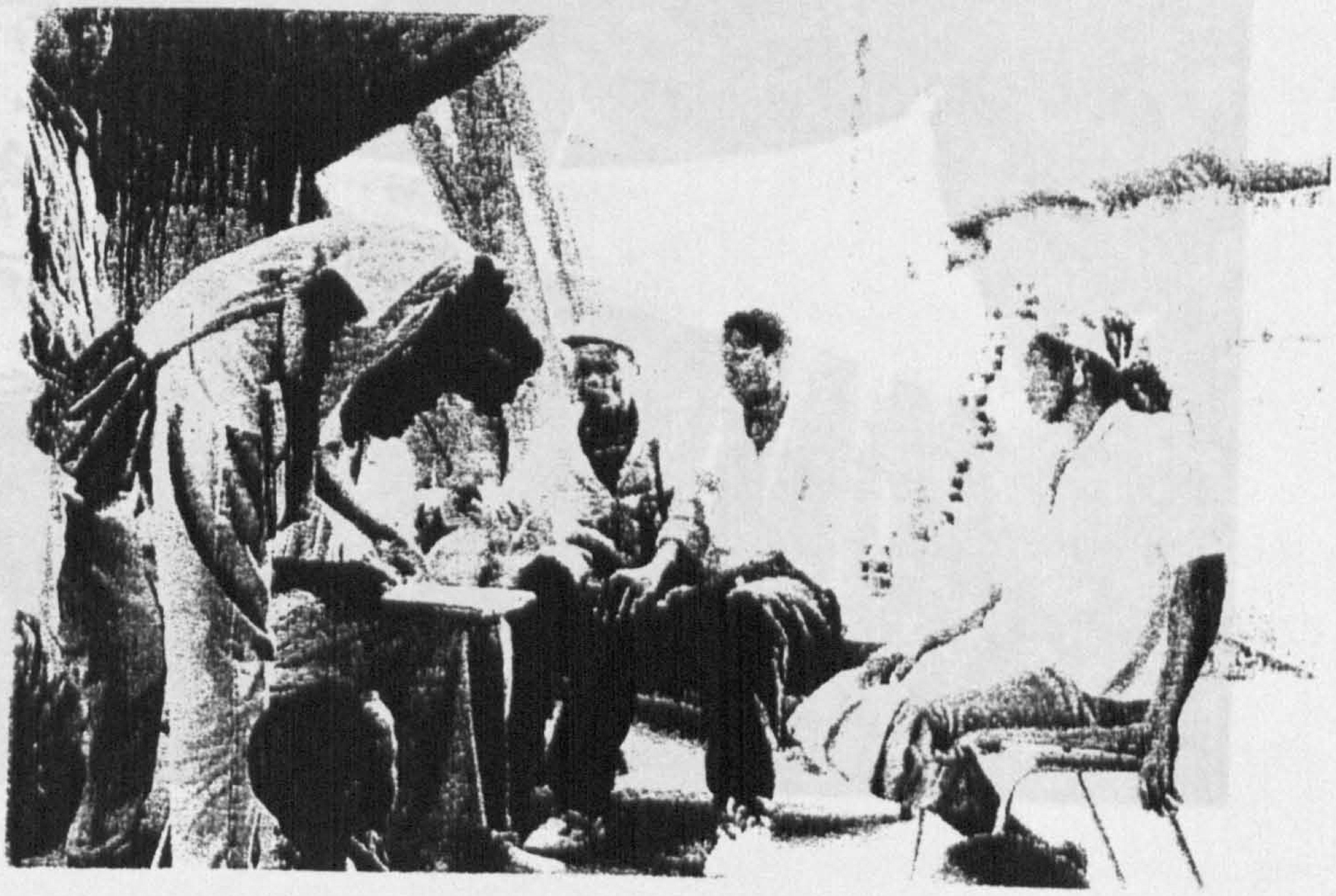
Picture 4.1: The Boane Health Centre

Picture 4.2: Partial view of the "Bairro Massaca I"

Picture 4.3: Houses of Boane



Picture 4.4: Cross sectional acceptability and usage of ITNs survey questionnaire interview



Picture 4.5: The drama group

Picture 4.6: An household with is own ITN

Picture 4.7: Demonstration of ITNs usage during a play in Boane

CHAPTER 5:
WILLINGNESS TO PAY AND ABILITY TO PAY FOR ITNs IN BOANE

5.1. Introduction

Charging consumers or patients for ITN's, and other cost recovery mechanisms, have increasingly been advocated in the public health sector with the aim of improving the financial sustainability of health programmes. However, it has not been well documented how household characteristics determine the level of demand for ITNs, and thus what level of price can be charged.

Before embarking on large scale programmes, planners will have to decide what price to set for the ITNs, taking into account ability to pay as well as willingness to pay, as that will have an effect on whether the objectives of the programme are achieved.

A contingent valuation (CV) presents individuals with different hypothetical scenarios of a programme under evaluation. There are two approaches for CV, one measures the individuals' willingness to pay and the other measures their willingness to accept. The willingness to pay approach asks what is the maximum amount that the respondent would be willing to pay to obtain or prevent a hypothetical specified change in health (Chestnut *et al.* 1996). The willingness to accept approach asks the respondent the minimum amount that they would be willing to pay to accept the loss or reduction of certain goods or services (Morrison and Gyldmark 1992). Willingness to pay (WTP) is used in order to decide whether the programme should be introduced, and willingness to accept (WTA) is used to decide whether the programme should be terminated (Drummond *et al.* 1997). This review will focus on WTP.

The purpose of this study was threefold: first, to estimate the willingness of the people to pay for a non-market item, in an area where very few people had seen that item before; second, to monitor the demand for the item; and third, to evaluate again the willingness to pay for the items following its introduction. The ultimate test of the validity of the survey was done by comparing hypothetical payments with real-money transactions.

The objectives of this chapter are to determine the socio-economic factors associated with the households' willingness to pay for an insecticide-treated bednet, and to determine the household's ability to pay for an ITN and the price that most of the households are able to pay.

In addition, the chapter discusses the implications of the willingness to pay results for establishing the ITN price. These results will guide further discussions about the affordability of the ITN price in the Boane project, and how that price influenced demand for ITN's and affected the sustainability and the equity of ITN project.

5.2. Literature review

Willingness to pay can be used to establish the price of non-market goods, and to determine the difference between the maximum willingness to pay and the price that the individuals would have to pay if the goods were in the market. Thus, the estimate of consumer surplus (the difference between maximum WTP and the market price) can help the Government and the Health Care Agencies with the establishment of prices and of the financial mechanisms of health care activities, as well as with the budget allocation for different programmes, such as an ITN programme.

Contingent valuation was first developed in environmental economics to estimate the value of environmental changes (Johannesson 1996). One of the advantages of CV is that it can be applied where a market does not exist. A significant concern about the results of CV methodology is whether people respond accurately to payment questions, because what people say they are willing to pay and what they will really pay may be different (Chestnut *et al.* 1996). Another concern is that if the results of the WTP survey are to be utilised for the purpose of developing a policy regarding price, and taking into account budgetary constraints, particularly when the WTP amount does not cover the cost of the service, then additional financial resources have to be provided (Morrison and Gyldmark 1992).

In the past few years, the CV method has been used to measure WTP for changes in health care in developed and developing countries. In developed countries, CV studies have been undertaken in areas such as laparoscopy surgery (Donaldson and Shackley 1997, reproductive health (Ryan 1996), lung cancer disease (O'Brien and Viramontes, 1994) and cardiovascular diseases (Kartman *et al.* 1996). In developing countries very few studies have been undertaken. Some studies assessed WTP for malaria: one for the prevention of malaria by vaccination (Whittington *et al.* 1996), the other for re-treatment by Mills *et al.* (1994) and the other for bednets (Onwujekwe 1999) to assess the WTP for the prevention of malaria by the use of insecticide-treated nets. The purpose of the majority of the studies was to establish a price, taking into account the cost recovery perspective.

The willingness to pay methodology is still somewhat under experiment, this section will review the different methodological methods available to determine WTP. This section will introduce the concept of validity and reliability and will review the different methodologies used to assess the willingness to pay.

Reliability and validity of contingent valuation methods

The issues of the validity and reliability of CV methods are important to be considered in contingency valuation studies (Kartaman *et al.* 1996). Validity indicates the differential between the results of CV and real demand for the item. The "gold standard" of validity is the actual demand for the goods.

Reliability measures the consistency of replicable measurements concerning the same individual. One way to measure reliability is to interview the same individual a second time and to compare the results of the two interviews. Another way of testing reliability is to look for a connection between an independent and a dependent variable (both measured in the same individual) and then to try to determine whether the one can predict the other (Fox-Rushby, 1993).

Mitchell and Carson (1993) evaluated various ways of checking the reliability and validity of the surveys. They developed criteria for sampling procedures, for the way that the scenario should be presented to the respondents, for the methodology used to collect information, and for the way that the data should be analysed. Again, the National Oceanic and Atmospheric Administration Panel (1993) evaluated the procedures, to check the reliability and validity of the CV methodology. This panel emphasised the use of referenda to collect information regarding WTP, in addition to the collection of socio-economic data such as information about expenditure that could explain the respondents' WTP.

One of the major concerns of testing reliability is to select an appropriate time interval. If the time is too long, then the context that the survey was undertaken might have changed, if the interval is too short, then the interviewer may remember their first response and put it down, rather than answering the question *de novo* (Streiner and Norman 1995). Streiner and Norman (1995) recommended a retest interval of two to 14 days. Another important factor associated with reliability and validity is the sample size (Bhatia 1996). The size of the study's sample size has to be suitable for the subject under study. According to the Water Resource Council's guidelines (1979), the minimal sample size suggested was two hundred.

The majority of studies used regression models to analyse their data. Analysis of variables that have an effect on WTP shows that income and education were the most common variables. Others were the severity of disease and the patterns of household expenditure. The median figure was used in the majority of studies, as a better estimate of WTP than the mean (Bhatia 1996).

Some authors have started to check the validity of their results comparing hypothetical and actual WTP (Johannesson *et al.* 1998, Onwujekwe 1999). The results of these studies showed a variance of responses, from no divergence between hypothetical and real WTP to mild to severe differences. These variance of results shows that the technique needs to be developed, and more studies are needed to assess the hypothetical and actual WTP.

Willingness to pay elicitation methods

Fox-Rushby in an unpublished review of CV, described five main approaches for the collection of data on CV, which are as follows: the open-ended question, the payment card, the bidding game, the take-it-or-leave-it, and the take-it-or-leave-it with follow-up approach.

a) Open-ended technique

The open-ended question asks what is the maximum price an individual is willing to pay. This approach only works well if the respondents are accustomed to paying for the commodity. The disadvantages are, that many individuals find it difficult to answer, and state a price without any frames of reference, that the respondents often say that the price is "unacceptably high" or give no answers, and that this approach needs a skilled interviewer. In addition, the open-ended question may not always push the respondent to give the highest price but rather to give an amount acceptable to him/her (Donaldson, *et al.* 1997). The open-ended question was the method used in the first WTP survey in 1995 (see chapter 3). This approach was used because the study was undertaken before the "principal investigator" had the opportunity to explore other available methods (before he started formally his Ph.D training), which he did during the second WTP. Although, the open-ended question has the limitations described above, recent studies that have compared hypothetical and actual WTP, and that also compared the open-ended and close ended elicitation methods found that actual WTP was roughly the same regardless of which elicitation method was used (Bishop *et al.* 1992, Brown *et al.* 1996 and Loomis *et al.* 1997). For example Loomis *et al.* (1997) suggests that it may be premature to abandon use of open-ended WTP questions.

b) Bidding game technique

The bidding game is the oldest and mostly widely used approach, and is a closed-ended question format. It is modelled on a real life situation, in which the bidding game imitates an auction, at which the people are asked about their willingness to pay a specific price (YES or NO answers). The first bid is introduced and it is followed by higher or lower prices, until the respondent reaches the maximum price he is willing to pay. For example, the respondent is asked if he/she will pay $5.USD for an ITN. If he/she says Yes, then a higher price than that is asked, and so on until a price is reached that the respondent is not willing to pay. Alternatively, the bidding may open with a high price and move downwards until a price is accepted. This method was employed by O'Brien and Viramontes (1994). Its advantage is that it is based on a realistic decision, and thus it can reach the highest WTP as it enables the respondent to fully consider the value of the item. The starting point bias is the main disadvantage, as the starting bid tends to give an implied value to the item. This sort of bias is referred to as implied-value clues (Stålhammar, 1996). It is suggested that the principal reason for this bias is psychological; it is a more frequent problem when the respondent is not familiar with CV methods, and becomes very sensitive to the prices given and to other information related to the method. Respondents have also a tendency to say "YES" to the first bid, (Chestnut *et al.* 1996). In order-to overcome the starting bias, some studies randomly set either high or low starting bids for the respondents (Stålhammar, 1996, Chestnut *et al.* 1996).

c) Payment card technique

The payment card is the main alternative to the bidding game; it uses a direct approach and can improve response rates to WTP questions. The payment card method uses a series of cards marked with a wide range of prices, in random order. The respondent is asked to choose the price (or to name an intermediate figure) representing the most that he is willing to pay. The payment card method avoids the starting point bias, as it offers the respondent a context for the bid; it leads to fewer zero responses and is generally more likely to be answered, compared to the open-ended approach. The disadvantage is in the potential biases associated with the range of prices used on the cards, and the location of benchmarks.

d) Closed-ended technique (take-it-or-leave-it)

The "take-it-or-leave-it" approach uses a closed-ended WTP question format. In this approach, each respondent is asked if he/she is willing to pay a single price. The answer has to be YES or NO, without further qualification. Each price within the selected price range is administered to a number of random sub-samples. This approach uses a large number of pre-determined prices, chosen to represent the expected maximum amounts most respondents are willing to pay. For example, the respondent is only asked if he/she is willing to pay $5 for an ITN (YES/NO). The next person would be asked if he/she is willing to pay $7.50 and so on. Because each respondent is given only one price, this approach simplifies the respondent's answer, and it is less sensitive to strategic bias than the other approaches. This method simulates a real market situation, when either you buy the item or you do not. The data are analysed using econometric techniques such as probit analysis, which determines the relationship between the proportion of respondents accepting or rejecting the bid at different price levels. From that, a bid curve can be drawn, and using mathematical models, a median of WTP can be estimated. The disadvantage of this method is that it is relatively inefficient compared with the others. It is subject to starting point bias because the analyst selects the range from which the bids are sampled, although different prices are presented to overcome this bias. This methodology has been applied to various studies, such as the WTP for hormone replacement therapy (Zetharaeus, 1998).

e) Take-it-or-leave-it with follow-up approach

The take or leave it approach with follow-up asks the WTP a specific price and then, based on the YES or NO answer, another question is asked using a higher or lower price than previously mentioned. It allows only two jumps in either direction, and the follow-up price should be a distinct jump from the original price. In this way, the follow-up question gains additional information on price rises or falls. This method is designed to improve the take it or leave it approach. However, it requires a more complicated interview.

Discussion of the different methods utilised to evaluate willingness to pay

To summarise, it could be said that there is always some inherent difficulty in measuring the amount that individuals might be willing to pay for goods or services, no matter which WTP evaluation method is used (Diamond and Hausman 1994).

The problem of which method should be used, and which questions should be asked, of whom and how, needs to be resolved. The open-ended technique does not reflect a realistic market situation, but rather a voluntary contribution, and therefore it can only be used to measure imaginary WTP. The payment card does not reflect how people buy goods because goods do not have multiple choice prices, amongst which people can choose the prices they fancy. The binary system does not reflect the way that people buy in most markets in Sub-Saharan Africa, because there, negotiations must take place before anyone buys any goods. It is only in big supermarkets in urban areas that the binary system is adopted. However, despite all of these limitations, WTP has been used as a tool for the evaluation of people's preferences.

5.3. Methodology

Two surveys on willingness to pay were carried out. The first was part of the major survey described in chapter 3, in which during the census an open-ended question about how much people were willing to pay was asked of all households in the study area. This survey took place in 1995.

The second is the present survey which is detailed below. It took place two years after the introduction of ITNs in Boane (1998), among a selected sample of the households interviewed in 1995. In this section the results of the second WTP survey are presented. The results that are shown below refer to a sample of 543 households who were interviewed first in 1995 and again in 1998.

A cross-sectional questionnaire interview was chosen to collect data (Appendix 5.1). Two different groups were selected: one, households that had bought an ITN and the other, households that did not have an ITN. The survey instruments included socio-economic questions to examine what effects household wealth, income and expenditure have on WTP for an ITN.

5.3.1. Sample size selection

Cross-sectional surveys were done among a random sample of households, including some that had bought and some that had not bought an ITN, stratified by socio-economic level.

Households for both groups were randomly selected, using the random number generator of the EPINFO software program. Households that had bought an ITN were selected from the sales files, and households that had not bought one from the census files. The sample of households was stratified by socio-economic status. Three socio-economic levels were identified: household possession of a radio, television, refrigerator, electricity, running water and a house with concrete walls were the criteria used to measure the socio-economic status of the households (see chapter 3). For both groups of households (those that had and those that had not bought an ITN), the sample size of each socio-economic group was based on the proportion of that socio-economic group in the population.

5.3.2. Data collection

The type of question used was a form of contingent–valuation, which included an adaptation of bidding game approaches and open-ended questions. The first bid offered ($12.70) was the maximum price, which was 2.3 times the price of the ITNs (double size) being sold in the project. The householder was asked, in binary question form (YES or NO), whether he was willing to pay the assigned bid for an ITN. If the response was No the bid amount was lowered to $7.60. If the response was No again the bid was lowered to the actual price of the double size ITN ($5.50). If the response was No again, an open-ended question was asked, asking the maximum amount, below $5.50, that the householder would be willing to pay. Those who were not willing to pay $5.50, were asked the reasons for their refusal. The difficulty in setting the price meant that an arbitrary starting point was chosen. However, this may have introduced a starting point bias, because the reported WTP was likely to be affected by the size of the first bid offered.

Another potential source of bias when using the CV method to assess WTP is scenario mis-specification (Stålhammar, 1996). This can occur because of misinterpretation by the respondent or mis-specification of the questions by the interviewer. The scenario must have a realistic price and must be compatible with the policy change being evaluated. Based on the above considerations and the actual price of ITNs in Boane, the following scenario was formulated:

Scenario of WTP survey

As you are aware, malaria is a disease that can kill people. Malaria is a disease transmitted by mosquitoes. One way to avoid malaria is to sleep under an insecticide-bednet.

This net that you see is not an ordinary net, but has been treated with insecticide which will kill mosquitoes and protects you from mosquitoes and other insects. It will also reduce the number of episodes of malaria in households, and thus will reduce the total number of episodes of malaria.

This net will only protect you or your family members, when you are inside it. It will not protect you or others when you are outside the net or not using the net.

Remember one bite from a mosquito is enough for you to get malaria, and thus everyone should use a bednet, particularly children.

Because the net has been treated with insecticide, during the first week some of you may experience headache, burning eyes or coughing. However, the insecticide is not harmful to you or to children, even if the child puts the net in his mouth and swallows some insecticide.

As the effect of the insecticide lessens after some time, the net needs to be retreated again every year, so you will need to bring it once every year for retreatment at the PHC or village community centre in your village.

The nets should not be washed during the year, in order to avoid the loss of insecticide; however if you do wash it for any reason, please come back to the PHC to have your net retreated.

Did you understand?

Keeping the above information in mind, and if the nets are made available to you from the PHC, please, let us know the following:

Based realistically on your monthly income and expenditure, are you willing to pay $12.70 for an ITN? (YES or NO). If No continue with the next question.

After the willingness to pay question, the interviewer started collecting information about monthly household income and expenditure, and about the wealth of the household. Using open-ended questions the households were asked a series of questions regarding household income and expenditure. Different scenarios according to income and expenditure were given to the households, to help them think about how they had earned and spent money during the previous month.

Principle variables utilised to indicate socio-economic status:
The size of the family, who heads the family and his/her sex, the marital status of the head of the household, the level of education of the household members, the occupation of the household members, household possessions (radio, television, car, bicycle, cattle, etc.) land ownership, and housing conditions (electricity, number of rooms, water supply, type of walls and roof).

Principle variables utilised as indicators of monthly income:
Total household income generated during the previous month, which consisted of the sum of the monthly wages of each of the household members, rents collected, income from sales in the street market, the income from sales of farm produce and other remittances.

Principle variables utilised as indicators of monthly expenditure:
Food and drinks consumed in the household, household expenses such as electricity, gas, telephone repairs, transport, clothing, school fees, home furniture, recreation, farming expenses, (including upkeep of animals), health expenditures including malaria prevention, etc. Some of the expenditures were calculated on a monthly basis, others were calculated on seasonal basis, such as farming. The expenditures which were not calculated on a monthly basis, were divided by the number of months applicable to that specific expenditure in order to get the average estimated monthly expenditure for the item in question.

Information on expenditure for the treatment of illness was collected by asking the head of the household or the carer for the sick person how much they spent for the treatment of any sick person within the household during the previous three months. The expenditures were calculated according to the amount of money spent in a public clinic or a private clinic, paid to a traditional healer, or spent on self-medication. Travel costs were also estimated. The cost of medical treatment was estimated using information reported by patients.

5.3.3. Data analysis

Categorical variables were analysed using the χ^2 test with 95% confidence interval. Continuous data were analysed using the *t* test if they were normally distributed and non-parametric analysis if they were non-normally distributed data. The results of the WTP survey were presented by median or mean and standard deviation. Regression analysis was performed to determine whether there was an association between different variables and WTP. Possible predictors were monthly household income and expenditure, level of school education of the head of the household and the socio-economic level of the household. Multiple regression was employed in testing the internal validity of the contingent valuation method. As part of the validity testing, the regression analysis included explanatory variables such as income and expenditure. It was hypothesised that people with higher income and expenditure would be willing to pay a higher price for an ITN.

Ability to pay was measured in the Boane project in relation to the price of an ITN expressed as a percentage of monthly household income. Households in which the price of an ITN ($5.50) exceeded 5% of the monthly income (i.e. households with a monthly income less than $110) were considered "unable to pay", while those with a higher income were considered "able to pay".

There is no clear definition of ability to pay for ITNs in the existing literature. Some authors have used a cut-off percentage of household income to define people's ability to pay for curative health services. It has been said that households in Africa spend between 2-5% of their income on health care (Barton 1995 and Huber 1993, both cited by Russell 1996). However, Russell (1996) neither discusses those figures nor recommends any specific percentage of income to define people's ability to pay. Since there is no other definition, the present thesis will use the arbitrary cut-off point of 5% of household income as the maximum WTP for ITNs. However, there is no clear evidence as to whether this range (2-5%), which has been used to define Ability to Pay for curative services, might apply in the case of preventive services, such as the use of ITNs.

The data were analysed on a personal computer using two different programmes, the *EPIINFO* and *STATA 6.0 for Windows®*.

5.4. Results

The unit of analysis in this survey was the household. Five hundred and forty-three (543) households were interviewed. The sample size distribution can be seen in Table 5.1.

Table 5.1: Sample size distribution by socio-economic groups

Socio-economic Groups	N. HOUSEHOLDS		
	WITH ITNs	Without ITNs	Total Households
Poor	109	106	215 (39.5%)
Middle-income	171	134	305 (56.1%)
High-income	16	7	23 (4.2%)
TOTAL	296	247	543 (100%)

The mean age of the respondents was 40 years (sd=12.6) and the median age 38 years. 272 (50%) of the respondents were heads of the household. More than a quarter of the respondents were illiterate (table 5.2).

The data were collected in terms of the Mozambique currency and then converted to U.S. dollars. The exchange rate used in all of the following tables is $1US to 11,800MT, as that was the rate at the time of the survey.

Table 5.2: Baseline information of the households interviewed in 1998

Variables	Number
Number of households interviewed	543
Total population	2782
Mean number of people per household	5.1 (sd=2.6)
Mean age	40 (sd=12.6)
Number of persons interviewed who were head of household	272 (50%)
Sex ratios of head of household (M:F)	439/104
Proportion of illiteracy within respondents	145 (26%)
Number of households with an ITN	296 (54.5%)

5.4.1. Household income and expenditure in Boane

Income and expenditure data were collected and calculated on a monthly basis.

Table 5.3 shows information related to the sources of monthly income. 543 households were interviewed; however 143 (26.3%) households did not declare the amount of their monthly income. Table 5.3 only refers to the 400 households who did declare their income. The median income was $38 and the mean $51.

Salary was the principal source of income (79%), and represented 71.5% of the total monthly household income. The mean salary was $42 and the median $32. The second most important source of monthly income was the sales of goods in the street market (23%) and it was followed by the sale of farm produce.

Monthly household per capita income was calculated by dividing the total monthly income by the total number of people living in the household. The mean monthly per capita income was $13 (annual income per capita $156) and the median $8.

Table 5.3: Sources of monthly cash income and mean and median income in Boane District, June 1998, in US$

	Total =400					
	Number that declared (%)	Total value declared ($)	Mean ($)	Median ($)	Range($)	% in relation to total income
Total income	400 (100%)	$22,065	$51	$38	$2-398	100%
Salary	79%	15,784	50	38	9-261	71.5%
[1]Market sales	23%	2,368	26	16	0.8-170	10.7%
[2]Remittances sales	11%	3,302	75	42	4.2-106	14.9%
[3]Farming production	6.5%	611	23	13	1.3-102	2.7%
				-		
Total income per capita per month	400	5,057	13	8	0.4-136	
Total income per capita per year	400	60,684	152	102	4.4-1627	

[1]Market sales = income from any goods sold at the formal and informal market, including traditional alcoholic drinks.

[2]Remittances = money received from outside Mozambique, usually from migrant labor

[3]Farming production was valued on the basis of the cash received for sales of the crops produced during the previous six months, divided by six month to give a monthly figure

Monthly household expenditure data can be seen in table 5.4. All households (543) said they had spent certain amounts of money. The mean monthly reported expenditure was $67 and the median was $52. All households had spent money on food. The mean expenditure on food was $46. The second most frequently mentioned item was household expenses such as rent, electricity, gas, water, firewood, telephone. An analysis of the proportion of money spent per item in relation to the total expenditure showed that 67.6% of the total expenditure was on food.

The monthly per capita expenditure was also calculated by dividing the total household expenditure by the number of persons in the household. The mean per capita expenditure was $16 and the median was $12.

Table 5.4: Monthly expenditure and mean and median expenditure by item in Boane District, June 1998 in $

	Total = 543					
	Number that declared (%) N=543	Total value declared ($)	Mean ($)	Median ($)	Range($)	% in relation to total expenditure
Total expenditure	100%	$36,628	$67	$52	$1.8-410	100
Food	100%	24,767	46	37	0.4-249	67.6
House maintenance	63.4%	2,569	7	5	0.1-59	7
Transport	54.3%	1,833	6	3	0.3-80	5
Clothing	53%	1,333	5	3	0.1-35	3.6
School fees, books, etc.	53.4%	212	1	0.4	0.03-13	0.57
Health	48.8%	183	1	0.1	0.01-41	0.4
Others		3,909				10.6
Malaria prevention						
Mosquito coils	15.5%	82	1	1	0.1-3	0.2
Insecticide in cans	5.5%	83	3	2	0.7-11	0.2
ITNs*	34.8%	1,658	9	6	2.1-26	4.5
Total expenditure per capita/ month	100%	8,712	16	12	0.2-137	
Total expenditure per capita per year	100%	104,545	193	140	2.7-1639	

[1]House maintenance = water, electricity, gas, monthly rent, firewood, telephone

[2]Transport=money expended on transport (bus, train, taxis, etc.)

[3]Clothing=money expended on clothes for all members of the household

[4]School fees, books, etc.= money expended on schoolbooks, school fees, other books, newspapers, pens, etc.

[5]Health= money expended on consultation, medicines, laboratory analyses, (public, private, traditional healer) (as in- or-out-patients)

[6]Malaria prevention = money expended on ITNs, mosquito coils, insecticide in cans

*ITNs refers to expenditure during the last 3 months, divided by 3 to give a monthly figure

A correlation analysis was undertaken between income and household. The results showed a correlation between income and expenditure, as the higher incomes were correlated with higher expenditures (Pearson correlation=0.407, two tailed significance level<0.0001). The linear regression between income and expenditure showed an association between the two variables (R^2=0.166 95%CI=0.10-0.26, Anova test: F=86.86, p<0.001). The association between the two gives evidence of the reliability of the data.

5.4.2. Willingness to pay for treated bednets

The actual price of an ITN being sold in Boane will be used for analytical purposes as the cut-off price to distinguish the households willing to pay from those not willing to pay. Households reporting a willingness to pay $5.50 or above in 1998 were classified as willing to pay, and those only willing to pay below that price were classified as not willing to pay. The mean WTP in 1998 was $5 and the median was $5.50. About 70% (382/543) of the households were willing to pay $5.50 for an ITN.

5.4.2.1. Comparison of WTP variables as predictors

The following variables were selected to study whether they could predict WTP: socio-economic level, level of school education of the head of the household, and possession of an ITN. Table 5.5 shows the relation between these variables and WTP.

5.4.2.2. Socio-economic factors and WTP

Households were placed in three different socio-economic strata according to their possessions (see Table 5.1). Table 5.5 shows the association between socio-economic level and willingness to pay. As can be seen, the highest proportion of households willing to pay was in the high-income group (χ^2= 16.7; p=0.002).

5.4.2.3. Level of school education and WTP

The level of school education of the heads of household was analysed according to three criteria, as follows: heads of household without any school education were placed in one group, those with primary school education in a second group, those with secondary school education in a third group. Table 5.5 shows a statistically significant relationship between level of school education and WTP.

The majority of respondents had only been to primary school, and 31% were illiterate. The proportion of WTP among families where the respondent did not have any education was 57.5%. It increased to 85.3% among households where the respondent had a secondary school level of education (χ^2=20.6; p<0.001) (Table 5.5).

5.4.2.4. WTP versus demand for an ITN

Households that bought at least one ITN were identified (Table 5.5). A higher proportion of households willing to pay than those not willing to pay had already bought an ITN (χ^2=7.76; p=0.005). However, it was observed that 13.4% of the households (73) said that they were not willing to pay, although they had already bought an ITN. On the other hand, about a third of the households (159) said they were willing to pay but did not buy an ITN. Summarising, 232 of the households either said that they were willing to pay and did not buy or said that they were not willing to pay and bought an ITN, in the other words, the results of the WTP survey were misleading in about 40%.

Table 5.5: Willingness to pay for an ITN by socio-economic group and level of education, and actual purchase of ITNs in Boane - 1998

Socio-economic groups	Total respondents	Willing to pay	χ^2	P
Poor	215	130 (60.5%)	16.7	0.002
Middle-income	305	234 (76.7%)		
High-income	23	18 (78.3%)		
TOTAL	543	382 (70.3%)		
Level of School				
Education of respondent	Total respondents	Willing to pay	χ^2	P
Illiteracy	167	96 (57.5%)	20.6	<0.0001
Primary level	342	247 (75%)		
Secondary level	34	29 (85.3%)		
Total	543	382 (70.3%)		
Purchased an ITN				
	Total respondents	Willing to pay	χ^2	P
NO	247	159 (64.4%)	7.7	0.005
YES	296	223 (75.3%)		
TOTAL	543	382 (70.3%)		

5.4.2.5. Monthly household income and expenditure versus WTP

Household income and expenditure were used to observe the relation between these variables and WTP.

5.4.2.5.1. WTP versus monthly household income

The households were divided into five groups according to monthly income: 1) households that did not state their income; 2) households with income less than \$30; 3) households with income of \$30 or more but less than \$85; 4) households with income of \$85 or more but less than \$169; 5) households with income of \$169 or more. The rationale behind the division into those groups is that the minimum salary in Mozambique is about \$30 and people with an income of more than \$169 can be classified as having the highest standard of living in Boane. Table 5.6 shows that only about 2.7% of the households had an income of more than \$169 per month, that WTP was related to the level of income, and that the proportion of WTP increased significantly, from 62.2% in the lowest income group to 76.7% in the highest (χ^2=7.76; p=0.005).

Table 5.6: Willingness to pay according to monthly household income in 1998

Income groups ($)	TOTAL	Willing to pay	χ^2	P
Not declared	135	84 (62.2%)	7.7	0.005
>$0-29	135	91 (67.4%)		
$30-84	215	160 (74.1%)		
$85-169	43	33 (76.7%)		
>=$170	15	14 (93.3%)		
Total	543	382 (70.3%)		

5.4.2.5.2. WTP versus monthly household expenditure

The analysis of monthly household expenditure showed that households willing to pay had a higher monthly expenditure ($75, n=161) than those not willing to pay ($55, n=382) ($p$=0.001).

Expenditure was divided into four different categories. The same cut-off levels used to divide the income groups were used to divide the expenditure groups. Table 5.7 shows that the proportion of households WTP increased with expenditure. About 61% of households spending less than $30 per month were willing to pay for an ITN, compared with 83.9% of households spending $169 or more ($\chi^2$=12.3; p=0.006).

Table 5.7: Willingness to pay according to household expenditure in 1998

Expenditure ($)	TOTAL	Willing to pay	χ^2	P
>$0-29	150	91 (60.7%)	12.3	0.006
30-84	239	170 (71.1%)		
85-169	123	95 (77.2%)		
>=170	31	26 (83.9%)		
Total	543	382 (70.3%)		

5.4.3. Monthly household income and expenditure versus purchase of ITNs

Household income and expenditure were used to observe the relation between these variables and purchase of ITNs (tables 5.8 and 5.9). The same cut-off levels used to divide the income and expenditure groups in the previous analysis (WTP versus income and expenditure) were used to divide the income and expenditure in the present analysis. As it can be seen from the table 5.8 and 5.9 the proportion of households who purchased an ITN increased with income or expenditure.

Table 5.8: Purchase of ITNs according to monthly household income in 1998

Income groups ($)	TOTAL	Purchase of ITNs	χ^2	P
Not declared	135	67 (49.6%)	11.22	0.02
>$0-29	135	69 (51.1%)		
$30-84	215	117 (54.4%)		
$85-169	43	31 (72.1%)		
>=$170	15	12 (80%)		
Total	543	296 (54.5%)		

Table 5.9: Purchase of ITNs according to household expenditure in 1998

Expenditure ($)	TOTAL	Purchase of ITNs	χ^2	P
>$0-29	150	64 (42.7%)	18.3	0.0003
30-84	239	131 (54.8%)		
85-169	123	77 (62.6%)		
>=170	31	24 (77.4%)		
Total	543	296 (54.5%)		

5.4.4. Ability to pay for an ITN

There are no clear guidelines as to the proportion of household income that households are able or not able to pay for an ITN. For the purpose of this study, an arbitrary figure of 5% of income was used as the amount that people are able to pay for an ITN (see Section 5.3.3). Thus, if the ITNs cost more than 5% of the monthly income of a particular household, then that household was classified as not able to pay.

These calculations assume implicitly that the price of an ITN must be paid out of the income for one month. Yet an ITN will last much longer than one month. Therefore, similar calculations were carried out assuming that the payment of the price of a net could be spread over three, six or twelve months. The results in table 5.10 showed that more households would be defined as "able to pay", in relation to their reported income or expenditure, if the payment for the ITN were spread over three or six months, and that nearly all would be "able to pay" if the payment were spread over a year (assuming that the people would save money in order to be able to buy the ITNs). In other words, for a large majority of households, the price of an ITN was greater than 5% of their monthly income or expenditure, but less than 5% of their annual income or expenditure.

Table 5.10: Ability to pay according to monthly income and expenditure in 1998.

Ability to pay based on 5% of income *	**Income (Number of households=400)**			
	Monthly	Quarterly	Semi-annual	Annual
Able	8%	52.5%	83.7%	95%
	Expenditure (Number of households=543)			
Ability to pay based on 5% of Expenditure	Monthly	Quarterly	Semi-annual	Annual
Able	18.2%	65%	84.5%	94.4%

* Households were regarded as "able to pay" if their income exceeded $110 over the relevant time period.

5.4.4.1. Ability to pay measured according to the purchase of ITNs

This study of household purchase of ITNs, and of ability to pay according to monthly income, showed that the proportion of households buying an ITN was higher among households classified as able to pay than among those classified as unable to pay (χ^2=6.62, p=0.001).

However, as seen in Table 5.11, there was no relation between the actual purchase of ITNs and the households' ability to pay the price of the ITNs as a proportion of household income, even when the cost was spread over three, six and twelve months.

On the other hand, the above analysis of the purchase of ITNs and ability to pay the price of the ITNs as a proportion of monthly household expenditure and of household expenditure spread over three, six and twelve months, demonstrated that the purchase of ITNs was influenced by whether the expenditure came out of the monthly income or was spread over three, six and twelve months (Table 5.12).

Table 5.11: Ability to pay according to income and to having purchased ITNs

Income / **Ability**	**Monthly** ITN No	ITN Yes	Total	χ^2= 6.62; p=0.01
Yes	7	25 (78%)	32	
No	167	201(55%)	368	
Total	174	226	400	

Income / **Ability**	**Quarterly** ITN No	ITN Yes	Total	p=0.1
Yes	84	126 (60%)	210	
No	90	100 (53%)	190	
Total	174	226	400	

Income / **Ability**	**Semi-annual** ITN No	ITN Yes	Total	p=0.7
Yes	147	188 (56%)	355	
No	37	38 (59%)	65	
Total	174	226	400	

Income / **Ability**	**Annual** ITN No	ITN Yes	Total	p=0.7
Yes	166	214 (56%)	380	
No	8	12 (60%)	20	
Total	174	226	400	

Table 5.12: Ability to pay according to expenditure and to having purchased ITNs

Expenditure	Monthly			χ^2= 14.45
	ITN		Total	*p*=0.0001
Ability	No	Yes		
Yes	28	71 (72%)	99	
No	219	225 (51%)	444	
Total	247	296	543	
Expenditure	**Quarterly**			χ^2=12.51
	ITN		Total	*p*=0.004
Ability	No	Yes		
Yes	141	212 (60%)	353	
No	106	84 (44%)	190	
Total	247	296	543	
Expenditure	**Semi-annual**			χ^2=6.61
	ITN		Total	*p*=0.01
Ability	No	Yes		
Yes	198	261 (57%)	459	
No	49	35 (42%)	84	
Total	247	296	543	
Expenditure	**Annual**			χ^2=7.69
	ITN		Total	*p*=0.005
Ability	No	Yes		
Yes	226	287 (56%)	513	
No	21	9 (30%)	30	
Total	247	296	543	

5.4.4.2 The ITN price as a hypothetical proportion of monthly household income and expenditure

The price of one ITN ($5.50, for the double size) was divided into household income and household expenditure in order to determine what percentage of monthly household income and monthly household expenditure would be required to purchase one ITN. From the data on monthly income and expenditure, the median and mean values were calculated, and compared to the price of an ITN. This price ($5.50) represent 14.4% of median monthly income, 23% of mean income, 10.6% of monthly median expenditure and 18.1% of mean expenditure (Table 5.13).

5.4.4.3. A hypothetical ITN price that half the households would be able to pay

The price that most households would be able to pay was estimated to be 5% of monthly household income and monthly household expenditure. (5% of monthly household expenditure was suggested previously as the maximum amount most households would be able to pay for an ITN). The median and mean values of these calculations were determined. On the basis of 5% of monthly household income, the median price that half of the population would be able to pay was $1.90 (mean=$2.50); on the basis of 5% of expenditure, the price was slightly higher (median=$2.50, and mean=$3.30) (table 5.13).

Table 5.13: Proportion of the ITN price in relation to monthly income and expenditure and the hypothetical price that half of households would be able to pay

	Income	Expenditure
Overall median	$38	$52
Overall mean	$51	$67
Median proportion of monthly income or expenditure required to buy an ITN at $5.50	14.4%	10.6%
Mean proportion of monthly income or expenditure required to buy an ITN at $5.50	23%	18.1%
Price necessary for 50% of households to be classified as "able to pay" by monthly income or expenditure	$1.90	$2.50

5.4.5. WTP in 1995 versus purchase of ITNs

A comparative analysis of WTP and purchase of ITNs was undertaken in 1995.

Table 5.14 shows the number of households that bought an ITN in relation to their stated willingness to pay in 1995. The table shows that stated WTP of more than \$5.50 in 1995 was not significantly associated with the actual purchase of an ITN later. More than a half of the households who claimed not be willing to pay an ITN did in fact buy an ITN later (54%; 285/526). On the other hand, not all the households who stated that they were willing to pay did buy later.

Table 5.14: WTP in 1995 versus purchase of ITNs

	WTP 1995	
Bought a net	No	Yes
No	241	6
Yes	285	11
Total	526	17
χ^2=0.74 p=0.3		

5.4.6. WTP in 1995 versus WTP in 1998

It was observed that between 1995 and 1998, the amount that people were willing to pay had changed. Table 5.15 shows the relation between WTP in 1995 and WTP in 1998. As can be seen, 76% of the households among the seventeen households that were willing to pay in 1995 continued to be willing to pay in 1998, but less than 30% of the households among the 526 not willing to pay in 1995 continued to be not willing to pay in 1998. On other words, only 170 households (31%) did not change their willingness to pay between the two surveys.

Table 5.15: WTP in 1995 versus WTP in 1998.

WTP 1998	WTP 1995		
	No	Yes	Total
No	**157**	4	161
Yes	369	**13**	382
Total	526	17	543

The bold numbers refer to the households who did not change their willingness to pay along the time. Those who said "YES" in 1995 were more willing to say again "YES" in 1995 (76.4%, 13/17), than those who said "NO" in 1995 were less willing to say "NO" again in 1998 (29.8%, 157/526)

5.4.7. Purchase of ITNs versus WTP in 1995 and WTP in 1998

An analysis of willingness to pay and the purchase of ITNs in 1995 and in 1998 can be seen in Table 5.16. Among the households that actually purchased ITNs (296) only 9 (3%) stated that they were willing to pay in both surveys. On the other hand, 35% (86/247) of the households that did not purchase ITNs, were not willing to pay in both surveys. As for the remaining majority of 448 households, none could predict what they would be willing to pay and whether they would remain consistent as to buying or not buying to an ITN. To summarise, it can be seen that many households that said, before the implementation of the ITN programme, that they were not willing to pay, did buy an ITN later (52.4%; 285/543), and some that said they were willing to pay, did not buy an ITN (1%; 6/543).

Table 5.16: Purchase of ITNs versus WTP in 1995 and WTP 1998

Total = 543							
Bought ITN (N=296)				**Did not buy ITN (N=247)**			
	WTP 1998		Total		**WTP 1998**		Total
WTP 1995	No	Yes		**WTP 1995**	No	Yes	
No	71	214	285	No	**86**	155	241
Yes	2	**9**	11	Yes	2	4	6
Total	73	223	296	Total	88	159	247

296 households bought ITNs and 247 did not. The bold number 9 (out of 296, 3%) represents the households who were willing to pay in 1995, continued to be willing to pay in 1998 and in fact did buy. The bold number 86 (out of 247, 34.8%) represents the number of households who were not willing to pay in 1995, continued to be not willing in 1998 and did not buy.

5.4.8. Logistic regression analysis

5.4.8. 1. Logistic regression analysis – Willingness to pay in 1998 and predictor variables

The results of the logistic regression analysis of the willingness to pay in 1998 can be seen in tables 5.17. Different models for the study of the relation between different variables and the willingness to pay in 1998 were created. The best model was observed when the level of education, the socio-economic level and the purchase of ITNs were analysed together, the results showed a significant *p* value for these variables, but not for the other variables (income, expenditure).

Table 5.17: Logistic regression model: Willingness to pay in 1998 and level of education, socio-economic level and purchase of ITNs

Factor **Willingness to pay**	**Unadjusted OR and 95% C.I.**	***p***	**Adjusted OR and 95% C.I.**	***P***
Level of education				
Illiteracy	1		1	
Primary level	1.9 (1.3-2.9)	0.001	1.8 (1.1-2.7)	0.005
Secondary level	4.6 (1.9-11)	<0.001	3.7 (1.5-9.1)	0.004
Socio-economic groups				
Poor	1		1	
Middle-income	2.1 (1.4-3.1)	<0.001	1.8 (1.2-2.7)	0.002
High-income	2.3 (0.8-6.5)	0.1	1.4 (0.4-4.3)	0.4
Purchase of ITNs				
No	1		1	
Yes	1.6 (1.1-2.4)	0.006	1.6 (1.1-2.3)	0.01

5.4.8.2. Logistic regression analysis – Purchase of ITNs and predictor variables

The results of the logistic regression analysis of the purchase of ITNs can be seen in table 5.18. Different models for the study of the relation between different variables and the purchase of ITNs were created. The best model was observed when the monthly expenditure and willingness to pay in 1998 were analysed together, the results showed a significant *p* value for these variables, but not for the other variables (income, socio-economic level, and level of education).

Table 5.18: Logistic regression model: Purchase of ITNs and monthly household expenditure and willingness to pay in 1998

Factor **Purchase of ITNs**	**Unadjusted OR and 95% C.I.**	***p***	**Adjusted OR and 95% C.I.**	***P***
Monthly Expenditure				
>$0-29	1		1	
$30-84	1.6 (1.0-2.4)	0.02	1.5 (1.03-2.3)	0.034
$85-169	2.2 (1.3-3.6)	0.001	2.1 (1.2-3.4)	0.003
>=$170	4.6 (1.8-11.3)	0.001	4.2 (1.7-10.4)	0.002
WTP in 1998				
No	1		1	
Yes	1.6 (1.1-2.4)	0.006	1.5 (1.04-2.2)	0.028

5.5. Discussion

There are two approaches which can be used to measure willingness to pay. The first is called the revealed preference approach, where the decisions that people make concerning health risks is inferred according to how much they will pay to achieve certain results. The second approach uses surveys to determine the expressed willingness of individuals to pay for their preferences with regard to improved health care (Johannesson, 1996). This method is known as the contingent valuation (CV) method.

This study used both these approaches to estimate the demand for ITNs.

The present results show that demand for ITNs was more closely related to household expenditure than to household income, the reasons being that people do not always reveal the total income earned within the household, but are more willing to reveal the amount of their expenditures. In the Mozambican cultural context many husbands do not share information about their income with their spouses, whereas the wives know what the household expenditure is because they do most of the shopping. This study shows that whereas only about 70% of the households provided information about their income, all of the households provided information about their expenditures. Thus, the use of household expenditure data was likely to be more reliable than that for income, and in future studies, the collection of household expenditure data should be sufficient for an analysis of the implication of household budgets on the purchase of ITNs.

The level of education of the head of the household was also related to WTP. This connection has already been seen in other studies, which have shown that better educated people tend to seek better health care (Groomsman *et al.* 1972, Zetharaeus 1998). The positive relation between education and WTP may lead to a decrease in the marginal cost of investing in an ITN programme, if there is investment in education.

The proportion of households WTP for an ITN in 1998 was much higher than in 1995. One of the explanations could be that in 1995 ITNs were unfamiliar object to almost all households, which had not been given enough information about them, and therefore most people were not aware of the benefits of owning an ITN. During the implementation process, between 1995 and 1998 many activities were undertaken, such as providing information, encouragement and communication. People also had the opportunity to experience the benefits of sleeping under an ITN or seeing their neighbours do so. Another explanation might be the price of the ITNs. The majority of people stated that they were willing to pay the price that the ITNs were sold for in Boane.

The WTP technique is based on the premise that the maximum amount that a person is WTP for a commodity indicates the value that commodity has for the individual. The Boane results showed that people gave a higher WTP for an ITN in 1998 than in 1995. This can mean that in 1998 an ITN had a higher value for the people than in 1995. Little information is available in published literature regarding the changes that people make in their WTP before and after the introduction of an ITN programme. Comparing the two WTP surveys, one of the most interesting results that emerges is the clear demonstration of the impact of the price of the ITNs on the WTP survey in 1998.

The comparison of WTP in 1995 and WTP in 1998, and of people having bought or not having bought an ITN shows that there is a need to understand the psychological reactions underlying the people's uncertainty about the decision that they have to make. When people are making decisions about spending money without certainty as to the outcome, they consider not only their financial assets, but also the possibility of experiencing regret, if they make a wrong decision. On the other hand, people are happy when they realise that they have made the right decision (Loomes and Sugden 1982). People may also experience disappointment (defined "as a psychological reaction to the outcome of an event not living up to its expectations" (Ryan 1996). In the Boane study, it was observed that many people changed the amount they were willing to pay for an ITN. The majority of people not willing to pay in 1995 changed their WTP in 1998 and bought an ITN. This can be psychologically explained as a case of the people being satisfied with the service provided. However, there were households who bought an ITN in 1995, but said in 1998 that they were not willing to pay. This group of households may have experienced some disappointment with their ITN, or may have felt that it wasn't worth paying for another ITN. The surveys conducted demonstrated that although most households were satisfied with having purchased an ITN, they considered the price of the ITN to be very high. Most of them have bought more than one ITN. Thus, having covered the majority of their beds they might had continued to play a game to lower the price. This is probably the major reason why many people who bought an ITN said later that they were only WTP a lower price.

The discrepancies observed between the results of the WTP surveys and the demand for ITNs may be explained by the introduction of potential biases in both surveys. It is known that WTP is subject to a strategic bias, where the interviewee gives a response to the WTP question that is over or under the true price that he/she would pay. That may have been the case in the 1995 WTP survey, where people were aware that the survey results would be used to establish the price of the ITNs, and therefore, they were likely to under-estimate their true WTP for the ITNs. Another consideration to take into account is the hypothetical nature of the 1995 survey, since the ITNs were not yet available when that survey took place. This is an important criticism of WTP surveys, if they are done when people are not familiar with the product.

An additional source of bias emerges when a range of prices is provided in the WTP question. That is known as the *range bias* (Ryan 1996). The methodology used in the 1998 WTP survey had bid values, and that was a potential mechanism for introducing the range bias.

The design of the WTP survey in 1995 was different from that in 1998: In 1995 an open-ended question was used, but in 1998 an adaptation of the bidding game was used. The open-ended question has the disadvantage that people do not give their maximum WTP, but rather the price that is acceptable to them (Donaldson *et al.* 1997). The bidding game in 1998 had the disadvantage that the starting price was very high. Since some of the respondents said that they would be willing to pay $12.70, it is possible that some of them would pay an even higher price. In the first WTP survey there were no ITNs in Boane, so the majority of the people did not have a bednet at home, or had not even seen one before. Thus, they did not have enough information to make an accurate decision. The second WTP survey was undertaken after people had experienced the benefits of ITNs, and that influenced their WTP.

There is no simple answer to the problem of overcoming this inconsistency in the WTP methodology, but two sensitive points can be raised: First, before the introduction of a product or a programme, the WTP is hypothetical. Second, the psychological satisfaction of the community depends on how the service is provided, how people perceive the benefit, and what their expectations are. In order to increase their satisfaction, the delivery of a promotional campaign during the implementation phase of the programme can increase the willingness to pay.

This study showed that people changed their minds and their WTP over time, and that the majority changed in a positive direction. The ITN programme may have to concentrate on the people whose WTP becomes negative and investigate why this has occurred, in order to improve the results of the programme. Managers may also have to concentrate on the households who are consistently not willing to pay, and do not buy an ITN. Some potential factors can be identified, such as the affordability and accessibility of the ITNs as well as lack of information about them.

The WTP surveys carried out in Boane 1995 and in 1998 illustrate the difficulty in deciding the price of the ITNs. In 1998 the price biased the WTP of the respondents, since more than half of the households said that they were willing to pay the actual price, although a large proportion of these households had in fact not bought ITNs.

Affordability and ability to pay

The question of affordability and ability to pay for an ITN has become an important issue for the development of a national policy for malaria control in Sub-Saharan Africa. Rowley (1997) stated at an ITN conference that affordability is a key aspect of a successful ITN programme and that people will have to have access to the ITNs if they need them. However, the people should not have to use resources needed for food or other essentials in order to obtain the bednets.

Although the affordability and ability to pay terminology has been used among people involved in ITN programmes, there is no clear definition in conventional economics of what affordability and ability to pay mean. Russel (1996) argues that ability to pay needs to be looked at if the utilisation of ITNs is deterred for financial reasons, or when consumption of health care and other essential commodities falls below the minimum needs of the people. Consumers are considered able to pay if they are willing to pay (Ibid). Thus, the concept of affordability and ability to pay is associated with the relation between the price of the goods and the income or expenditure of the consumer.

However, according to Russell (1996) this association has not always been seen. There are studies that define ability to pay for curative health care in relation to household income (Weaver et al. 1996). This study used the figures of between 2.5%-5% of household income or expenditure as the benchmark definition of ability to pay. Russell (1996) in his revision. found that other authors used similar benchmarks to define people's ability to pay. However, he argues that to define ability to pay is a complex issue, and that it is not only the relation between price and income and/or expenditure that determines ability to pay. There are other factors that need to be assessed, such as whether the consumption of health care would fall to a level which could threaten the health and future earning capacity of the people, and the sustainability of their livelihood. Therefore the 5% figure cannot be applied for all situations.

There are other authors who have discussed the question of ability to pay for health care in the developed world (Donaldson 1999, Stuart and Grana 1998). None of them has stated a cut-off figure to define the people's ability to pay in relation to their income. However, Stuart and Grana (1998) found for example that people with high annual incomes were more likely to utilise health care services than people with low incomes.

Although there are no clear guidelines to define affordability and ability to pay in general, and in particular for ITNs, this study considered an affordable price for ITNs to be a price that was less than 5% of monthly household income or expenditure. As in Boane, many projects have found the issue of price-setting to be problematic.

Ability to pay is an important issue to consider if the ultimate objective of an ITN programme is to secure the maximum possible sustainable coverage. In Boane at the current price of the ITNs, only 24% coverage was achieved during the first two years of the project; however, it should be taken into account that this coverage could have been higher if the ITNs had not sold out.

Using monthly income as the measure of ability to pay, only 9% of the population were able to pay. Using expenditure as the measure, the percentage increased to 19%. However, it was noted that of households not able to pay according to the income or expenditure variables, 50% had bought an ITN. Therefore, this demonstrates that income or expenditure are not the only basis on which to determine why people decide to buy or not to buy an ITN. It might also suggest that a longer time period than one month would be more appropriate, in assessing ability to pay, because having used monthly income as the measure of ability to pay resulted in many people having been classified as unable to pay, when in fact they did buy ITNs.

In Boane, the price of an ITN in households that bought at least one ITN was 7.8% of their monthly household expenditure. Thus, 5% would be a reasonable benchmark figure. If 5% of monthly household expenditure were to be used to buy an ITN, it would on average cost between $2.60 and $3.50 in Boane.

Assuming that the ITN would cost $3.50, this would represent about 62% of the manufacturer's price ($5.50). Again, the remaining 40% would need to be subsidised by the government or by non-governmental organisations. Furthermore, this price does not include other costs involved in the sale of ITNs, such as promotion and delivery. Thus, a subsidy of more than 40% of the wholesale cost would actually be needed in order to achieve a sustainable programme.

More studies need to be undertaken to assess the best way to set the price, in order to achieve a high and sustainable coverage of ITNs in the community. The results of the WTP survey should not be generalised without taking into account factors such as preferences with regard to health care, income, and reimbursement systems. Comparisons between WTP surveys in different regions can provide valuable information regarding the results, particularly if the countries share similar economic and cultural characteristics.

In conclusion, it can be said that due to the experimental stage at which contingent valuation studies about ITNs are at the moment, it is too early to use CV as the only basis for establishing a policy on price.

In the next chapter (Chapter 6) the cost of implementing the ITN project in Boane will be calculated, and the total unit cost of delivery per ITN will be determined. The calculation of the unit cost per ITN delivered, and the results already presented about the willingness to pay and ability to pay of the households, will guide the discussion in Chapters 7 and 8, of the financial sustainability and equity of an ITN programme in Mozambique.

CHAPTER 6:
COST AND SENSITIVITY ANALYSIS OF THE INSECTICIDE-TREATED BEDNET PROJECT - BOANE -1996-1998

6.1. Introduction

Chapter 5 provided information about the willingness of the households in Boane to pay for ITNs and about their ability to pay. This information was collected from the point of view of the consumers. The evidence was that the majority of the people were not able to pay the cost-recovery price for an ITN, although the majority of them were willing to pay a much lower price. In this chapter the total cost of implementing the Boane ITN project will be analysed in order to determine the unit cost per ITN sold and compare it with the price at which the ITNs were sold.

This is the first unit cost analysis study of ITNs undertaken in Mozambique. The principal objective of this chapter is to provide relevant information for the future development of an ITN project in Mozambique.

A detailed economic cost analysis will be done in this chapter in order to facilitate the development of a policy with regard to ITNs, in order to define the actions that the government should consider, and in order to identify the factors that might improve the coverage of ITNs in Mozambique.

The objective of this chapter is to calculate the financial and economic cost of an ITN project implemented throughout the primary health care system in Boane, and to calculate the cost of the project. The results of these calculations will guide future discussion about the financial sustainability of a nation-wide ITN programme.

A summary of the concept of cost-evaluation studies is given below.

Cost-evaluation studies

Economic evaluation is a method that is generally used to identify criteria that are in order to make financial decisions, and it provides a systematic framework to clearly identify the relevant alternatives in the presence of scarce resources (Drummond *et al.* 1997). The analysis compares the inputs (costs) with the outputs (consequences) of activities.

Comparison is one important aspect of economic evaluation. Because some studies do not incorporate comparative analysis, they cannot be classified as economic evaluation studies, and they are called partial evaluation studies. Examples are studies that describe only the cost. On the other hand, if only cost is compared, and not the consequences of the alternatives, it is called cost analysis (Drummond *et al.* 1997).

There are four types of economic evaluation: the cost-effectiveness analysis, the cost-benefit analysis, the cost-minimisation analysis and the cost-utility analysis (this review was taken from Drummond *et al.* 1997)

Cost-minimisation analysis compares two interventions where the consequences are identical, and the analysis is based on the comparison of cost of the two interventions. The question that cost-minimisation tries to answer: which intervention programme costs is less for the same result?

Cost-effectiveness analysis compares the costs and effects of two programmes's outcome of the both programmes being similar. The results can be expressed in several ways (eg: cost per years of life gained, or years of life gained per dollar spent). A cost-effectiveness analysis answers the question: which programme costs less per unit of effect?

Cost-benefit analysis evaluates the costs and the results in terms of money on the basis of past results, in order to determine which programme will achieve the best results for the least money. In health care, the benefits are measured from three perspectives: first, the health benefits, which will extend life and reduce morbidity; second, the productivity benefits, where less time is lost from work, and third, future medical costs. A cost-benefit analysis is usually undertaken to evaluate benefits that can easily be expressed in monetary terms.

Cost-utility analysis is even more difficult to apply than the cost-benefit analysis. This method uses utility as a measure of the value of the programme. This is a new approach, which adds qualitative analysis ("utility"), such as the preference of an individual or society for a health outcome, to the quantitative measurement (*e.g.*: mortality). The results of this analysis are usual presented by quality – adjusted-life-year (QALYs) gained by applying one programme compared with others. It provides information for comparison on cost and outcomes for the different interventions. People who have reservations about using monetary values for benefits prefer this methodology. Utility analysis is a powerful tool, because it provides information on QALYs and at the same time provides the comparative costs and outcome measurements of two different programmes. Cost-utility analysis attempts to answer the question: which programmes do people prefer?

In conclusion the cost-benefit and cost-utility analysis give the opportunity to assess broader choices, because they address the issue of outcome evaluation. Cost-benefit analysis can also provide information enabling comparison of health programmes with other programmes outside the health sector and the selection of the best choice. Cost-minimisation and cost-effectiveness analysis assumes in principle that the intervention is worthwhile for society.

The present study fits in the classification of partial cost-evaluation study because the study only describes the cost of the project per unit of output and does not compare with alternatives.

6.2. Methodology

This analysis of the financial and economic costs of the Boane ITN project mainly concerns the resources allocated by the government and by the project to run the study from the provider's perspective. Only direct costs were considered. Information was obtained on the capital and recurrent costs of the implementation of the project. The financial and economic costs did not include any research costs, or the costs of surveys undertaken for research purposes. ITN distribution, retreatment and the promotion of the use of ITNs were the main activities that were studied to determine the cost of the implementation of the ITN project.

The financial cost of the project represents the amount of money that was actually spent in order to implement the Boane ITN project. The economic cost of the project also includes the opportunity costs of components such as the cost of insecticide and their storage, which were provided to the project free of charge, and it is a measure of the total resources used by the project. The reference period for data collection on costs was from May 1996 to May 1998. By May 1998 all of the ITNs had been sold (3,785).

6.2.1. Financial cost

The financial costs of the project were calculated in order to determine the amount of money likely to be required to run an ITN project. This included capital and recurrent costs, such as bednets, equipment, staff and so on. Mozambique has a freely floating exchange rate, and annual costs were converted from the Mozambican currency ("Metical") to US dollars each year (1996, 1997 and 1998) using the mid -year exchange rate (for each year), as provided by the Bank of Mozambique (the national central bank). The effect of inflation was removed by deflating the cost after conversion from meticais to US dollars, by using the US gross domestic product deflator (an average of 3.2% over this period (WDR, 1998)).

Sources of information:

Information on costs was obtained from the following sources: Provincial Health and District Health offices, the Ministry of Health and the National Institute of Health. The information was collected from receipts, pay vouchers, records and reports.

The costs included personnel, supplies and equipment as well as nets and insecticide. Cost were classified by inputs as shown below:

Capital costs:

The project recorded as capital costs the cost of goods whose use extended beyond one year, such as vehicles, buildings, and nets, and which included the following:

- The project used (but did not purchase) one vehicle from the INS (the National Health Institute): a four wheel drive Toyota-Landcruiser which was used for transporting bednets and insecticide to Boane, and for promotional campaigns and surveys in Boane.

- In addition, when needed, the project used a room at the Boane Health Centre to treat and dry the nets. Since no rent was paid for these rooms, advice was obtained from the District administration office about the rental value of similar rooms in order to calculate the economic cost.

- The costs of office equipment and furniture were obtained from the INS administration files and from the Health Center files. For shared equipment, the proportion of time during which the equipment was used in the project was calculated. For example, a car from the INS was not fully allocated to the project, which only used the vehicle part of the time, and thus the full capital cost of the vehicle was multiplied by the percentage of time that it was used, to estimate the economic cost of that item to the project.

- The project used one room at the Boane Health Centre to sell the ITNs and a second room was shared with the Health Centre for storage use (nets and insecticide were stored along with materials belonging to the Health Centre). The project also used one room at the INS to store nets and insecticide.

Recurrent costs:

The project recorded the following recurrent costs: personnel costs (all staff, supervisors, health workers, casual labour), supplies, vehicle operation and maintenance (petrol, diesel, lubricants, etc.), social mobilisation, promotional materials for the ITNs, costs associated with treatment and retreatment of the ITNs, such as plastic bags, washing soaps, and other costs for goods which last less than one year and which were used by the project.

For all of the personnel involved in the implementation of the ITN project (district and provincial health staff, INS staff, other staff working on a part-time basis, the project manager, the supervisors and planners), the time that they allocated to the programme, their duties and responsibilities, their gross salary and the allowances they received from the project were calculated. The cost of their time was calculated as a proportion of the sum of their gross salary. Transport costs and subsistence payments made by the project were also recorded.

The major proportion of the recurrent cost was spent on personnel. The project employed part-time personnel from the National Institute of Health (INS) and the District Directorate of Health of Boane. Only one permanent employee was hired to sell ITNs. About nine workers from the INS were allocated to the project. One was assigned to treat the nets, and others to assist with the promotion of the ITNs. They all received an allowance for the work and the time they devoted to the project.

The district staff consisted of the District Health Director, the head of the Health District Health Finance Unit, the head of the District Health Pharmacy, two health nurses responsible for health promotion, three nurses who work at the antenatal, adult and child outpatient clinic, and two nurses working at two health posts where the ITNs were sold

They all received an allowance according to the extent of their involvement and the time they devoted to the project.

The District Director was responsible for the daily management of the ITN programme in Boane. It was the responsibility of the Health Centre Pharmacy to control and distribute the nets and insecticide, and to collect the money from the sale of the ITNs. In addition, an average of eight activists recruited from the local community was employed on a part-time basis to sell and promote the use of ITNs.

Finally, about fifteen community volunteers were involved in the project. They participated in promotional campaign activities, retreatment of nets and community awareness and mobilisation programmes. The volunteers were paid a small allowance for the time they spent on specific activities (about $10 on average per person per month), such as the retreatment of ITNs. The time that they spent on the project was about 5 to 10 hours per month. The overall project was designed and managed by a member of the INS on a part-time basis. No allowance or payment was allocated for this specific activity.

6.2.2. Annualised financial cost and economic cost

The calculation of economic cost was used to measure the cost per unit of the project. All capital items were annualised. Annualisation involves spreading the cost of a capital item over its life and allows for adding the opportunity cost to the capital cost of the item (as reflected by the discount rate) (Mills, 1998, unpublished). The economic cost was calculated on the basis of the life span of the item at a 3% discount rate.

The financial cost was annualised to compare it with the economic cost. The total cost was divided by the number of years of useful life of the item. Because the financial cost was converted to US dollars, an inflation rate of 3.2% was used to calculate the annualised financial cost and economic cost of the capital item during the second year of the project. Financial cost represents the resources actually spent to implement the ITN project, the money that was paid out for bednets, staff, equipment and so on. On the other hand economic cost incorporates the opportunity cost - all the resources that were used, but were not paid for out of the project's budget, such as volunteer work, donated items, etc.

Capital costs were calculated on the basis of the current value of the capital item, its useful life, the discount rate (3%) and the annualising factor as follows:

a) the current value of the capital item (the amount of money that would be required to purchase a similar item at the present time);

b) the useful life, in the other words, the estimated number of years of useful life that the item realistically can be expected to have after being purchased;

c) a discount rate of 3% was used to annualise the cost after consulting the annualising tables to calculate the correct factor. The annual cost was calculated by dividing the current price of the item by the number of years it will be used.

The calculation was then made on the following basis:

1st year: Current cost/annualising factor, at a discount rate of 3%.
2nd year: First year annual cost plus 3.2% of the inflation rate.

Recurrent costs were added to the financial cost; this included the monetary value of volunteer work, of donated items and other unpaid recurrent costs.

The results are presented in 1998 U.S. dollars.

6.2.3. Unit cost analysis

This study examines the cost per unit of the ITN programme in terms of average cost per ITN sold, average cost per person and child in a household with at least one ITN, and the average cost per household with at least one ITN. The results are compared with other ITN studies done elsewhere, since this is the first study undertaken in Mozambique.

The present study will express the results of unit cost analysis in terms of ratios, for example cost/unit of ITNs sold.

Other than the crude cross-sectional surveys reported in chapter 4, the study did not collect data on morbidity and mortality; thus, it was not possible to evaluate the outcomes according to the number of malaria cases prevented, or the number of deaths averted.

6.2.4. Sensitivity analysis

All economic evaluation studies are subject to some degree of uncertainty, imprecision or methodological controversy (Drummond *et al.* 1997). Therefore, economists identify critical methodological assumptions or areas of uncertainty such as what would be the result if there were changes in compliance or in direct or indirect cost. The analysis based on these assumptions is called a sensitivity analysis. Economic evaluation analysis results seem more reliable if the result of the sensitivity analysis is not very different from that of the economic evaluation analysis. On the other hand, if there is a big difference, further effort will be required to reduce the uncertainty or to improve the accuracy of critical variables. Three examples of sources of uncertainty are, firstly, when there is an absence of available data to estimate the effectiveness of a new medical technology; secondly, when no firm estimate exists; thirdly, when the analyst incorporates controversial value judgements into the study, such as the choice of a discount rate, or the value of health priorities.

Discount rates are often used to reflect the devaluation of money over time by assigning lower values to, for example, dollars paid in the future than to dollars paid in the present. The implication is that money paid in the future is worth less than money paid today. For health programmes, such as the ITN project, where costs or savings are spread over time, the practice of discounting is essential.

The British National Health Service recommends a real discount rate of 6% (Parsonage and Neuburger 1992). The World Bank recommends a discount rate of 3% to measure the disability-adjusted life years (DALYs), and the Centers for Disease Control and Prevention recommended a discount rate of 5%, in a range from 0% to 8%. The Office of Management and Budget of the United States of America developed guidelines and has recommended 7% as the discount rate for cost-benefit analyses. In the past, a discount rate of 10% has been the most widely used (Gold *et al.* 1996).

A study conducted in Ghana (Binka *et al.* 1997) increased the discount rate from 3% to 6% and 10%. The cost-effectiveness study in The Gambia used a discount rate of 6% (Aikins *et al.* 1998). This study used 3% as the base discount rate and the alternatives of 6% and 10% to perform a sensitivity analysis to allow comparisons with the Binka study, which provided bednets, and with The Gambia study that did not provide bednets.

The output variables identified for the sensitivity analysis in this study were the cost per ITN sold and the cost per person in households with at least one ITN.

Three hypothetical factors were considered in the sensitivity analysis of the unit cost analysis in this study: 1) the discount rates, 2) a reduction of the bednet cost by 30%, and 3) a reduction in the financial cost of staff.

The cost of ITNs was reduced by 30% to allow for the realistic possibility that a larger scale project could buy bednets for $4 each or even less.

Staff (almost all of them already employed by the government) accounted for about 23% of the total financial cost of the project. In future projects implemented by the government, staff may not receive any extra allowance for their time spent on the project. Thus a sensitivity analysis was undertaken to estimate the cost of the project if the project did not pay any allowances or salaries.

6.3. RESULTS

6.3.1. Financial Cost

This section will provide a breakdown of the amounts spent on the project.

Table 6.1 shows the non-annualised financial cost of the project in US dollars, to reflect the actual expenditure pattern and the budget requirements. The non-annualised financial cost was sub-divided into capital cost and recurrent cost. The cost shown in the table only refers to the amount paid by the project. The total non-annualised financial cost, which included the capital cost of items such as bednets and other equipment which had an extended life of more than one year, and recurrent costs such as the payment of staff, vehicle maintenance and promotion, was $36,263. The total capital cost was $24,497.50 (67.3% of the total cost). The total recurrent cost was $11,855 (32.7% of the total cost).

Bednets were the major area of expenditure; the total amount spent on bednets was $20,817.50 (57.4% of the total cost). The second highest area of expenditure was staff, which was about 23% of the total cost ($8,248.50). Thus, bednets and staff together accounted for more than 80% of the total cost of the project.

The remaining costs were related to promotion (6.7% of the total cost), office equipment (5.5% of the total cost), and promotional supplies (4.4% of the total cost).

Table 6.1: Financial costs (non-annualised) of the Boane ITN project (in US$): 1996-1998

ITEM	May:1996 April:1997	May:1997 May1998	TOTAL May:1996 May:1998	% OF TOTAL COST
1)CAPITAL COSTS				
Bednets	$20,818	$0	$20,818	57.4
Office equipment	2,000	0	2,000	5.5
Promotional equipment (television, video, radio)	1,590	0	1,590	4.4
Furniture	0	0	0	0
Vehicle	0	0	0	0
Store	0	0	0	0
Subtotal	**24,408**	**0**	**24,408**	**67.3**
2)RECURRENT COSTS				
Staff	4,124	4,124	8,248	22.7
Insecticide	0	0	0	0
Vehicle maintenance and petrol	180	120	300	0.8
Stationary	475	200	675	1.9
Promotional materials	2432	0	2432	6.7
Utilities (telephone, lighting, water)	0	0	0	0
Office rental	0	0	0	0
Others	100	100	200	0.6
Subtotal	**7,311**	**4,544**	**11,855**	**32.7**
TOTAL	**31,719**	**4,544**	**36,263**	**100**

Source: based on the records collected during the project.

6.3.2. Annualised financial cost and economic cost

Total financial cost was annualised to facilitate a comparison between economic and financial costs.

Total annualised financial cost is shown in table 6.2. The total annualised financial cost was $21,774.70. Capital costs accounted for 45.6% of the total cost. Bednet purchases represented the greatest proportion of the total cost (38.9%). Recurrent costs accounted for 54.4% of the total. The amount paid to staff was $8,248.50, representing 37.9% of the total cost. Vehicle maintenance and petrol accounted for 11.2% of the total cost.

Table 6.3 is an economic analysis. The total economic cost of the project was $27,625.80. The economic cost was about 22% higher than the annualised financial cost. The economic cost was higher than the annualised financial cost mainly because of the opportunity cost of staff who worked for but were not paid a salary by the project, and the cost of insecticide which was donated; the combination of wages paid to staff and the opportunity cost of volunteer personnel was estimated to be $11,811.60, which represented 42.8% of the total economic cost. Bednets were the second highest expenditure ($9,236), and accounted for 33.4% of the total expenditure.

As was observed with the financial cost, bednets and staff accounted together for more than 75% of the total economic cost and annualised financial cost.

The third major economic cost was promotional materials (9%). Office equipment and insecticides accounted for a similar amount (over $800).

Table 6.2: Annualised financial costs of the ITN project in Boane (in US$): 1996-1998

ITEM	Total Financial cost	Useful life	May:1996* April:1997 (first year)	May:1997** May1998 (second year)	TOTAL May:1996 May:1998	% OF TOTAL COST
1)CAPITAL						
Bednets	20,818	5	4,164	4,297	8,460	38.9
Office equipment	2,000	5	400	413	813	3.7
Promotional equipment (television, video, radio)	1,590	10	318	328	646	3.0
Furniture	0		0	0	0	0
Vehicle	0		0	0	0	0
Store	0		0	0	0	0
Subtotal	**24,408**		**4,882**	**5038**	**9,919**	**45.6**
2)RECURRENT						
Staff			4,124	4,124	8,248	37.9
Insecticide			0	0	0	0
Vehicle maintenance and petrol			180	120	300	1.4
Stationary			475	200	675	3.1
Promotional materials			2432	0	2432	11.2
Utilities (telephone, lighting, water)			0	0	0	0
Office rental			0	0	0	0
Others			100	100	200	0.9
Subtotal			**7,311**	**4,544**	**11,855**	**54.4**
TOTAL			**12,193**	**9,582**	**21,775**	**100**

*Total Financial cost divided by useful years life

** Annual cost of the first year plus 3.2% of inflation rate

Table 6.3: Annualised economic costs of the ITN project in Boane (in US$): 1996-1998

ITEM	Total Financial cost	Useful life	Ann.factor at discount rate of 3%	May:1996 April:1997[1]	May:1997 May1998[2]	TOTAL May:1996 May:1998	% OF TOTAL COST
1)CAPITAL							
Bednets	20,818	5	4.58	4,545	4,691	9,236	33.4
Office equipment	2,000	5	4.58	437	451	887	3.2
Promotional equipment (TV,video, radio)	1,590	5	4.58	347	358	705	2.6
Furniture	200*	10	8.53	23	24	48	0.2
Vehicle	25,000*	10	8.53	73[3]	76	149	0.5
Store				120	124	244	0.9
Subtotal				**5,546**	**5,723**	**11,269**	**40.8**
2)RECURRENT							
Staff				5,906	5,906	11,812	42.8
Insecticide				403	403	806	2.9
Vehicle maintenance and petrol				180	120	300	1.1
Stationary				475	200	675	2.4
Promotional materials				2,432	0	2,432	8.8
Utilities (telephone, lighting, water)				36	36	72	0.3
Office rental				30	30	60	0.2
Others				100	100	200	0.7
Subtotal				**9,562**	**6,795**	**16,357**	**59.2**
TOTAL				**15,108**	**12,518**	**27,626**	**100**

*estimated cost; [1]Total financial cost divided by annualisation factor; [2]Economic cost (annualised) of first year plus 3.2% of inflation rate; [3]Economic cost (annualised) multiplied by 2.5% (usage time)

6.3.3. Unit cost analysis results

Table 6.4 shows the cost per unit. The following output variables were used to measure the unit cost of the project: cost per ITN sold, cost per adult and child living in a household with at least one ITN, and cost per household with at least one ITN.

Dividing the total economic cost of the project ($27,625.50) by the total number of ITNs sold (3,785) gives a unit cost per ITN of $7.30. Approximately 7,700 persons (adults and children) lived in households with at least one ITN. Dividing the total cost of the project by the total number of people living in households with at least one ITN gives the unit cost per person protected of $3.60. About 1,027 children lived in households with at least one ITN. Dividing the total cost of the project by the number of children living in a household with at least one ITN gives the unit cost per child protected of $26.90. The total number of households with at least one ITN was 1,536. The unit cost per household protected by at least one ITN was $18.

Table 6.4: Unit cost of the Boane ITN project (May 1996- May 1998)

Total economic cost implementation cost (1996-1998)	$27,625.50
Total ITNs sold*	3,785
Cost per ITN	$7.30
Total number of people in houses with at least one ITN**	7,681
Cost per person protected	$3.60
Total children under 5 in a house with at least one ITN**	1,075
Cost per child protected	$25.70
Total households with at least one ITN*	1,536
Cost per household protected	$18

*Source: Data from the demand file. See chapter 4

**Source: Calculation based in the census data and coverage of 24%. See chapter 3 and 4.

6.3.4. Sensitivity analysis results

Discount rates, the price of the bednets and ITN household coverage were the main variables in the sensitivity analysis in this study.

Two discount rates (6% and 10%) were used to perform the sensitivity analysis. From table 6.5 it can be seen that the variation in the discount rate had little impact on total cost and on the unit cost per ITN of the programme. Increasing the discount rate from 3% to 6% and 10% would increase the total cost by about 3.6% and 8.1% respectively. Reducing the cost of the bednets also had little impact, as a reduction to $4 each would reduce the cost ratio by only about 10%. Thus, this study demonstrated that these changes did not substantially affect the results. However, if the project did not pay additional allowances to government staff, then the cost ratio would be reduced by 30%.

In conclusion, the results of sensitivity analysis showed that cutting the allowances paid to government employees would have a potentially higher impact on the cost ratio of the ITN project than reducing the cost of bednets would have.

Table 6.5: Sensitivity analysis

Parameter change	Total economic cost (US$)	Cost per ITN (3785 total)($US)	Cost per person protected (7681) ($US)
Discount rates			
Discount rate of 3%	$27,625.50	$7.30	$3.60
Discount rate of 6%	28,698.40	7.60	3.70
Discount rate of 10%	30,050.90	7.90	3.90
Bednets reduced by 30% ($4)	25,106.60	6.60	3.30
No additional allowance for government staff	19,377	5.10	2.50

6.4. DISCUSSION

6.4.1 Financial and economic costs

The financial cost was estimated from the perspective of a government ITN programme. The data showed that bednets are the major item that the government has to make available to implement an ITN project; the nets accounted for nearly 60% of the total cost of the budget. A similar percentage was observed in the Ghana ITN study, where bednets accounted for 60% of total spending (Binka *et al.* 1997). Paying staff was the second most important financial cost, because the project paid allowances to the majority of staff who gave some of their time to the project. This finding may be subject to error, because one of the most common errors in calculating the costs of studies is in estimating the proportion of the cost to be correctly attributed to the programme and the proportion to the research itself (Gilson *et al.* 1997). For example, in the present project the recurrent economic cost of the staff was 30% higher than the recurrent financial cost. This reflects the time spent by the project's office staff in conducting and supervising the project. This situation may occur in situations where the research and the implementation of projects are conducted together, as was the case with the ITN project in Boane.

Promotional activities were the third most important financial expenditure. They took more than 5% of the total budget. Very few studies have reported how much they spent on promotional activities; therefore it was difficult to do a comparison of this result.

6.4.2. Unit cost analysis discussion

Unit cost in the present study was defined in terms of the cost per ITN sold, the cost per person (including children) sleeping in each household with at least one ITN, and the cost per household having at least one ITN.

To lower the unit cost per ITN sold, a reduction in the cost of the bednets and a reduction in the additional allowances paid to government staff would be required. Thus, efforts should be made to buy good quality bednets at a more competitive price. Market research needs to be undertaken to obtain the best value for money, before the programme buys large quantities of bednets.

Cutting the allowances paid to government employees seems to be an important factor if the unit cost is to be decreased. However, in many countries, government staff will not agree to do extra work if they are not paid an extra allowance to perform additional activities. A solution must be found for this controversial problem. In Mozambique there has been some discussion within the government about this issue, and at present, government policy is to allow government staff to receive additional allowances, if the project has the budget for it. However, a question arises about what to do when the budget has no money for allowances, but the activities have to be continued. In many situations what results is a lack of government staff willing to continue that activity.

The unit cost analysis conducted by The Gambian National Impregnated Bednet Programme observed that bednet coverage was very high, with 85% nation-wide coverage (Aikins *et al.* 1998). Because the programme did not provide bednets, a sensitivity analysis including the cost of the bednets was undertaken. The cost per ITN was US$3.30 and the cost per person sleeping under an ITN was $1.90. The Ghanaian study managed to deliver each ITN at a cost of $4.76 ($148,245/31,100 ITNs) (or $2.38 per year; $4.76/2 years of the study) (Binka *et al.* 1997). The ITN project in Boane carried a cost per ITN of $7.30 over two years or $3.65 per year. Compared to the above studies, it can be concluded that the unit cost of the Boane project was slightly higher than those studies. However, the Boane project sold the ITNs, whereas the Ghana project provided the ITNs free of charge, while in The Gambia, the coverage of bednets was already very high. Thus, if the coverage of ITNs had been higher in the Boane project, its unit cost might have been similar to that observed in Ghana and The Gambia. The unit cost of the results achieved by the Ghana and The Gambia trials were due to their very high coverage, whereas in Boane the coverage was under 30%.

The need for money to implement the ITN projects is a fundamental factor to be addressed in future government decisions about the scale of the ITN programme in Mozambique. A model-based analysis has determined that the cost of achieving full coverage of children under five with the provision of ITNs would cost about 24% of the existing health care budget in a typical low-income country (Goodman *et al.* 1999). The annual budget for public health in Boane is about $140,000. The total financial cost of the project (not annualised) was $36,263. This represents about 26% of the total budget allocated to Boane district. Achieving a higher coverage would cost more and thus would take a higher proportion of the existing budget. This clearly demonstrates that ITN programmes cannot be fully implemented under the present budget, if the ITNs are distributed free-of-charge, with no revenue to offset part of the cost. This is an important issue because the additional percentage of coverage would apply to the poorest part of the population, people that are not able to pay. Therefore, to increase coverage the majority of ITNs would have to be provided free-of-charge, but the cost could not be borne by the public health system in Mozambique.

A mechanism of long-term financial sustainability is needed, and it is important to address at the time that the projects are being planned before implementing an ITN project; otherwise, there is the risk if not the probability that the project will collapse when the money runs out.

Although ITNs have been regarded as a cost-effective way to control malaria in many parts of Africa, the district health authorities in Boane and many parts of Mozambique do not have the financial resources to implement large-scale ITN programmes. Even if the budget is increased, it seems unrealistic to believe that it will be sufficient to permit the local authorities to implement ITN programmes. An injection of additional funds is required if the aim is to extend the use of ITNs among the community. Health planners in the government and donor agencies should give a high priority to ITNs and to obtaining the funds to finance a comprehensive ITN project.

The Gambia is one of the few African governments that have already integrated ITNs into their malaria programme (a National Insecticide Programme). Governments and other organisations need to learn from the experience of The Gambia in selecting cost-effective ways to implement ITN programmes.

6.5. Conclusion

The unit cost of the ITN programme in Boane was slightly higher than in other ITN projects (Ghana and The Gambia), because the programme had a lower coverage than in those studies. However, since those projects provided the bednets free-of-charge, whereas the Boane project had to sell them, the cost achieved can be considered reasonable even with the low coverage achieved by the project. Future projects should aim to increase coverage, in order to get a better unit cost. However, the expansion of the project should take into consideration issues related to the sustainability of the project. Chapter 7 will explore the implications that an expansion of the project might have on its financial sustainability. The cost calculations which were done in the Boane project provided useful information for future planning for ITN programmes in Mozambique; this will be discussed in Chapter 8.

CHAPTER 7:
MARGINAL COST ANALYSIS OF THE ITN PROJECT IN BOANE

7.1. Introduction

In chapter 6 the cost of the ITN project which was undertaken in Boane was examined. The cost was calculated on the basis of the coverage achieved by the project. Many ITN projects have begun with the assumptions (stated or unstated) that the expansion of the project, and/or an expansion of the volume of bednets sold, would automatically lead to a reduced need for a subsidy, or even to full financial self-sufficiency. This chapter examines this assumption using the Boane data.

In order to see what effect increasing the household coverage of ITNs would have on the financial cost and to determine the financial sustainability of the project, a marginal analysis technique will be applied in this chapter.

Marginal analysis concerns the financial consequences of adding one extra unit of products or supplies, and aims to optimise the volume produced or supplied. Marginal analysis is not a new concept in health. Marginal analysis has been discussed by, for example, Mooney *et al.* (1986), and Cohen (1994). However, very few examples of the use of marginal analysis for health care delivery have been published, and most of those that have been done are from developed countries, with very few from developing countries.

For example, marginal analysis has been used in Great Britain. In 1994 the Welsh Health Planning committee used the concept of marginal analysis for the development of a strategy for improvements in the health services, by identifying areas for investment and disinvestment. Based on the results, some policy decisions were made (Cohen 1994). Marginal analysis has been also used for analysing the cost of laboratory work (Langlois and Donaldson 1998). Another example of the application of marginal analysis comes from a study conducted in Scotland, where marginal analysis was used to assist in developing a strategy for purchasing maternity services. The study examines the feasibility of an expansion of maternity services and seeks to determine which services should be reduced in order to achieve that expansion (Ractliffe *et al.* 1996). A few attempts to use marginal cost analysis in developing countries have been made. Gray discusses one such study undertaken in Mali to determine the marginal cost of expanding the primary health care service (Gray 1986).

There has been no literature using marginal analysis for malaria control programmes and particularly for programmes using ITNs. This is therefore the first attempt to introduce the marginal analysis concept for malaria control activities in Mozambique.

The calculation of the cost of the Boane project revealed that the price of the ITNs was lower than the cost to the project per ITN sold. In this chapter the implications of the difference between cost and price will be analysed to see how the financial sustainability of the project could be achieved, and what the implications of that would be.

The objective of this chapter is to use marginal analysis to compare marginal cost (*MC*) with marginal revenue (*MR*) in the Boane project in order to assess the unit price which would be required in order to achieve the financial sustainability of the project, in order to determine the cost implications of increasing household ITN coverage.

This chapter will focus on "profit" or the surplus. Therefore, it will analyse the difference between cost and revenue from the point of view of a for-profit commercial company, although this was a public health project. The question that the chapter will address in doing that concerns the need for a subsidy, and the degree to which the present project could be a model for a national programme. Thus, if the intention of this project is to help develop a national programme, the lessons learnt about price will be relevant. In Chapter 4 it was demonstrated that the price of the bednets was an important limitation on coverage, and hence on the achievement of the public health goals.

7.2. The application of marginal analysis to the Boane ITN project

Marginal analysis is primarily an analysis of cost estimates and/or revenue at the margin. Marginal cost estimates the increase in total cost when the output of an item is increased by a single unit.

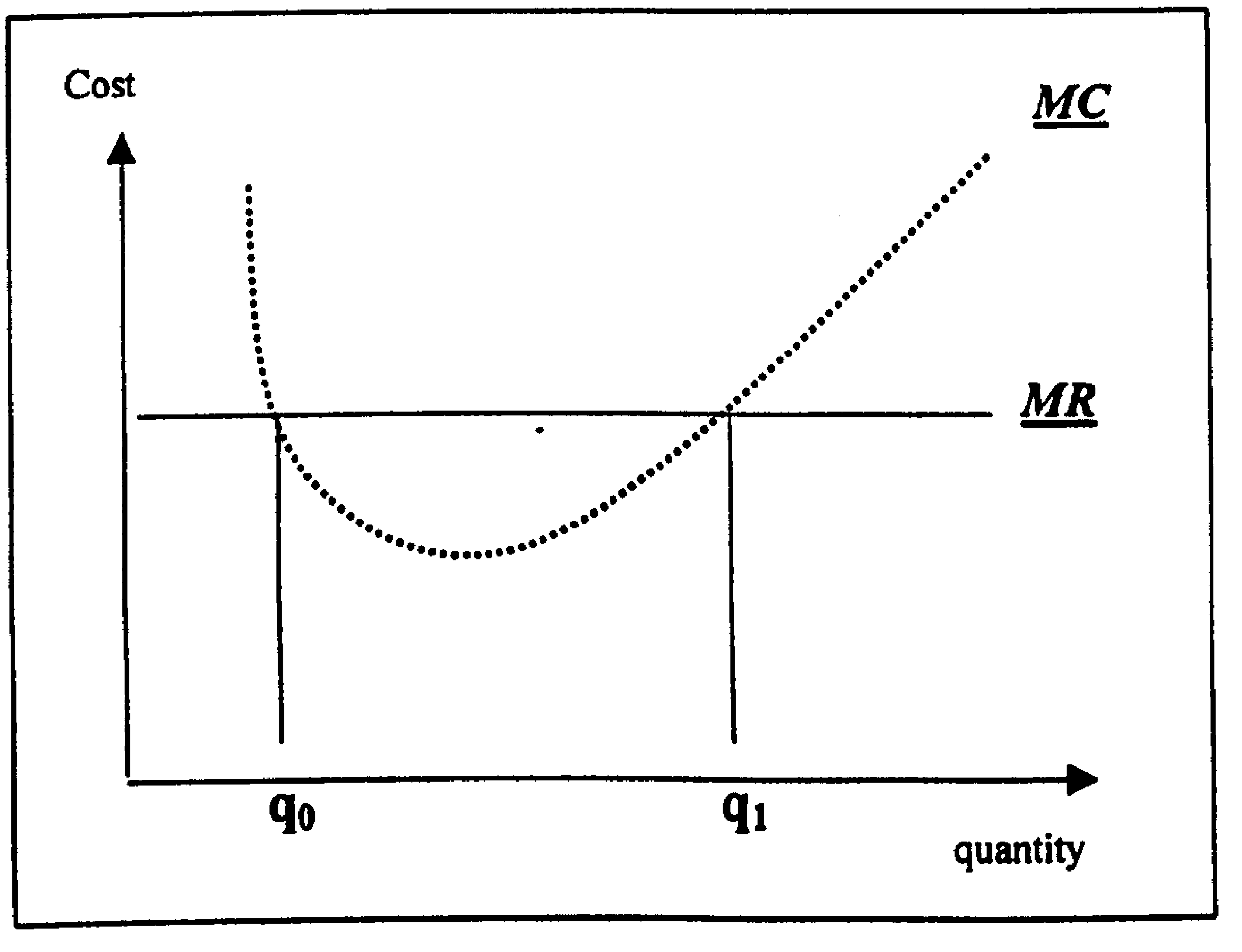
Total revenue is the price of a given product times the quantity of that product that is sold. Marginal revenue is the increase in total revenue when an additional unit of output is sold. Thus, total and marginal revenue will depend on the demand for a given product and the price. The profit or surplus is the difference between total cost and total revenue when revenue is greater than cost. However, maximising revenue does not necessarily mean that profits will be maximised.

A financially self-sustainable ITN project would have to sell ITNs at a break-even or higher price, so that the marginal revenue would be equal to or even exceed the marginal cost. However, if the marginal cost exceeds it the marginal revenue, then an expansion of ITN coverage will increase the differential between marginal cost and marginal revenue. In other words, in cases where profit is the objective - for example, in the private sector - the marginal cost should intersect the marginal revenue curve from below. This ensures that the MC is less than the MR to the left of the profit-maximising output and greater to the right of the profit-maximising output (Figure 7.1) (Lipsey & Chrystal 1995).

Figure 7.1 shows two outputs where marginal cost equals marginal revenue. Output q_0 is a minimum-profit position; for outputs below q_0, marginal cost exceeds marginal revenue and profit can only be increased by reducing output, while for outputs above q_0, marginal revenue exceeds marginal cost and profit can be increased by increasing output. Output q_1 is the maximum-profit position. At outputs below it, marginal revenue exceeds marginal cost and profit can be increased by increasing outputs towards marginal q_1. At outputs just above q_1, marginal cost exceeds marginal revenue and profit can be increased only by raising the price or by reducing output towards q_1. In other words, a programme aiming at financial sustainability should not sell the product if for all levels of output, the variable cost (cost of a variable input, a cost that varies with output level, Parkin *et al.* 1997) of delivery exceeds the total revenue from sale if the product or, if the average variable cost of producing exceeds the price at which it can be sold.

Figure 7.1: Two outputs where marginal cost equals marginal revenue.

"Output q_0 is a minimum –profit position because a change of output in either direction would increase profit: for outputs below q_0 marginal cost exceeds marginal revenue and profits can be increased by reducing output, while outputs above q_0, marginal revenue exceeds marginal cost and profits can be increased by increasing output. Output q_1 is a maximum profit position, since at outputs just below it marginal revenue exceeds marginal cost and profit can be increased by increasing output towards q_1; while at outputs just above it marginal cost exceeds marginal revenue and profit can be increased by reducing output towards q_1" (Source: Lipsey and Chrystal, 1995, p222)



The basis of the calculation of marginal cost and marginal revenue can be seen below:

a) Total cost $TC=TVC+TFC$ (TC=total cost; TVC=total variable cost; TFC=total fixed cost)
b) Average total cost $ATC=TC/Q$ (ATC=Average total cost; TC=Total cost; Q=Quantity)
c) Total revenue $TR=P\text{x}Q$ (TR=Total revenue; P=Price; Q=Quantity)
d) Average revenue $AR=TR/Q$ (AR=Average revenue; TR=Total Revenue; Q=Quantity)
e) Profit $\pi=R-(F+V)$ (π= profit; R= revenue; F=fixed cost; V=variable cost

The cost analysis of the Boane project which was presented in chapter 6 will be used to determine the marginal cost and marginal revenue which would result from increasing household coverage of ITNs in Boane.

In estimating the costs of enlarging the project, the conventions used in previous health and social care studies were adopted in which short-run costs (current average costs) plus capital costs (buildings and equipment) and recurrent costs, are regarded as sufficiently close to a long-run marginal cost for most evaluative purposes (Lipsey & Christal 1995). The *short run* is a period of time in which the quantity of at least one input is fixed and the quantities of the other inputs can be varied. The *long run* is a period of time when all inputs can be varied. For the purpose of the present study, the short run was selected in order to analyse the total cost assuming that the only variable cost was the cost of the ITNs.

7.3. Methodology

7.3.1. Marginal analysis calculation

To explore the issue of whether an expansion of the project (increasing the number of households with ITNs) under different price scenarios would eventually lead to financial sustainability, the total financial cost and the total revenue were calculated. Two assumptions were made, one regarding the price of the ITNs, and the other regarding coverage, in order to explore how revenue would vary if the actual project coverage (24%) and the price ($5) (the average price of large ITNs and small ITNs made is $5) were compared with two other different hypothetical coverage levels (50% and 80%), and three different hypothetical prices: $2.50 (a price which would increase coverage, but would require a large subsidy), $9 (the approximate break-even price), and $14 (a price that would ensure a large profit on each ITN sold). These assumptions are discussed in more detail below.

7.3.1.1. Assumptions about the price of the ITNs

1) The subsidised price of $2.50 was the price at which 50% of the households in Boane would be classified as "able to pay" on the assumption that the households could afford to spend 5% of their monthly income on the ITNs. Based on the income data presented in Chapter 5, the mean amount that households were able to pay was calculated. To do that, household income was multiplied by 5% (considered to be the limit of the households' ability to pay). The mean value of this calculation was $2.50.

2) The price of $9 was selected because it is the approximate break-even price at the actual coverage of 24%.

3) The price of $14 was selected as a price at which the project could be confident of making a profit on the basis of 24% coverage.

7.3.1.2. Assumptions about expanding the coverage of the ITNs

Assumptions regarding coverage were based on the mass-killing effect theory (Lines 1996). It was assumed that it would be desirable to achieve coverage of at least 80%, however, since the ITNs are not distributed free of charge, a second coverage ratio of 50% was used. When treated bednets are used by almost everyone in a community, they can have a mass effect on the local mosquito population, reducing the density and infection rate of the local vectors (Lines 1996). This effect has been seen in some trials. For example it was clearly important in Tanzania (Magesa *et al.* 1991) and Ghana (Binka *et al.* 1996). This type of mass effect gives protection to the whole community and is additional to the individual protection given through personal use of a treated bednet. By analogy with house-spraying, which is effective primarily through this kind of mass effect, it was assumed that 80% coverage with ITNs would be necessary in order to ensure such an effect in Boane. However, even if there is no mass effect (Quinones *et al.* 1998), so that only those under the ITNs are protected, it is a public health goal to achieve high coverage. These two hypothetical results were compared with the actual coverage of 24%.

The total number of bednets needed to achieve coverage of 50% and 80% respectively was calculated from the total number of households in Boane as recorded in the census files. It was assumed that the average number of ITNs bought by a net-buying household would remain constant at 2.5 ITNs per household. In order to increase household coverage to 50% and 80% (*i.e.* from 1536 to 3006 and 4809 households respectively) the number of bednets required was calculated as 7,885 and 12,616. Table 7.1 shows the actual coverage and the total number of ITNs needed to cover 50% and 80% of the study population.

Table 7.1 Hypothetical scenario numbers

Coverage	Number of Households (total=6337)	Number of ITNs (ITN/household=2.46)
24% *	1,536	3,785
50%	3,169	7,809
80%	5,070	12,493

*actual coverage

7.3.1.3. Assumptions about the cost

Total cost was subdivided into two categories: fixed cost and variable cost. Fixed cost (cost of a fixed input) are those that do not change as output changes, *i.e.* fixed costs are independent of the output level. Variable costs are the cost of the variable inputs, which vary with the output level. For the purpose of this analysis, it was assumed that the only variable cost would be the cost of the nets and insecticide; other costs (capital and recurrent) were considered fixed. Thus, we began by adopting the most optimistic cost scenario in order to explore the question of financial sustainability. If analysis of these conservative assumptions showed that the project staff and structures would not be capable, without additional resources, of distributing the nets to the whole of Boane, then it could be concluded that additional resources would certainly be necessary in more realistic conditions.

Thus, the hypothetical cost of household coverage of 50% and 80% was calculated as the total fixed cost (constant and equal for the three coverage levels (24%, 50% and 80%) plus the total variable cost of buying the number of bednets required to achieve 50% and 80% coverage. These costs were taken from calculations (financial non annualised costs), reported in Chapter 6 (see table 6.3).

7.4. Results

7.4.1. Total revenue collected during the implementation of the project

The programme sold 3,785 ITNs. The total revenue collected from the sales was $18,925, which gave average revenue per ITN sold of approximately $5.

7.4.2. Total Variable cost, total fixed cost, total revenue, total profit

Table 7.2 shows total cost (*TC)* and its division into total fixed cost (*TFC*) and total variable cost (*TVC)*. The first row of table 7.2 shows the financial cost consisting of fixed costs of $15,446, variable costs (the cost of the nets) of $20,817, and a total cost of $36,263. Average total cost (*ATC)* is the cost per unit of output (quantity (*Q*)). Dividing the total cost ($36,263) by the actual number of nets sold (3785) gives the average cost per ITN of $9.60. The total revenue from the sale of the ITNs was $20,817. Average revenue is the revenue divided by the quantity of ITNs which were sold; this gives the average revenue per ITN of $5. The profit or surplus is the total revenue minus the total cost. It can be seen that total revenue was less than the total cost. The ITN project therefore operated at a loss of $17,338 or $4.60 per ITN. In other words, the Boane project had a negative profit per unit (total revenue less total cost divided by total ITNs).

The other rows of table 7.2 show the hypothetical financial results if the project had succeeded in achieving greater levels of coverage, assuming that the only additional costs required for this would be those of the extra nets. Assuming that the number of ITNs sold increased to 7,885 and 12,616, then the average cost would decrease to $7.50 and $6.70 per ITN respectively. Although the table shows that by increasing the number of ITNs sold, the project would have lost more money (*e.g.* an expected loss of $21,754 at 80% coverage), it is important to note that the loss per unit decreases as the coverage increases (cost column of table 7.2).

Table 7.2: Marginal Analysis of the Boane ITN project at the actual price of the ITNs

Price	Household coverage	Total ITNs	Financial Cost (not annualised) (US$)				Revenue (US$)	Profit (US$)	
			Fixed	Variable	**Total cost**	Average cost/ITN	Total revenue	Profit/ Loss	Average Profit/ITN
5	24%	3785	15,446	$20,817	**36,263**	$9.60	18925	-$17,338	-$4.60↓
5	50%	7885	15,446	43,367	**58,813**	7.50	39425	-19,388	-2.50↓
5	80%	12616	15,446	69,388	**84,834**	6.70	63080	-21,754	-1.70↓
5	100%	15631	15,446	85,971	**101,417**	6.50	78,155	-23,262	-1.50↓

↑ Profit; ↓ Loss

Figure 7.2 shows the average cost curves arising from the cost assumptions specified in section 7.2.3. The average fixed cost curve slopes downward exponentially as the fixed costs are spread over a larger number of ITNs sold. The average variable cost is constant, because the exercise assumed the only variable cost to be that of the ITNs actually sold. The average variable cost per ITN is assumed to be simply the cost of the average ITN, and therefore does not vary with the number of ITNs sold. The sum of these two, *i.e.* the average total cost, therefore declines rapidly at first, then approaches the average variable cost and does not decline further.

Table 7.3 shows further hypothetical calculations to explore what might have happened if the ITNs had been sold at a cheaper price ($2.50), in an attempt to increase coverage. It can be seen that then the total cost exceeds the total revenue by a higher margin. Note that in tables 7.2 and 7.3, the average loss (negative profit) per ITN declines as coverage increases, but the total loss increases. Thus the need for subsidy increases with higher coverage.

Table 7.4 shows similar calculations assuming a price of $9. There would still have been a marginal loss if the actual level of coverage had been achieved (24%). At higher levels of coverage at this price a profit would have been made. At this higher price, therefore, increasing coverage tends to reduce and eventually eliminate the need for subsidy.

Finally, table 7.5 shows similar calculations assuming an even higher price of $14. It can be seen from the table that at that price, the project would make a profit even with low coverage.

Figure 7.2: The relationship between coverage and costs, assuming that the costs are as observed in the Boane project, and that the costs of the ITNs are the only variable cost

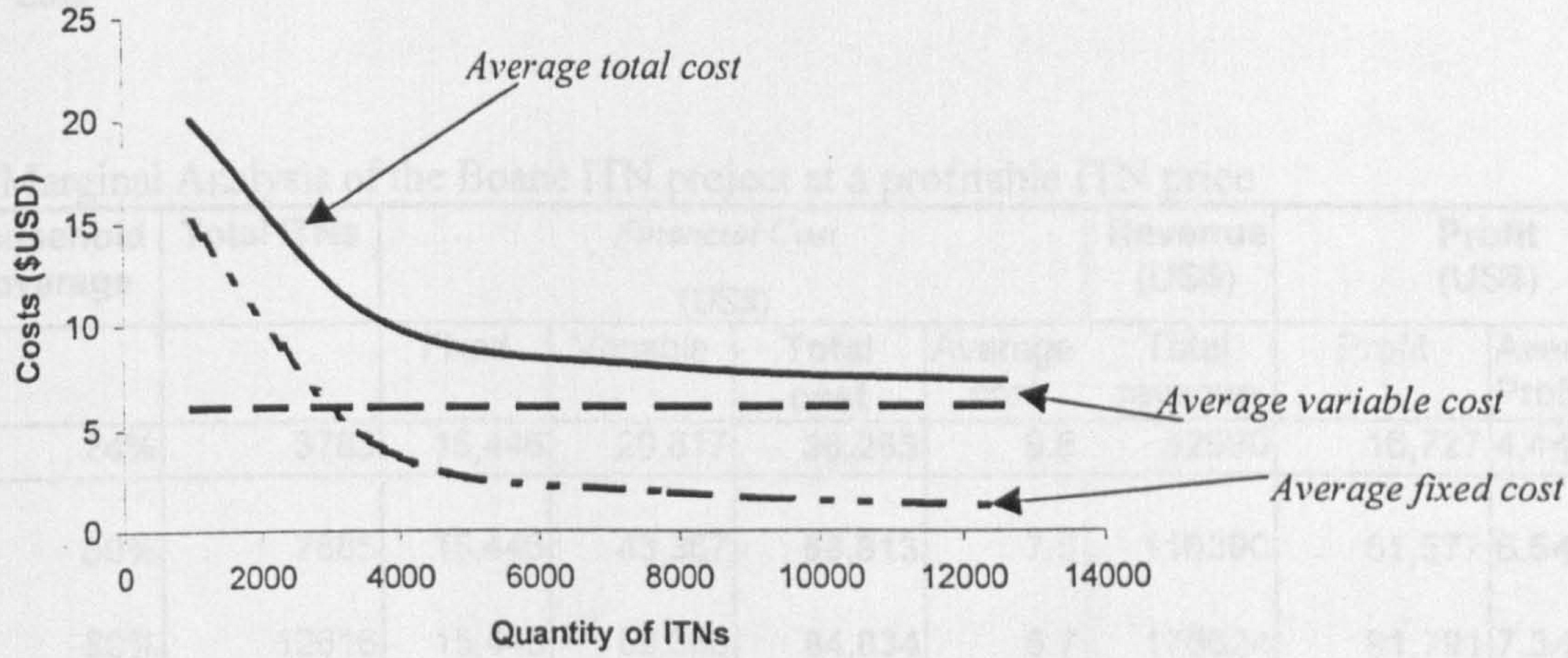


Table 7.3: Marginal Analysis of the Boane ITN project at a subsidised ITN price

Price	Household coverage	Total ITNs	*Financial Cost* (US$)				Revenue (US$)	Profit (US$)	
			Fixed	Variable	Total cost	Average cost	Total revenue	Profit/ Loss	Average Profit
2.5	24%	3785	15,446	20,817	**36,263**	9.6	9463	-26,801	-7.1↓
2.5	50%	7885	15,446	43,367	**58,813**	7.5	19713	-39,101	-5.0↓
2.5	80%	1216	15,446	69,388	**84,834**	6.7	31540	-53,294	-4.2↓

↑ Profit; ↓ Loss

Table 7.4: Marginal Analysis of the Boane ITN project at a near break–even ITN price

Price	Household coverage	Total ITNs	Financial Cost (US$)				Revenue (US$)	Profit (US$)	
			Fixed	Variable	**Total cost**	Average cost	Total revenue	Profit/ Loss	Average Profit/ITN
9	24%	3785	15,446	20,817	**36,263**	9.60	34,065	-2,198	-0.60↓
9	50%	7885	15,446	43,367	**58,813**	7.50	70,965	12,152	1.50↑
9	80%	12616	15,446		**84,834**	6.70	113,544	28,711	2.30↑

↑ Profit; ↓ Loss

Table 7.5: Marginal Analysis of the Boane ITN project at a profitable ITN price

Price	Household coverage	Total ITNs	Financial Cost (US$)				Revenue (US$)	Profit (US$)	
			Fixed	Variable	**Total cost**	Average cost	Total revenue	Profit	Average Profit/ITN
14	24%	3785	15,446	20,817	**36,263**	9.6	52990	16,727	4.4↑
14	50%	7885	15,446	43,367	**58,813**	7.5	110390	51,577	6.5↑
14	80%	12616	15,446	69,388	**84,834**	6.7	176624	91,791	7.3↑

↑ Profit; ↓ Loss

7.4.3. Marginal cost and marginal revenue

Table 7.6 presents a marginal analysis of the scenario already seen in tables 7.2 to 7.5. Most of the information is the same as shown in those tables. The additional information is in the marginal cost column and the marginal revenue column.

As shown in previous tables, when the coverage of ITNs increases from 24% to 50%, the total cost also increases. The increase in output is 4,100 ITNs, and the increase in total cost is $22,550. The marginal cost of one of the 4,100 ITNs is $5.50 (22,550/4,100). When the coverage of ITNs increases from 50% to 80%, the increase in output is a further 4,731 ITNs and the increase in total cost is $26,020.50. The marginal cost of one additional ITN is $5.50. The two amounts are identical because it is assumed that the only variable cost is the cost of the ITNs. Therefore although there is an increase in the total cost, the marginal cost is maintained.

Marginal revenue is the change in total revenue resulting from one additional unit in the quantity sold. The marginal cost and revenue appear between the lines of the quantity sold, as a reminder that marginal cost and revenue result from changes in the quantity sold.

As can be seen from the table 7.6, if the marginal revenue is lower than the marginal cost the project incurs a deficit and requires a subsidy. If marginal revenue is higher than marginal cost the project can make profit if the project sells enough ITNs to cover the total costs.

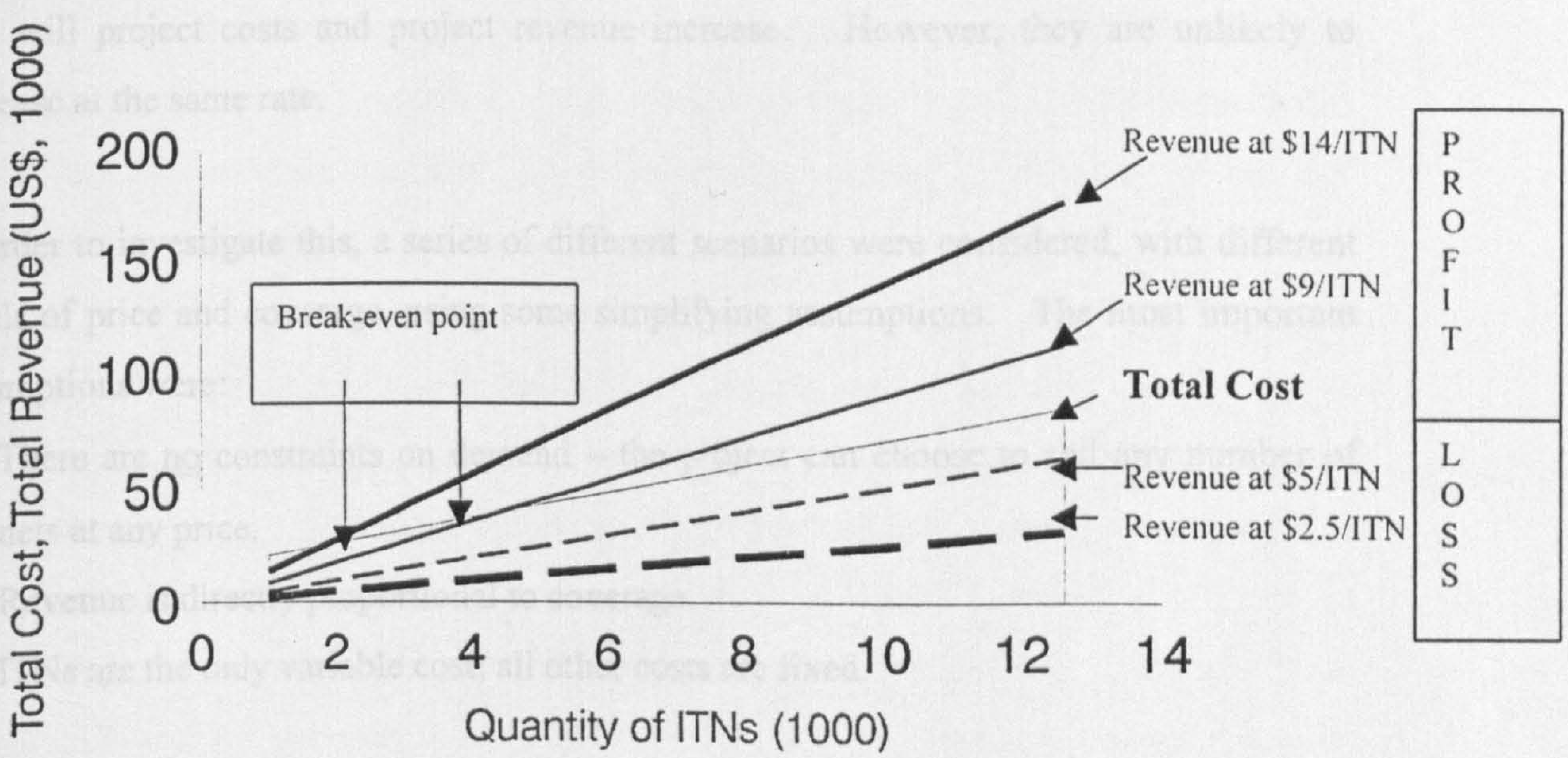
Figure 7.3 presents the total cost and revenue under different prices. Profits are shown above the total cost line, and losses are shown under the costs. As can be seen, if marginal revenue exceeds marginal cost, then extra revenue from selling one more unit exceeds the extra cost incurred to produce it, and therefore the profit increases if output increases. On the other hand, if marginal revenue is less than marginal cost, the extra revenue from selling one more unit is less than the extra cost of producing it, and thus the loss increases if output increases. As the project expands the gap between total cost and total revenue increases and economic loss also increases. On the other hand, the project makes a profit when total revenue exceeds total cost

Table 7.6: Marginal cost and marginal revenue at different ITNs prices and coverage

			Financial Cost (US$)			Revenue (US$)			Profit (US$)	
Price	Coverage	Total ITNs	Total Cost	Average cost	**Marginal cost**	Total Revenue	Average revenue	**Marginal Revenue**	Profit	Average Profit
2.5	24%	3,785	36,263	9.6		9,463	2.5		-26,801	-7.1↓
					5.5			**2.5**		
2.5	50%	7,885	58,813	7.5		19,713	2.5		-39,101	-5.0↓
					5.5			**2.5**		
2.5	80%	12,616	84,8334	6.7		31,540	2.5		-53,294	-4.2↓
			Financial Cost (US$)			Revenue (US$)			Profit (US$)	
Price	Coverage	Total ITNs	Total Cost	Average cost	**Marginal cost**	Total Revenue	Average revenue	**Marginal Revenue**	Profit	Average Profit
5	24%	3,785	36,263	9.6		18,925	5		-17,338	-4.6↓
					5.5			**5**		
5	50%	7,885	58,813	7.5		39,425	5		-19,388	-2.5↓
					5.5			**5**		
5	80%	12,616	84,834	6.7		63,080	5		-21,754	-1.7↓
			Financial Cost (US$)			Revenue (US$)			Profit (US$)	
Price	Coverage	Total ITNs	Total Cost	Average cost	**Marginal cost**	Total Revenue	Average revenue	**Marginal Revenue**	Profit	Average Profit
9	24%	3,785	36,263	9.6		34,065	9		-2,198	-0.6↓
					5.5			**9**		
9	50%	7,885	58,813	7.5		70,965	9		12,152	1.5↑
					5.5			**9**		
9	80%	12,616	84,834	6.7		113,544	9		28,711	2.3↑
			Financial Cost (US$)			Revenue (US$)			Profit (US$)	
Price	Coverage	Total ITNs	Total Cost	Average cost	**Marginal cost**	Total Revenue	Average revenue	**Marginal Revenue**	Profit	Average Profit
14	24%	3,785	36,263	9.6		52,990	14		16,727	4.4↑
					5.5			**14**		
14	50%	7,885	58,813	7.5		110,390	14		51,577	6.5↑
					5.5			**14**		
14	80%	12,616	84,834	6.7		176,624	14		91,791	7.3↑

↑ Profit; ↓ Loss

Figure 7.3: Total cost and total revenue scenario of the Boane ITN Project with ITNs sold at different prices and in different quantities



7.5. Discussion

A marginal analysis of the financial cost (not annualised) of the ITN project was carried out from the perspective of a government. The questions of total cost, profit and price needed to be addressed so as to provide information for decision-making.

The main issue in this chapter is the assumption commonly made in ITN projects that an expansion in coverage and/or an increase in sales will improve sustainability and reduce the need for subsidy. Here, "sustainability" is defined as the degree to which project costs are met by project revenue. A project is assumed to be fully sustainable if total revenue exceeds total cost, that is, if it makes a profit or surplus. Conversely, if total cost exceeds total revenue (i.e. the project makes a loss), it is assumed that this loss must be met by subsidy. The issue here is about how "sustainability" changes with price and with volume. There are two critical questions for any given price. First, what volume allows the project to break even, *i.e.* brings revenue equal to costs? Second, what volume maximises profit?

The balance between costs and revenue will depend not only on the price selected by the project, but also on coverage (i.e. the number of ITNs sold). As coverage increases, so also will project costs and project revenue increase. However, they are unlikely to increase at the same rate.

In order to investigate this, a series of different scenarios were considered, with different levels of price and coverage, using some simplifying assumptions. The most important assumptions were:

(a) There are no constraints on demand – the project can choose to sell any number of nets at any price.
(b) Revenue is directly proportional to coverage.
(c) ITNs are the only variable cost; all other costs are fixed.

It follows from (b) that the curve relating average unit costs to volume is not U-shaped, as would normally be expected (Fig 7.1). Instead, as volume increases, the average unit cost declines rapidly at first and more slowly later, until eventually it gradually approaches the variable cost (i.e. in this case the cost of the net) (Fig 7.2).

Because there are fixed costs, even a very high price (e.g. $14) can result in a loss, if the number of nets sold is extremely small. Nevertheless, at this price, the project can reduce the loss by selling more ITNs, and does not need to increase sales by very much before it breaks even. Above the break-even point, further increases in sales result in even greater profits.

At a slightly lower price (e.g. $9), the project must sell a larger number of ITNs in order to reach break-even point, but it is still possible to make a profit if the volume is large enough. Given the costs and coverage levels observed in the Boane project, a price of

$9 would have allowed the project to operate at close to the break-even point, and a price of $10 would have provided a small profit. However, the project achieved only a 24% level of coverage with a much lower price, and it is very unlikely that as many ITNs would have been sold if the price had been as high as $9 or $10.

On the other hand, if the price is set much lower than that, there comes a point where it is no longer possible for the project to break even or to make a profit. If the price is any lower than this critical point, then the project will lose money. The size of the loss depends on coverage: the more ITNs the project sells, the more money it loses.

Our original question was "is it justified to assume that expanding the project or increasing coverage will reduce the need for subsidy?" The answer depends on the price at which the nets are sold. If the price is above a threshold level, the answer is "yes". In this case, progressive expansion (i.e. an increase in sales) leads to a progressive improvement in the project's financial balance, and can eventually lead to a profit (with no further need for subsidy) if enough ITNs are sold. Below this critical price, by contrast, the answer is "no". If the price is too low, increases in sales inevitably lead to larger and larger losses, so that the project will require larger and larger subsidies in order to survive.

However, the assumptions made in the scenarios analysed here are not realistic. In fact the number of ITN's sold will almost certainly decline as price increases, and in practice this will be an important constraint. For example, as already noted, it is unlikely that the project would have sold as many ITNs as it actually did, if it had charged a price that could have allowed it to break even or to make a profit. It is also not realistic to assume, as these calculations do, that the cost of one ITN is the only variable cost – in fact other costs would also increase with increasing coverage. Nevertheless, these simplifying assumptions are useful because they represent the circumstances in which it would be possible for a project to attain financial sustainability. In other words, if a project could not achieve sustainability in the conditions assumed here, it would certainly be unable to do so in more realistic circumstances.

The analysis in this chapter has defined sustainability in terms of independence from subsidy, i.e. from the point of view of a donor. There is an intense effort at the moment to raise international funding for the purpose of increasing the availability and use of ITNs in Africa. However, it is not clear whether this additional funding is intended as an initial investment, or whether there is a commitment to sustained financial input in the medium-to-long-term. If the extra finance is temporary, it may succeed in raising levels of demand, but is otherwise irrelevant to the conclusions of this chapter concerning sustainability. On the other hand, if there is a commitment to sustained external financing, then it may be possible for a project to plan for long term dependence on subsidy, and thus to remain sustainable. Nevertheless, projects that adopt this "sustainable subsidy" strategy should not forget that if they select a selling price which is significantly lower than their marginal costs, then their need for subsidy will increase as coverage expands. In other words, if a project loses money on every ITN that it sells, then the level of coverage that it can sustain will be limited by the amount that donors are willing to contribute in the long run. Thus, setting a price will involve consideration not only of the willingness to pay of ITN users, but also the willingness to pay of donors.

So without knowing what level of subsidy can be sustained it is difficult to set a price. If information is available on the leval of subsidy that will be provided, then it is also necessary to have information on the price elasticity of demand (the responsiveness or proportionate change in the quantity demanded, due to a change in price that brought it about (Lipsey and Chrystal 1995) in the market for the goods. With this information, one can select the price that will maximise coverage for the given level of subsidy. Conversely, if that the target coverage of consumers and the price elasticity of demand for a particular item are known, then one can determine the price needed to attain that coverage. Having selected the price, the project can tell donors how much of a subsidy is needed every year.

Any prices above $5.50 (*i.e.* break-even or profitable prices) would presumably in practice achieve less coverage than was achieved in Boane during the two years of the programme. Therefore, it will be difficult to achieve better coverage than 24% at a price of $5.50 or more. On the other hand, lower prices that will achieve a higher coverage, will lose more money, and therefore expanding the project will make the it less financially sustainable, and not more so.

In conclusion, the results of the Boane project suggest that at prices which would allow for increased coverage (through increase of demand) and expansion of the programme, economies of scale are limited. Thus the project can never become self-sustaining even under the most favourable cost and coverage scenarios. If ITNs are sold at a loss, increasing the number of ITNs sold, increases the gap between the total financial cost and total revenue, and makes the project much less self-sustainable. Non-subsidised projects do not have the potential for continuity without external support, and this explains much of the observation and experience gained from the Boane project, as well as from ITN projects elsewhere (Chavasse, 1999).

An adequate pricing policy should be developed, taking into account both the main objectives, which are to maximise coverage by setting a price which is within the people's ability to pay.

7.6. Conclusion

Marginal analysis was undertaken to determine the relationship between cost and revenue under price charged and the coverage achieved in the Boane ITN project, and under hypothetical price and coverage scenarios.

The total cost of the ITNs in Boane ($36,263) was higher than the total revenue ($20,817), and thus the project lost US$4.60 for each of the 3,785 ITNs sold. If the project had managed to increase coverage it would have lost much more money. The only way to have a financially sustainable ITN programme would be to sell the ITNs at a price of $9.60. However, selling the ITNs at that high a price would lead to a decrease in coverage, because the majority of the population cannot afford to pay more than $3. Thus, price is one of the most important issues to consider in order to have a successful programme.

In Chapter 8 the cost implications of expanding the ITN programme in Mozambique, and the strategies that can be applied to implement a project covering the whole country, will be discussed.

CHAPTER 8:

EXPANDING THE ITN PROGRAMME IN MOZAMBIQUE: The Future

8.1. Introduction

The Roll Back Malaria campaign aims to halve malaria-associated mortality by 2010 and again by 2015 (Nabarro and Tayler 1998). The RBM has identified the universal coverage of ITNs as the "means" to this "ends". A key assumption by the RBM is that scientific and technical inputs can be channelled through effective health systems and supported by adequate financing and political commitment. Mozambique is in the process of committing to the campaign (David Nabarro, oral communication, ITNs conference, Tanzania 1999), thus attempting to achieve full ITN coverage in a long-term sustainable way. Given the context of RBM and the government's commitment to participating in it, this chapter will consider how the lessons from the Boane ITN project will shed light on how to expand the ITN programme in order to achieve universal coverage.

This chapter will examine some of the relevant issues that policy-makers may have to take into account in order to make decisions about overall policy objectives and on how to introduce a large-scale ITN programme. The following points will be considered in this discussion:

a) What are the delivery mechanisms that are available to achieve universal coverage within 5-10 years
b) The cost of a national ITN programme
c) The paradigm of sustainability and equity in the ITN programmes in Mozambique
d) The role of the government
e) The alternatives to delivery of ITNs in Mozambique if the programme cannot be totally funded

PART I

8.2. Potential delivery mechanisms to achieve universal coverage of ITNs in Mozambique

While the Boane implementation was done by the government, this part will discuss alternative delivery mechanisms that may be used to ensure the universal coverage of ITNs in Mozambique. It discusses the potential advantages and disadvantages of alternative delivery mechanisms. This part addresses issues relating to sustainability and equity. A detailed discussion of these concepts is covered in chapter 2, section 2.4.

8.2.1. Private sector

In many countries the private sector has played an important role in supplying many low-income communities with bednets. For example in Tanzania it is estimated that more than 1,500,000 are produced by the local private industry. The private sector can meet the needs of upper and middle-income groups, and that the public sector or donor-funded NGOs are required to reach the poorest people (Chavasse *et al.* 1999)

David McGuire in an ITN conference held in Tanzania in 1999 (personal communication) defined three important tasks (among others) of what should be the role of the private sector as follow: a) to ensure supply; b) to develop a market for ITNs and c) to increase access to ITNs.

The advantage of the private delivery of ITNs is that it may ensure long-term financially sustainable delivery. The main disadvantage is that it does not ensure an equitable distribution of ITNs.

In order to achieve the universal coverage of ITNs using the private sector to distribute ITNs the following assumptions have to be made:

1: There would be available credit available and as well incentives for making long-term investments in the bednet industry and bednet and insecticide delivery services.

2: most people would purchase ITNs if they were available

However, at present these assumptions cannot be made. In Mozambique the private sector has little incentive to invest in a major permanent way in a low-income area, because there is no certainty that the demand for their product will continue. Thus, the unit cost of privately-produced ITNs (due to operating on small-scale) would be therefore be higher than would be the case if there were a larger market for the ITNs.

The private sector in Mozambique faces both a shortage of credit for investment and a lack of incentive for making long-term investments not only in the bednet industry and bednet and insecticide delivery services, but also in respect of other commodities. The shortage of credit has made it difficult for small-scale entrepreneurs, or co-operatives of residents, to raise the capital they need to produce the nets and to develop services. There is not yet an industry of producing bednets in Mozambique and private entrepreneurs are only selling a small volume of imported bednets.

At the time that this thesis was written, the potential role of development assistance for ITNs in Mozambique was limited. Only one organisation (NETMARK) has approached different Mozambican institutions to explore the possibility of creating a market for ITNs (McGuire 2000, personal communication).

8.2.2. Non Governmental Organisations (NGOs)

In Mozambique, NGOs could play an important role in providing welfare services to those who cannot be reached through markets, particularly in areas where government is failing to ensure that there is universal coverage of ITNs.

The advantage of having NGOs deliver ITNs is that they distribute them at a lower subsidised price and therefore their projects may reach more of the poor and so be more equitable. The disadvantages of the provision of ITNs by NGOs include the fact that NGO-sponsored projects are less sustainable because they rely on external sources of funding, supplies and expertise (Chavasse *et al.* 1999).

In Mozambique there are few local NGOs engaging in health activities are very few and most of them have limited capacity. The majority of NGOs are concerned with socio-economic development, such as woman's associations and regional development associations. Although few NGOs are devoting their work to health activities, some of them may become interested in investing in ITNs as part of their contribution to the socio-economic development of the communities that they are serving. However, many of these local NGOs are quite small and have only a local orientation, and it is difficult for them to expand because they receive little or no public attention. At the time that this thesis was written there were no local NGOs distributing ITNs in Mozambique.

International NGOs operating in Mozambique are able to mobilise more resources than national ones. Some of these NGOs are active in health activities. Examples of such NGOs operating in Mozambique are: Save the Children-UK, Care International, Africare, "Doctors Without Borders" from Spain, France and Switzerland. These organisations can actively contribute to the expansion of ITNs in Mozambique, particularly towards reaching rural areas, where there is poor health access. However, there are currently no International NGO currently distributing ITNs.

Although there is a potential for developing the role of NGOs for distributing ITNs in Mozambique, experience from other countries, for example in Papua New Guinea – The Rotary Against Malaria project (Chavasse *et al.* 1999), show that they will likely be geographically limited and it will take time to develop these projects, and they might not be able to achieve national coverage.

8.2.3. Community based ITNs projects

Communities can take an important role in solving their own problems and their developing capacity to design, manage, execute, control and evaluate projects, which aim to develop their settlements. It is an empowering and progressive possibility, however, how this can apply for ITNs projects remain poorly understood.

Community based ITN projects would require that there is some degree of technical support and resources for:

a) finding credit for ITNs and services related to their distribution,
b) the bulk purchase of bednets and insecticide and
c) a help in negotiating with government and private organisations to assist in getting funds

There are severe limits in Mozambique as to what communities can achieve for themselves, either individually (in building their own ITN business) or collectively (in building or developing an ITN delivery system for the entire region) without some degree of technical support and without financial resources. The lack of technical training among staff from NGOs, and government organisations to enable them to carry out participatory projects, is a serious barrier to the implementation of successful ITNs projects. Until now there has never been an ITN community based project in Mozambique. In other settings where community based ITN projects were implemented (in Tanzania for example – The Bagamoyo ITN project) they found difficulty in ensuring project sustainability, because of lack of financial resources and trained staff (Chavasse *et al.* 1999).

The advantage of community based projects is that they can reach poorer parts of the community to improve equity, but the disadvantage is that they are geographically confined, and therefore it may not a useful strategy to achieve national coverage in a short period of time.

8.2.4. Public sector

Some governments are already playing an important role in delivering ITNs (Chavasse *et al.* 1999). Rosenthal and Newbrander (1996) argue that the private sector is typically seen as being more efficient, and the public sector as more equitable. The World Bank data suggests that public provision plays an important role in expanding coverage, and shows the role of the public sector to be more important providing for people at lower income levels (World Bank 1994, cited by Hanson *et al.* 2000). In Mozambique most of the people live below the poverty line (Programa das Nações das Unidas 1998), and therefore the strong participation of the government is justified in order to ensure a more equitable distribution of ITNs.

Some of the disadvantages of using public funds are: a) the capacity of structures and staff to add ITN activities to existing workloads and b) the reliance on government commitment and financing for procurement and distribution of supplies (Chavasse *et al.* 1999).

8.2.5. Public-Private Partner-ship (Futuristic vision)

Given scarce resources, it has been advocated that the government should focus on the people that need more ITNs and cannot afford them, and should leave the wealthiest groups to be targeted by the private sector.

It has been argued that the commercial partnership can be seen as an extension of the national malaria control strategy, as a complementary force of the overall programme (McDonald and McGuire 1999). Recently the RBM has emphasised the development of strategic partnerships between the commercial sector and the public sector, to share investments initially needed to research and build a market environment that would result in mutual benefits of increased access and usage of ITNs (Ibid.).

The advantage of the public-private partnership system is that it obtains the best will of the public and the private sector. However, advocacy of a public-private partnership is based on two critical assumptions:

1) that the expansion of private sector is possible;
2) that the public sector can effectively target subsidies

The government and private sector can benefit from this partnership. The government would benefit from the achievement of the objective of delivering more ITNs in less time and at less cost to the government's budget. There would also be the possibility of improving the services by improving the targeting of the limited resources and by reallocating those resources. The private sector would benefit by sharing risk with the public sector to develop an ITN market, of improving relations with the local authorities, and enhancing the image of the company and of their products.

However, the private sector in Mozambique is still embryonic, and therefore, it will take time before this initiative can take place. Secondly, the government need to target those who are in most need of ITNs. In order to succeed in reaching those people, the assumption has to be made that the public sector can effectively target the subsidies (i.e., that the subsidies will go to the poorest people or to the highest risk groups, such as pregnant women and young children). However, it is still not well known if subsidies for ITNs can be effectively targeted because of the high tradability of ITNs.

8.2.6. Discussion of the different delivery channels

Although NGOs have helped to pioneer various distribution systems (Chavasse *et al.* 1999), this has not occurred to a significant extent in Mozambique, as is in other countries. Almost all of the projects developed by NGOs are on a very limited scale, and it is highly unlikely they have the capacity to provide a system that can achieve a national coverage of ITNs within 5-10 years. Therefore, in Mozambique, the involvement of NGOs cannot be seen as a sole means of achieving universal coverage of ITNs.

In Mozambique there are no community based ITNs projects. Experience from other countries show that these projects eventually failed, if they did not receive sustainable financial and technical external support. Given these circumstances, community based ITN projects cannot be seen in Mozambique, as an alternative to bringing about national ITN coverage.

Private sector activity for ITNs is mainly confined in some major cities of Mozambique. There is no bednet industry in the country, and the price of bednets sold by the private sector ranges from $15-$60 (Shretta 1999), which is well above an affordable price range for the majority of the population. Thus, the role of the private sector in providing universal coverage of ITNs is limited in the next 5-10 years.

The public sector can help to improve an equitable distribution of ITNs if there are funds available in order to subsidise those who cannot afford. However, it is not known how much financial resources are already available to be invested in a national programme.

One likely vision for Mozambique is to encourage the public-private partnership to deliver ITNs, and that some proportion of people will get their ITNs from them, when this expansion happens. However, because a great many people do not have enough money to buy ITNs, the public sector will have to play an important role. A public-private partnership is essential if a very large distribution of ITNs is to be attempted in Mozambique. However, the promotion of ITNs in Mozambique will require the Government's help in order to create an enabling environment in which private enterprise can sell ITNs.

In addition it will be necessary to undertake reforms in the public sector in order to provide efficiently the ITN service. The Government will have to change the regulatory regime (for example, they will have to reduce or remove the tariff on imported ITNs) in order to make possible the large distribution of ITNs. However, this can be seen as a futuristic vision of universal ITN coverage in Mozambique; at present the private sector is still not well developed, and therefore the potential for a public-private partnership is still weak.

Looking at these alternatives and trying to identify what options would provide universal coverage in a short period of time to achieve the RBM goal none of the options are very convincing, although it seems that the public sector is by comparison the mechanism most likely to achieve high coverage in a short period of time in terms of both delivery and mobilising financing resources. The rational beyond this conclusion are:

a) the government can reach more of the vulnerable groups, and therefore increase coverage.

b) the government can mobilise external funding by calling upon the collaboration of international agencies.

The next Part will address how much it would cost to deliver an ITN programme within the public sector in order to achieve national coverage. The experience from the Boane project will be used to calculate the cost to expand the project in Mozambique.

PART II

8.3. Financial projections for expanding an ITN programme in Mozambique within the public health sector

This section attempts to estimate the total cost required to implement an ITN programme in Mozambique. That does not mean that the government alone should pay the total cost; this is an exercise aimed at illustrating the size of the financial resources that a national ITN programme would need. Based on the Boane experience this estimate does, however, assume that the public sector would be responsible for the implementation of the programme, as they are for household spraying activities in Mozambique, and as was the case with the Boane project.

8.3.1. Assumptions used to estimate the financial projections for expanding an ITN programme in Mozambique within the public health sector

The estimates of the cost of the expansion of the ITN programme in Mozambique will be based on the data obtained from the ITN cost analysis in Boane. The method to be used to do this will consist of three separate steps (Over, 1986). First, we will define the number of ITNs to be sold according to the coverage we would like to achieve. Second, the average cost of each ITN will be estimated using the data from Boane. Third, the estimated unit cost will be multiplied by the total number of ITNs that will be purchased in each future years, in order to estimate the future cost of the programme.

Therefore, estimates of the following parameters are required:

a) the target population;
b) the number of ITNs needed to cover the target population;
c) the unit cost of the ITNs;
d) the unit cost of retreatment;
e) the duration of the programme.

a) the target population

The last census that took place in Mozambique in 1997 revealed that the total population of Mozambique was about 15,700,000 inhabitants in about 3,624,000 households (Instituto Nacional de Estatistica, 1997).

There is no data as to the proportion of households living in high-risk malaria areas in Mozambique (A map of malaria-risk areas has been developed and soon will be accessible). However, almost all of the people, including those living in major cities, are at some degree of risk of acquiring malaria. It is assumed that about 80% of the Mozambique population are at risk, which would mean that the total number of people at risk is about 12,560,000, and that the total number of households 2,900,000.

However, it is not realistic to think that an ITN project can achieve coverage of 100% of any group. Thus, it is assumed that the aim is to achieve 80% of coverage of the risk population. The target population to be covered would thus be 10,048,000 - in other words, 64% of the total population.

b) number of bednets

To calculate the total number of ITNs needed it was assumed that each ITN would cover 1.5 people (Njunwa *et al.* 1991), which is approximately what would be the ideal situation in Boane (3 ITNs per household, equivalent to 1.5 ITNs per person (on average there are five persons per household in Boane). The total number of people to be covered was divided by 1.5 to give the total number of ITNs to cover the targeted population. This gives a total of 6,698,667 ITNs.

c) unit cost of bednets and insecticide

The basic unit cost of the ITNs was assumed to be the same as in Boane: $6.70 (for hypothetical coverage of 80%, see Chapter 7, table 7.2). However, an expansion of the project throughout Mozambique would bring additional expenses, such as the cost of transport to remote areas, as well as the cost of a large promotional campaign. Thus, 10% was added for each ITN, giving a unit cost of $7.40 per ITN delivered. To calculate the total financial cost of implementing an ITN programme in Mozambique, the number of ITNs to be delivered was multiplied by the unit cost of $7.40. This is the unit cost that would have been expected if the Boane project had achieved 80% coverage, and if the cost of the ITNs were the only variable cost, with an allowance for transport and promotion. The costs of the project from the second year were adjusted for inflation. The cost calculation assumed a constant unit cost per ITN delivered. The increase of the unit cost from the second year was due to the inflation adjustment.

d) Retreatment cost

Each ITN should be retreated once a year, to maintain maximum effectiveness (Chavasse *et al.* 1999). The estimated unit cost for retreatment was $0.50. This cost was taken from the literature (Bid) and was used in the economic evaluation in Chapter 6.

e) duration of the programme

The insecticide on the bednet only lasts one year, and therefore a retreatment service would be needed every year. For various reasons, such as the availability of ITNs to distribute and the logistic capacity to store and distribute the nets, a three-year scenario for the full distribution of the total projected ITNs will be considered. It will be assumed that the programme could distribute about 33% of the total ITNs per year.

Bednets only last about five years; therefore a provision of new nets would be needed every five years. Thus, the cost projection from the sixth to the tenth year of the programme would be approximately equal to the cost of the first five years; however, it is expected that because of the population growth, more ITNs would be needed for the second five years, and that because of inflation the unit cost of the ITNs, and thus the total cost of the programme would be slightly higher in the second five years. Therefore, this exercise will present the cost only of the first five years of the programme.

8.3.2. Financial cost of distributing ITNs throughout Mozambique

Table 8.1 shows the scenario for the distribution of the total projected number of ITNs in three years. During the first year no substantial retreatment service would be required or provided. However, it is expected that some people would wash their nets (Chavasse *et al.* 1999), and therefore a limited retreatment service will be provided to cover 5% of the total ITNs distributed. This number is based on evidence from Ghana, where 97% of the people did not wash their nets during the first 6 months of the project (Ibid). Beginning the second year, the project would retreat all the existing ITNs distributed one or more years before. From the second year the cost of the project is adjusted for an inflation rate of 3.2% each year (World Bank 1998). The total cost of the programme would be about US$18 million per year during the first three years, and then the cost would drop to about $5 million each year. The total cost of the project for the first five years would be approximately $64.3 million.

Table 8.1: Total cost (in U$) of a hypothetical 5 year ITN programme in Mozambique, with the nation-wide distribution of the ITNs spread over three years (assuming that the unit cost per ITN during the first year was $7.40)

	ITNs			Re-treatment			Total
Year	Number of ITNs	Unit cost	Total cost	Number of Nets	Unit cost	Total cost	
Y1	2,210,560	$7.40	$16,358,144	110,528	$0.50	$55,264	$16,413,408
Y2	2,210,560	7.60	16,880,256	2,210,560	0.52	1,140,649	17,940,905
Y3	2,210,560	7.80	17,242,368	2,210,560	0.54	2,372,550	19,614,918
Y4	167,467	8.00	1,339,736	6,631,680	0.56	3,695,703	5,035,439
Y5	167,467	8.30	1,389,976	6,631,680	0.58	3,832,581	5,222,557
TOT	6,966,614		$ 53,130,480	20,005,568		11,096,746	64,227,226

<u>Alternative cost-scenarios</u>

The calculation above was based on the cost of the ITN projects in Boane. However, the unit cost of the Boane project was slightly higher than that which was observed in other projects. Among the factors associated with the higher unit cost in the Boane project was the intensive labour required to promote and to sell ITNs.

It has seen elsewhere that ITNs can be promoted at a cost of $1 per ITN, and the total cost per ITN delivered including the promotion cost could be $5 per ITN ($4 per bednet and insecticide plus $1 for promotion) or $4 ($3 per bednet and insecticide plus $1 for promotion) (Chris Lengeler, 2000, personal communication – experience from KINET project, Tanzania). Let us weaken the estimated cost of scaling the project in Mozambique. Because we do not have a model how cost will change given the limited information as scale increases, we will consider two level unit costs scenarios. Therefore, if in Mozambique we could have a similar pattern of costs as it was seen in the Ifakara project, then scaling-up the programme would cost about $47.5 million ($5 per ITN) (table 8.2) or about $40 million ($4 per ITN) (table 8.3), suggesting that these costs would be 71% or 62% of the cost of the hypothetical scenario, if the cost per ITN were $5 or $4 respectively.

Table 8.2: Total cost (in U$) of a hypothetical 5 year ITN programme in Mozambique, with the nation-wide distribution of the ITNs spread over three years (assuming that the unit cost per ITN during the first year was $5)

	ITNs			Re-treatment			Total
Year	Number of ITNs	Unit cost	Total cost	Number of Nets	Unit cost	Total cost	
Y1	2,210,560	$5	$11,052,800	110,528	$0.50	$55,264	$11,108,064
Y2	2,210,560	5.2	11,406,490	2,210,560	0.52	1,140,649	12,547,139
Y3	2,210,560	5.4	11,862,749	2,210,560	0.54	2,372,550	14,235,299
Y4	167,467	5.6	933,260	6,631,680	0.56	3,695,703	4,628,963
Y5	167,467	5.8	967,825	6,631,680	0.58	3,832,581	4,800,406
TOT	6,966,614		36,223,124	20,005,568		11,096,746	47,319,870

Table 8.3: Total cost (in U$) of a hypothetical 5 year ITN programme in Mozambique, with the nation-wide distribution of the ITNs spread over three years (assuming that the unit cost per ITN during the first year was $4)

	ITNs			Re-treatment			Total
Year	Number of ITNs	Unit cost	Total cost	Number of Nets	Unit cost	Total cost	
Y1	2,210,560	$4	$8,842,240	110,528	$0.50	$55,264	$8,897,504
Y2	2,210,560	4.1	9,125,192	2,210,560	0.52	1,140,649	10,265,841
Y3	2,210,560	4.2	9,353,321	2,210,560	0.54	2,372,550	11,725,871
Y4	167,467	4.3	725,869	6,631,680	0.56	3,695,703	4,421,572
Y5	167,467	4.4	743,152	6,631,680	0.58	3,832,581	4,575,732
TOT	6,966,614		28,789,774	20,005,568		11,096,746	39,886,520

However, it is not clear how much the promotion of use of ITNs would cost in Mozambique, since the bednet coverage is much lower than what was observed in Tanzania (in Mozambique the coverage of bednets is less than 0.3%, whereas in Ifakara the coverage was 37%, Schellenberg 1999). It is not clear how much it will cost to deliver ITNs to remote areas, given the bad conditions of many rural roads. Nevertheless, the costs might be lower than those presented here if better and cheaper alternative ways to distribute ITNs in Mozambique could be identified, this could include buying ITNs in bulk, transporting high volumes of ITNs at once, maximising the number of ITNs sold per person and expanding the programme.

However, it should be noted that expanding the programme will not always decrease the unit cost per ITN delivered (see figure 7.1, chapter 7). There is a level at which the expansion of the project will increase the unit cost per ITN delivered, because more resources will be required (for example at certain levels of expansion of the project, the complexity of handling money and the logistics of storing and delivering ITNs might increase the cost per ITN delivered).

Nevertheless, a wider-scale programme in Mozambique could deliver ITNs at lower unit cost than was observed in Boane. The point here was to present a range of how much national programme based on the only available experience in the country could cost, and not to provide precise point estimates.

If the total funds required to pay the costs of a nation-wide ITN programme cannot be raised – for example if the government managed to raise only 20% of the total funds required – the direct result of that limited funding would be that the project could not achieve the intended universal coverage.

Thus, a discussion of aspects of the sustainability and the equity of ITN programmes is relevant. The Boane project provided some experiences in this field, which can be used to draw broad guidelines regarding the implementation of ITN projects on a much larger scale.

PART III

8.4. Sustainability and its implications for ITN programmes

In order to fulfil the goal of the RBM, the national ITN programme will have to be sustainable. The following section will discuss the concept of sustainability and how it is relevant to the Mozambican situation.

According to La Fond (1995) the question of sustainability incorporates two concepts: the capacity for continuity and for effectiveness. Therefore in order to measure sustainability it is necessary to incorporate indicators of continuity and effectiveness. Thus the programme needs to be able to secure sufficient resources locally and to use the resources effectively and efficiently to meet health needs (Ibid.). The sustainability of a programme will depend on the amount of resources available that can easily be used by the health system and on how they are used to achieve an effective quality of care within a given budget.

The capacity for continuity should also be considered in the context of minimum external support. Therefore, a third dimension of sustainability is self-reliance. However, many African countries are and will continue to be dependent upon foreign aid to maintain their health systems, and therefore they may not have the capacity for continuity without substantial external support. During the late 1980s donors began to be concerned about the sustainability of the programmes supported by donor funds after the projects were handed over to the governments. It was seen that many donor-funded projects failed to survive after the subsidy was withdrawn. It had been assumed that the countries would take over the projects at some point in the future. However, what was actually seen was the collapse of many projects as soon as the external funding was exhausted. Therefore, unsustainable projects have become a serious concern for the donor agencies.

In one hand the financial sustainability can be improved by charging consumers. It can be argued that user fees are justified on the ground that people are willing and able to pay for health services. The advantage is that charging consumers can reduce the expenditure of public funds through raising revenue, and by reducing the number of people attending the facility. However, on the other hand the disadvantage of user fees is that even modest charges may reduce utilisation, and therefore the trade-off is equity. Thus, the introduction of user fees for ITNs will reduce their utilisation, particularly in poor areas.

The Boane study showed that the price of $5 per ITN was too high for the poorer people (see chapter 5, section 5.4.3). If we extrapolate this nationally then in order to achieve maximum coverage in Mozambique, the ITNs will have to be distributed free of charge or sold at a lower price.

None of the literature discusses national ITN projects that have been financially self-sufficient. Based on the fact that the efficacy of ITNs in decreasing mortality in children under five is not questionable at the moment and on the fact that that many African countries are still heavily dependent on external funds to run their health services, it can be argued that the provision of ITNs by the health services cannot be postponed until the programmes is financially sustainable. Immunisation campaigns – especially the Expanded Programme for Immunisation – is a good example of a large and expensive preventive health programme that is regarded by donors as a worthwhile and necessary use of international aid transfers. We can made similar arguments for ITN, the cost-effectiveness studies showed that it is worthwhile to use public funds to invest on ITNs programmes (Goodman *et al.* 1999)

The argument made here is therefore that although the financial sustainability of ITN programmes is desirable, it is not possible under current economic circumstances in Mozambique.

So in the case of Mozambique it is more appropriate to define sustainability in terms of development and effectiveness objectives, than to define it in purely financial terms, since the health system itself is not financially sustainable in Mozambique (more than 50% of health budget comes from international aid - Beattie and Kraushaar 1999). If the RBM initiative is going to be implemented in Mozambique, then the aims of ITN projects in Mozambique need to be oriented towards the achievement of high coverage, by stressing the capacity to sustain the subsidy needed to sustain the coverage. Thus, sustainability can be seen as the capacity of the system to maintain a **"sustainable subsidy"** for the long term. That is the only way to achieve nation-wide coverage of ITNs within a relatively short term (about 5 years) and to make it possible to achieve the goal of the Roll Back Malaria project: "To decrease malaria by 50% within ten years". This argument of sustainable subsidy is supported by a review made by Lengeler (1999), where he argues that ITNs programmes should not aim to focus in the long-term on sustainability of health interventions in an ecological sense, but focus on the levels of subsidy based on what level of cost recovery can be borne by the users, and if it is acceptable to the majority of the population.

In conclusion it can be argued that for the case of Mozambique the government seems the most appropriate channel for mobilising international funds to promote a "sustainable subsidy" for the long term.

8.5. Equity and its implications for ITNs programmes

In order to achieve universal coverage of ITNs in Mozambique, the programme will have to be equitable. Equity here is defined as the equality of use (see chapter 2, section 2.4.2), in the other words, a situation where people with equal needs for ITNs receive equal ITNs, both in terms of the number of ITNs and the quality of the service to provide them (such as for example the quality of the bednet).

There are factors, which might influence the equity of the programme. Some potentially important factors are:

a) Price, - because it can deter part of the community from having access to ITNs.
b) Geographic location of the public service, - because if the service is not near to people's residence, then they will have to travel long distances to benefit from the service, therefore they will spend more money on transport and time in obtaining ITNs than those living near to where the service is provided.
c) Supply of the goods, - an equitable ITN programme means a programme capable of securing a regular supply of ITNs

d) Level of income of the household, - ITNs are income-sensitive; therefore poorer people will not have the same access to ITNs as the high-income people.

The Boane experience suggests that low prices are necessary for equitable (high) coverage, but at the cost of making financial sustainability impossible to achieve. On other hand higher prices allow at least the possibility of sustainability, but make it impossible to achieve equity. In conclusion, the more financially sustainable the programme is the less equitable it is likely to be. To improve equity it may be necessary to subsidise the provision of ITNs to ensure that most of the people will be prevented from using ITNs because of their inability to pay for them.

In conclusion an equitable ITN programme in Mozambique means a highly subsidised programme. The subsidy can go through government channels for the distribution of the goods, or to the private sector. However, public distribution would be preferred if the cost of distribution of the goods is lower in the public sector than in the private sector or if there is not a sufficiently developed private sector selling nets, which is the case of Mozambique.

In conclusion it can be argued that the government should actively participate in the delivery of the programme.

8.6. Government intervention

We have already raised some arguments that call for the strong government participation in an ITN programme in Mozambique in order to achieve national ITN coverage a "sustainable subsidy" and equitable distribution. One more additional argument can be made in favour of the government participation, and this is the "externality" characteristic of ITNs.

This section will address two issues: a) the externality of ITNs and b) the negative implications of subsidising an ITN programme.

The externality of ITNs

One of the arguments in favour of government intervention is the externality characteristic of ITNs. Externalities (benefits accruing to people other than the buyer of the good) can be cited as an economic argument against full charges for private benefits. Vaccinations are an example of an intervention with a positive externality (Donaldson and Gerard 1993). The existence of an externality can be coincidental with the existence of private benefit. The protection gained by an individual from being vaccinated is private. On the other hand, when there is high coverage, people who were not vaccinated may also be protected against the disease, because the reservoir of the infection in the community is reduced. ITNs also have externality characteristics. They have an individual benefit, but with high coverage they can have additional community benefits in reducing the transmission of malaria. However, if ITNs are not supplied on a large scale, the social benefits for consumption are lost. This is the case with ITNs, where an ITN protects the individual and can protect others who are not using ITNs through the mass killing effect (Magesa *et al.* 1991). In the case of ITNs, government subsidises of ITNs for people who cannot afford them may be justified, in order to promote high ITN coverage and therefore to enable everyone to benefit from the potential externality of ITNs and their mass killing effect.

Potential problems with government intervention

There are three major factors negatively affecting government intervention:

a) The potential for the reduction in the extension of the programme –

One of the major problems with subsidies is that subsidised programmes cannot continue when the funds paid from the subsidy run out. In other words, because of the limitation of funds, subsidies reduce the possibility of extending ITN projects to reach more people and to continue on a long-term basis.

b) The tradability of ITNs-

There is a major problem with the "sustainable subsidy" strategy, which makes ITNs different from for example immunisation. This is that bednets are a highly tradable commodity. The fact that they are a means of long-term protection can be assessed readily by a prospective buyer, and bednets can therefore be bought and sold. On the other hand, immunisation, once it has been delivered, cannot be bought or sold (for obvious reasons). Even before it has been delivered, prospective buyers cannot assess the quality of the immunisation just by inspecting the package or the vaccine itself; instead they rely on the reputation of the person delivering the vaccine as a guarantee of its quality.

For these reasons, supplying subsidised or free bednets is likely to lead to a black market in bednets, whereas free immunisation campaigns do not create problems of this kind. Experience with subsidised ITN projects in other countries confirms that this sort of problem does arise, although it has rarely been quantified.

If a "black market" in bednets does arise, it leads in turn to two kinds of problems. First, it means that the subsidy is not reaching its target. Instead of the poor and vulnerable, it goes either to the buyer of the black market bednet, or to the trader, both of whom are likely to be richer and less vulnerable to malaria than the intended recipient of the subsidy. Second, because rich people can buy black market bednets, they will not buy bednets sold on the legitimate market. Thus, the existence of a black market in subsidised ITNs can inhibit the growth of an independent legitimate commercial market in bednets.

The tradability of bednets also means that it is hard to maintain large price differentials in the absence of natural barriers to trade. That is, it is hard to devise a system that will allow very different prices to be charged to rich and poor people in the same community (assuming that rich and poor can be reliably identified), or to urban and nearby rural communities. It is even possible that the Roll Back Malaria policy of making ITNs available to everyone at risk for $2 could only be achieved on a continental scale, *i.e.* by making ITNs so plentiful and common that their street-trading value is reduced to this level everywhere. Only then will it not be profitable for traders to buy up subsidised ITNs sold by the health services and to sell them on in areas where the selling price is higher.

Although subsidising the programme might have the risk of creating a "black market" for ITNs, a subsidised programme is seen in Mozambique as the only possible way to achieve the highest possible coverage so as to make an impact on public health.

c) The "crowding out" effect

A problem in the massive use of public funds is that it could lead to a government monopoly and this may discourage the development of a private sector (the "crowding out" effect), which could increase the availability of bednets and in the long-term achieve sustainability. However, the development of a private sector for ITNs in Mozambique is still incipient. Therefore, we can question if there is a normative justification for relying so heavily on market competition based on the actual evidence that ITNs can decrease malaria mortality?

Conclusion

This chapter has reviewed the different mechanisms to deliver ITNs in Mozambique. The main conclusion was that to fulfil the RBM goals, the most viable mechanism to deliver ITNs is the government in the short-term, and in the longer term to build the public-private partnership. In addition the chapter reviewed the concept of sustainability of ITNs. The main conclusion was that for the case of Mozambique, sustainability might be seen as the capacity to "sustain the subsidy", rather to look at the financial self-reliance. The chapter has also reviewed the concept of equity for ITN programmes. The main conclusion was to have an equitable ITN programme the government has to play an important role in subsidising those people who cannot afford to buy ITNs.

In conclusion, a central argument of this chapter is that in order to achieve adequate coverage (e.g., if the goal launched by the Roll Back Malaria project to decrease the burden of malaria by 50% during the next ten years is to be achieved), the distribution of ITNs will have to be equitable. The results of the Boane project lead to the conclusion that not many poor people could buy ITNs, therefore a priori there are strong arguments for the role of government in these circumstances in order to make ITNs available in an equitable way.

This section has explored the advantages and disadvantages of different channels with respect to sustainability and equity. On balance, while recognising the trade-offs, the government channel seems to be most feasible from the perspective of sustainability/equity of an ITN programme in Mozambique and reaching the RBM goal in short-period of time.

In the following Part, the different options for the implementation of an ITN programme with limited funds are examined.

PART IV

8.7. What are the alternatives to distribute ITNs in Mozambique if they were not enough resources to achieve the universal coverage through public sector provision?

This section will examine the question whether the RBM goal can be achieved using financial resources available for health in Mozambique, and will discuss what are the alternatives to delivering ITNs if there are insufficient funds to deliver a national programme.

Is the RBM goal feasible in Mozambique?

Total health sector financing in Mozambique, in both the private and public sectors, including households and all other traceable sources, was estimated to be $139 million in 1997 (Beattie and Kraushaar 1999). However, the government alone only covers less than 40% of the total budget of the National Health Service in Mozambique. For example, in 1999 the government budget for health was about $47 million (Ministério da Saúde – Direcção de Finanças – unpublished). This amount includes the budget for goods and services (about 21.6 million), for personnel (about 20.3 million) and for investment (about 5.2 million). The calculation of the cost of an ITN programme that would achieve universal coverage in Mozambique showed that the government would have to provide about $64 million over five years. The total cost of the ITN programme over five years would represent about 9-10% of the total health sector financing budget and about 27% of the government budget over the same period. At the present there is no written information about government "willingness to spend" on ITNs.

Although in this thesis the priorities of the Mozambican government are not discussed, it seems unrealistic to think that such an amount would be given to a single programme, under the current socio-economic conditions in the country (see Chapter 2, Part II). Therefore, it is questionable whether the targets of the RBM are realistic under the current socio-economic circumstances in Mozambique.

Some of the reasons why the RBM target cannot be achieved within ten years are as follows:

1. The majority of the Mozambican population cannot pay a market price for ITNs.

2. Malaria is one priority among many that the government of Mozambique has to consider in its budget. The amount of government money available for malaria control is not enough to subsidise a programme of universal ITN coverage.

3. At the moment there is not enough money available from the donor community to subsidise a programme of universal ITN coverage.

If there are not sufficient funds either from the government or from the donor community, and a significant contribution from the consumers is not possible, let us consider the possibilities for an ITN programme under a scenario of limited funds.

<u>The alternatives to deliver ITNs under funds constrain</u>

If there are not enough funds to deliver a programme achieving universal coverage, the government could select one of three main options:

a) The programme could be concentrated in one region and universal coverage could be achieved within that region – a geographically-based approach;

b) ITNs could be distributed all over the country, targeting the higher risk groups, but not achieving universal coverage in any of the regions of the country – a targeted distribution to higher risk groups throughout the country (subsidies are targeted to higher risk groups);

c) The limited funds could be invested in education about malaria mosquitoes and in the promotion of the use of ITNs – an approach that leaves little or no money for the provision of ITNs.

There are advantages in concentrating the programme in one region. First, within the region the programme could achieve an equitable and a universal distribution of ITNs. Second, the cost per ITN delivered would be cheaper than if ITNs were distributed all over the country (there would be savings on transport and promotion). Third, universal coverage within the region will lead to a greater public health impact of the programme in that region (e.g. the mass killing effect).

However, the disadvantage of the geographically-based approach is that the programme would not cover the country, and therefore, would not ensure universal equity. Second, this approach could be politically sensitive. How could one region be justified in a where malaria is endemic?

The second alternative using the targeting subsidies to higher risk groups implies that the ITNs would be delivered only to certain groups all over the country. This approach could potentially stimulate the private sector, because the groups that were not reached would have to buy ITNs. This mechanism could potentially stimulate the private sector, because the other groups who are not reached will have to buy from them if they need an ITN, leading to the "crowding in" effect. In the other words, the widespread provision of subsidised supplies, together with information and promotion which promotes demand could in fact increase demand and therefore help to create a commercial market. Similar arguments have been used for the provision of subsidised contraceptives (Hanson and Kumaranayake 2000). However, it is still not properly known how to effectively target ITNs (Schellenberg *et al.* 1999). Secondly, there is no available information about what would be the public health impact of such limited coverage. Thirdly, there is no data to indicate how much it would cost to deliver ITNs using this mechanism, but it is likely to be higher. This programme would also not be as equitable.

The third option is to use the resources available on a nation-wide campaign to promote the use of ITNs in Mozambique. This option assumes that the private sector and/or NGOs would be able to supply the ITNs. Therefore, the government would concentrate on promoting the use of ITNs at national level, and would not invest on delivering ITNs. The private sector would benefit by sharing the cost of the promotion, and they would concentrate on promoting their brand products.

The great disadvantage of this option is that the equity would not be ensured. In any case, the private sector is not yet developed enough in Mozambique to play an important role.

In conclusion, it must be said that there is no an easy answer to the question of what would be the best mechanism to maximise the delivery of ITNs, with very limited resources. This leads to the following questions that need to be answered:

1) How far can the private sector be expanded in Mozambique in a short period of time?
2) How feasible is it to target subsidies at the high-risk groups?
3) How much would it cost to the public sector to target the high-risk groups?

This chapter has presented some of the options that the government might have to consider, in view of the existing financial constraints, in order to provide universal coverage of ITNs in Mozambique. We are not advocating any of those options. We are however suggesting that in order to make a sensible choice, the questions cited above need to be addressed. What else the government can do in the meantime is not the issue here.

8.8. Conclusion

The Roll Back Malaria goal is to halve malaria-associated mortality by 2010. Widespread ITN coverage could be one of the means to this end. Such a goal implies that the programme would be both sustainable and equitable. The definition that this thesis adopted for a successful ITN programme in Mozambique is that it must be capable of securing a "sustainable subsidy" for the long run.

Equity is defined here as the equal provision of ITNs according to need. This thesis argues that in order to achieve universal coverage in an equitable and sustainable manner, the provision of ITNs via the public sector is the most likely way to achieve the RBM goal.

Based on the cost estimates from the ITN project in Boane, the cost of a national programme was estimated. A nation-wide ITN programme carried out through the public sector would cost between $40,000,000 to $65,000,000. That cost could be reduced by 25-30% if the programme could buy bednets at a lower price and if it could increase the efficiency of distribution. Nevertheless, these costs seem too high to be totally subsidised, and therefore the thesis examined three different ways to deliver ITNs under financial constraints. There are three main options: a) a geographically-based approach, b) an approach in which the subsidies would be targeted at high-risk groups, and c) an approach in which the subsidy would be spent on a massive promotional and educational campaign. No specific option was recommended in this thesis, but some questions were raised that need to be answered in order to make a sensible choice between those options.

The conclusion reached in this chapter is that although it is desirable to have a financial sustainable nation-wide ITN programme, the Boane study demonstrated that the majority of the people couldn't afford to pay a cost-recovery price for the ITNs. Moreover, given the level of Mozambican economy it can be argued that the government of Mozambique cannot afford to distribute the ITNs free of charge nor to highly subsidise the cost of a National ITN programme. Thus, it can be concluded that under these circumstances it will not be possible to have a national ITN programme in Mozambique unless the government receives external support from donor agencies or from foreign governments. Similar arguments have been made by Goodman *et al.* 1999, where they argued that ITNs are not affordable to very-low-income countries through government finance alone. This thesis recognises that there is a risk of government failing to provide full coverage in an efficient way and with high quality of services, however, it stresses that a careful assessment of the merits and the risks of different forms of government intervention has to take place to ensure that public health goals are met, and resources are used efficiently.

Thus, it will not be possible to have a national ITN programme in Mozambique unless the government receives external support from donor agencies or from foreign governments. Only with the collaboration of the international community, will it be possible in Mozambique to achieve full coverage of ITNs, and therefore fulfil the goal of RBM in 10 years: to halve malaria in Mozambique.

CHAPTER 9: CONCLUSIONS

9.1. Conclusions

The objective of this thesis was to evaluate the financial sustainability and equity of an ITN programme implemented through the primary health care system in Mozambique and to contribute to the development of a policy of ITN programme expansion in Mozambique.

The Boane ITN project, which was reported and analysed in Chapters 3 and 4, was the first ITN project in Mozambique. Before this project there were no ITNs available in the study area and less than 0.5% of households had bednets. After two years of implementation of the project, the household coverage of ITNs had reached 24% and had decreased the prevalence of malaria parasites among households that owned ITNs. The primary health care system had managed to create demand and to successfully implement the ITN project.

In this study it was shown that the local community accepted ITNs very well. Demand for and usage of the ITNs was mainly due to the perceived nuisance presence of mosquitoes. The average number of ITNs purchased per net-buying household was 2.2 and the ratio of people per ITN was 1.5. On average the households consisted of five people. Thus, ideally the average number of ITNs needed would be three per family to cover the entire family.

One of the goals of primary health care is equity (Hussein et al 1993). However, the concept of equity cannot be fully realised in a cost-recovery scheme, because some people will not have the ability to buy the ITNs when they need them. The Boane data demonstrated that the purchase of ITNs was associated with the socio-economic level of the household. Poor households were less likely to buy ITNs. Thus, to achieve a maximum level of equity, the findings from the ITN project in Boane suggested that in order to achieve universal coverage the ITNB need to be provided to most of people free or at a highly subsidised price. The Boane project was thus not equitable.

The willingness to pay for ITNs was affected by the income of the household; poor households declared less willingness to pay than the higher-income group. Many households that stated a low willingness to pay price for an ITN before the implementation of the project, did buy ITNs later during the implementation of the programme. However, many more, that had expressed their willingness to pay, did not buy any ITNs. Thus, the results of the willingness to pay survey were not a useful way to predict the households' probable purchase of ITNs.

The household's "ability to pay" was based on 5% of monthly expenditure as the price they could pay for an ITN. This cut-off of 5% is an arbitrary value used to express how many people would be able to pay. There is not reported in the "economic text books" this concept of ability to pay, and only very few papers have applied a cut-off to determine people's ability to pay. The interpretation is therefore dependent of choice of cut-off. If the price of the ITNs was higher than 5% of the household's monthly expenditure, they were defined as not able to pay; on the other hand, if the price of the ITN was equal to or less than 5% of the household's monthly expenditure they were defined as "able to pay". The analysis of the households' ability to pay showed that a great many people were not able to pay anything and that about half of the households could not afford to pay more than US$2.50. Nevertheless, a limited proportion of those households classified as "not able to pay" bought ITNs. Therefore, the concept of ability to pay still needs to be developed. Future studies are needed to address the issue of the income elasticity of demand to develop a better definition of people's ability to pay.

The cost analysis demonstrated that the cost of implementing the programme was about a quarter of the annual budget of the Boane Directorate of Health. The Boane programme demonstrated that financial self-sustainability cannot be achieved in Mozambique at current prices and coverage.

This thesis presents arguments to justify the focus of the government on the communities that need the ITNs and cannot afford them particularly those living in rural areas and among poor people living in urban areas. The following argument can be made as to why the government can provide ITNs free of charge or at a nominal price for those that cannot afford them:

a) the price is the most important barrier to the utilisation of ITNs,

b) the ITNs will be under-utilised if they are sold at a cost-recovery price (which only rich people will be able to afford if the ITNs are sold within the public health sector),

c) the people that cannot afford to buy ITNs are the ones that the government most desires to reach.

In conclusion, the study demonstrated that the cost-recovery price offered was too high for the majority of the population; however, under the circumstances, the results of the project were very good and showed that demand can be achieved. Nevertheless, the only way to achieve maximum coverage, is to offer ITNs at a highly subsidised price or even if possible free-of-charge, which in that case would require a large subsidy.

Based on the Boane experience future ITN projects in Mozambique will have to have long-term support. This conclusion does not necessarily imply unsustainability (if sustainability is defined as the capacity of the programme to secure enough subsidies, rather than become financially self-sufficient), but it does recognise the current economic constraints, which the country is facing. Sustainability under the Mozambique situation will not imply self-sufficiency (depending solely on the programme's own resources) but self-reliance, which will involve the long-term participation of the community, government and Donor agencies.

9.2. Contribution of research to knowledge and the implications

The major contribution of this research to knowledge is that it offers a comprehensive methodological approach to determine the sustainability and equity of ITN projects implemented throughout the primary health care system. This was the first project to methodically assess the financial sustainability of an ITN project by collecting data on demand, calculating the household's willingness and ability to pay, calculating the cost of implementing the project and projecting the costs of a higher scale project. Thus, the conclusions reached by this thesis are based on a variety of data. Moreover, this was the first ITN project in Mozambique. The results of this project might contribute to the further development of ITN programmes in Mozambique.

As discussed in Chapter 4, equity is not possible if the project charges a cost-recovery price equal to the unit cost of the nets paid to the factory. That price is beyond the affordability of the majority of the Mozambican population. This project was one of the pioneers in using economic and epidemiological methodologies to evaluate the sustainability and equity of an ITN project.

The study compared the willingness to pay for an ITN that the households stated in the pre-intervention survey with the actual purchase of ITNs during the Boane project, and compares the purchase of ITNs with another willingness to pay survey undertaken during the implementation of the project. This project was, again, one of the pioneers in evaluating the validity of willingness to pay as a criteria for setting the price of the ITNs. As pointed out in Chapter 5, the study showed that the willingness to pay technique did not predict future demand for ITNs in Boane.

This study differs from many previous studies which only estimated either the people's willingness to pay, or the cost-effectiveness of the project, or even only the demand for and acceptability of ITNs. This advance in methodology allows the investigator to document how financially sustainable and equitable the programme would be, and will help to develop the best ITN policy in order to reduce unnecessary expenditure by for example defining a more realistic price policy.

9.3. Recommendations

a) Under the Mozambique economic circumstances, it can be argued that the most effective way to achieve a high ITN coverage is for the government to provide the nets free of charge or highly subsidised. In Africa, The Gambia government has already taken responsibility for the delivery of insecticide (D'Alessandro et al 1995). In Asia, the government of Vietnam has also taken responsibility for the delivery of insecticide, and high coverage has been reported (Hinh Tranduc, ITN conference in Dar-es-Salam, Tanzania, 1999, oral communication). Thus, the study suggests that the government of Mozambique also take responsibility for the delivery of the ITNs to the people that need them.

b) At the moment it is not realistic to think that the government of Mozambique will increase taxes to finance the ITN programme. Thus, the study suggests that the government explore every avenue to obtain external financial support for the programme, from the international institutions such as The World Bank, or from aid organisations, or from the foreign aid programmes of the rich countries.

c) Sub-Saharan African countries could make joint efforts and make a joint application to create a fund to finance ITN projects in their countries.

d) In order to implement a national ITN programme this study recommends that the following information be collected:
- how many ITNs the programme aims to deliver;
- how much money the government can afford (and is willing to pay) to subsidise the delivery of the ITNs;
- how much money the consumers can afford to pay for each ITN;
- how much money the external aid agencies are willing to contribute towards the delivery of the ITNs.

9.4. Implications for further research

As presented in Chapter 5 the willingness to pay methodology did not predict the future demand for ITNs. However, household expenditure demonstrated a strong association with demand. Therefore, studies are needed in order to find the best ways of measuring affordability and to demonstrate that the method is valid and reliable. Moreover, 5% of monthly income or expenditure is still not the most appropriate measure of "ability to pay for a ITN". Many people whose income or expenditure was less than $110 per month did in fact buy ITNs. Thus, there is a need to find a better instrument to define the people's ability to pay.

The results of this thesis suggest that six main areas require further research. In the first place, willingness to pay for ITNs was not a useful criteria to predict demand for ITNs. Further research into finding the best ways to predict demand is needed. Furthermore, ways to explore how willingness to pay can be used to help to set-up a price for ITNs, which can make ITN projects financially sustainable or equitable without wasting resources are needed. Studies on the price elasticity of demand are needed to complement the results of willingness to pay studies. Moreover, research into the best ways of defining a household's ability to pay for ITNs is needed in order to develop national strategies and to identify the vulnerable groups that will benefit from subsidies. Studies on income elasticity of demand are needed to complement the information on the people's ability to pay. Therefore, special attention are needed to setting the price of the ITNs. More studies are needed to develop a better price-setting process which will allow the objectives of the project to be achieved.

Second, the estimates of the cost of the ITNs showed that the programme is not financially self-sustainable if the price of the ITNs is lower than the average cost. The results also demonstrated that if the marginal cost is lower than the marginal revenue, expanding the project increases the loss and increases the need for subsidy. There is no literature on studies analysing marginal cost and marginal revenue. Thus, more studies are needed to guide policy makers in terms of investment and disinvestment in the expansion of ITN programmes and in the choice of delivery mechanisms.

Third, the present study has provided evidence that ITNs decrease the prevalence of malaria parasites. However, the study did not examine the impact of ITNs on malaria morbidity and mortality. Moreover, the malaria vectors and malaria endemicity vary in different areas of the country. Therefore, there is a need to combine economic evaluation with studies of the epidemiological impact of ITNs in Mozambique. A larger study is needed to address this issue.

Fourth, it is not well known how the government can effectively target subsidies to high risky groups, therefore, there is a need to address this issue, in order to maximise a public-private partnership to deliver ITNs.

Fifth, it is not well known how much does it cost to expand an ITN to achieve a universal coverage in a country like Mozambique, where most of the people have never seen an ITN, and where there is not a well developed market for ITNs.

Finally, neither Mozambique nor many other African countries where malaria is endemic can afford to provide ITNs free of charge without outside financial support, and not many households in these countries are able to pay a price which would cover the total cost of the ITNs. Therefore, studies on financial mechanisms to massively subsidise the provision of ITNs are urgently needed.

Having reported on the Boane project and having studied ITN programmes in countries of a similar socio-economic level as that of Mozambique, the expansion of the ITN programme at a national level in Mozambique cannot be achieved by means of the financial contribution of the consumers to pay the full cost of the programme. Subsidies will be needed to make ITNs available to the people that most need them in an equitable way, and therefore to reduce the burden of malaria on the country.

9.5. Generalisation of the results

This study has clearly shown that an ITN programme cannot achieve a widely equitable distribution among poor communities without the financial contribution of the government or the donor community. However, the governments of low-income countries cannot afford to distribute the ITNs free of charge or highly subsidise them. Therefore, one of the general conclusions of the present study is that in countries with a similar level of economic development as that of Mozambique, the donor community will have to play a major role in order to have ITNs distributed in such way that they will have a public health impact, otherwise the Roll Back Malaria aim to reduce malaria-specific mortality by 50% by the year 2010 will not be achieved.

In order to achieve universal coverage, public health ITN projects need to achieve an equitable distribution. This study showed that increasing equity decreases financial sustainability. Therefore, ITN projects in poor countries need to achieve sustainable support from donors for their projects, as they are not able for the foreseeable future to generate enough revenue from the people nor to provide the financial resources from the government's budget, to make the projects financially sustainable.

The long-term goal need to encourage the private sector, which can deliver ITNs more efficiently, to invest in the production and distribution of ITNs, and to develop policies that permit more overt private sector responsibility for public priorities.

REFERENCES

Abdalla, S., Weatherall, DJ., Wickramasinghe, S and Hughes, M, (1980). The anemia of *P. falciparum* malaria. British Medical Journal of Haematology 46:171-183

Ad Hoc Committee on Health Research Relating Future Interventions Options (1996). Investing in health research and development. Geneva: World Health Organisation.

Aikins, M., Pickering, H., Alonso, P., D'Alessandro, H., Lindsay, S., Todd, J and Greenwood, B. (1993). A malaria control trial using insecticide-treated bednets and targeted chemoprophylaxis in a rural area of The Gambia, West Africa: 4. Perceptions of the causes of malaria and its treatment and prevention in the study area. Transactions of the Royal Society of Tropical Medicine and Hygiene. 87:supplement 2:25-30.

Aikins, M., Pickering, H. and Greenwood, B. (1994). Attitudes to malaria, traditional practices and bednets (mosquito nets) as vector control measures: a comparative study in five West African countries. Journal of Tropical Medicine and Hygiene. 97:81-86.

Aikins, M.(1995). Cost-effectiveness analysis of insecticide-impregnated mosquito nets (bednets) used as a malaria control measure: a study from the Gambia. Ph.D Thesis LSHTM, University of London, London.

Aikins, M., Fox,R-J, D'Alessandro,U., Langerock, P., Cham, K., New, L., Bennett, S., Greenwood, B. and Mills, A (1998). The Gambian National Impregnated Bednet Programme: costs, consequences and net cost-effectiveness. Social Science and Medicine. 46(2): 181-91

Alonso, P., Lindsay, S., Armstrong, J., Conteh, M., Hill, A., David, P., Fegan, G., Francisco, A., Hall, A., Shenton, F., Chan, K. and Greenwood, B. (1991). The effect of insecticide-treated bed nets on mortality of Gambian children. The Lancet. 337:1499-1502.

Alonso, P., Smith, T., Armstrong, J., Masanja, H., Mwankusye, S., Urassa, H., Bastos, I., Chonguela, J., Kobero, S., Mendez, C., Hurt, C., Thomas, M., Lyimo, E., Weiss. N., Hayes, R., Kitua, Lopez, M., Kilama, W. Teuscher, T. and Tanner, M. (1994). Randomised trial efficacy of SPf66 vaccine against *Plasmodium falciparum* malaria in children in southern Tanzania. The Lancet 344:1175-1181.

Amazigo, U., Noma, M., Boatin, B., Etya'ale, D., Seketeli, A. and Dadzie, K. (1998). Delivery systems and cost recovery in Mectizan treatment for onchocerciasis. Annals of Tropical Medicine and Parasitology 92 Suppl 1: S23-31

Beach, R., Ruebush, T., Sexton, J., Bright, P., Hightower, A., Breman, J., Mount, D. and Ollo, A. (1993). Effectiveness of permethrin-impregnated bed nets and curtains for malaria control in a holoendemic area of western Kenya. American Journal of Tropical Medicine and Hygiene 49(3):290-300

Beattie, A., Kraushaar, D. (1999). Health expenditure in Mozambique: an analysis of major policy issues (volume 2) Management Sciences for Health (not published).

Bhatia, M. (1996). Pricing efficient services: a study of malaria control in Surat, India. Upgrading report. University of London (unpublished).

Binka, F., Kubaje, A., adjuik, M., Williams, L., Lengler, C., Maude, G., Armah, G., Kajihara, B., Adiamah, J. and Smith, P. (1996). Impact of permethrin impregnated bednets on child mortality in Kassena-Nankana district, Ghana: a randomised controlled trial. Tropical Medicine and International Health. 1(2):147-154.

Binka, F., Mensah, O. and Mills, A. (1997). The cost-effectiveness of permethrin impregnated bednets in preventing child mortality in Kassena-Nangana district of Northen Ghana. Health Policy 41:229-239

Binka, F. and Adongo, P. (1997). Acceptability and use of insecticide Impregnated bednets in northern Ghana. Tropical Medicine International Health. 2(5): 499-507

Binka, F., Indome, F., and Smith, T. (1998) Impact of spatial distribution of permethrin-impregnated bed nets on child mortality in rural northern Ghana. American Journal of Tropical Medicine and Hygiene. 59(1): 80-5

Blagovescenky, D., Bergotova, N. and Monchadsky (1945). An investigation of new repellents for the protection of man against mosquito attacks. Transactions of the Royal Society of Tropical Medicine 34:147-150.

Bortell, W., Barutwanayo, M., delacollette, C., and Cossemans, M. (1996). Motivation a l'acquisition et a l'utilisation des mousquitaires impregnees dans une zone a paludisme stable au Burundi. Tropical Medicine and International Health. 1:71-80.

Bouvier, P., Rougemont, A., Breslow, N., Doumbo, O., Delley, V., Dicko, A., Diakite, M., Mauris, A. and Robert, C. (1997). Seasonality and malaria in a west African village: does high parasite density predict fever incidence? American Journal of Epidemiology 145(9): 850-7.

Brinkmann, U. and Brinkmann, A. (1995). Economic aspects of the use of impregnated mosquito nets for malaria control. Bulletin of the World Health Organisation 73:651-658.

Browne, E. (1996). The impact of insecticide-treated bednets on malaria and anaemia in pregnancy in Kassena-Nakana District, Ghana. PhD Thesis. London School of Hygiene and Tropical Medicine.

Bruce-Chwatt, L. (1985). Essential Malariology. Willian Heinemann Medical Books Ltd. London.

Campbell, H., Byass, P. and Greenwood, B. (1987). Bed-nets and malaria suppression. The Lancet i:859-860.

Carnevale, P., Bitsindou, P., Diomande, L. and Robert, V. (1992). Insecticide impregnation can restore the efficiency of torn bed nets and reduce man-vector contact in malaria endemic areas. Transactions of the Royal society of Tropical Medicine and Hygiene **86**:362-364.

Carnevale, P. and Coosemans, M. (1995). Some operational aspects of the use of personal protection methods against malaria at individual and community level. Annales de la Societe Belge de Medicine Tropicale. **75**:81-103.

Cham, M., D'Alessandro, U., Todd, J., Bennet, S., Fegan, G., Cham, B. and Greenwood, B. (1996). Implementing a nationwide insecticide-impregnated bednet programme in The Gambia. Health Policy and Planning **11**(3):292-298.

Chandre, F., Darrier, F., Manga, L., Akogbeto, M., Faye, O., Mouchet, J. and Guillet, P. (1999). Status of pyrethroid resistance in *Anopheles gambiae sl.*. Bulletin of the World Health Organisation. 77(3): 230-4

Charlwood, D. and Jolly, D. (1984). The coil works (against mosquitoes in Papua New Guinea. Transactions of the Royal Society of Tropical Medicine **76**:678.

Chavasse, D., Lines, J. and Ichimori, K. (1996). The relationship between mosquito density and mosquito coil sales in Dar es Salaam. Transactions of the Royal Society of Tropical Medicine and Hygiene **90**:493.

Chavasse, D., Reed, C. and Attawell, K. (1999). Insecticide Treated net projects: a handbook for managers. Malaria Consortium, London Liverpool.

Chestnut, L., Keller, M., Lambert, W. and Rowe, R. (1996). Measuring heart patients' willingness to pay for changes in angina symptoms. Medical Decision Making **16**(1):65-77.

Choi, H., Breman, J., Teush, S., Liu, S., Our, A. and Sexton, J. (1995). The effectiveness of insecticide-impregnated bed nets in reducing cases of malaria infection: A meta-analysis of published results. American Journal Tropical Medicine and Hygiene **52**(5):377-382.

Cohen, D. (1994). Marginal analysis in practice: an alternative to needs assessment for contracting health care. British Medical Journal **309**:781-784.

Coleman, P., Goodman, C. and Mills, A (1999). Rebound mortality and the cost-effectiveness of malaria control: potential impact of increased mortality in late childhood following the introduction of insecticide treated nets. Tropical Medicine and International Health 4(3): 175-86

Crook, S. and Baptista, A. (1995). The effect of permethrin-impregnated wall-curtains on malaria transmission and morbidity in the suburbs of Maputo, Mozambique. Tropical Geography and Medicine. 47(2):64-67.

Cuamba, N., Dgedge, M. (1994). Transmissao da malaria em dois ecotipos da provincia do Maputo: Estudo preliminary. Revista Medica de Moçambique. (supll. 2):S46

Curtis, C., Myamba, J. and Wilkes, T. (1996). Comparison of different insecticides and fabrics for anti-mosquito bednets and curtains. Medical and Veterinary Entomology **10**:1-11.

Curtis, C., Miller, J., Hodjati, M., Kolaczinski, J. and Kasumba, I. (1998a). Can anything be done to maintain the effectiveness of pyrethroid-impregnated bednets against malaria vectors? Philos Transaction of the Royal Society, series B. **353**(1376): 1769-75

Curtis, C., Maxwell, C., Finch, R. and Njunwa, K. (1998b). A comparison of use of a pyrethroid either for house spraying or for bednet treatment against malaria vectors. Tropical Medicine and International Health. 3(8): 619-31

D'Alessandro, U., Aikins, M., Langerock, P., Bennet, S. and Greenwood, B. (1994). Nationwide survey of bednet use in rural Gambia. Bulletin of the World Health Organisation 72(3):391-394.

D'Alessandro, U., Leach, A., Drakeley, J., Bennet, S., Olaleye, B., Fegan, G., Jawara, M., Langerock, P., George, M., Targett, G. and Greenwood, B. (1995a). Efficacy trial of malaria vaccine SPf66 in Gambian infants. The Lancet **346**:462-707.

D'Alessandro, U., Olaleye, B., Mcguire, W., Thomson, M., Langerock, P., Bennet, S. and Greenwood, B. (1995b). A comparison of the efficacy of insecticide-treated and untreated bed nets in preventing malaria in Gambian children. Transactions of the Royal Society of Tropical Medicine and Hygiene **85**:596-598.

D'Alessandro, U., Olaleye, B., Langerock, P., Bennett, S., Cham, K., Cham, B. and Greenwood, B. (1997). The Gambian National Impregnated Bed Net Programme: evaluation of effectiveness by means of case-control studies. Transactions of the Royal Society of Tropical Medicine and Hygiene. 91(6): 638-42

Dgedge, M., Mercedes, D., Zualo, P., Arif, G., Jani, J., Araujo, C., Gloria, V., Magid, N., Gomes, A. e David, E. (1994a). Avaliaçao dos conhecimentos atitudes e praticas de maes em relaçao a malaria na zona suburbana da cidade de Maputo. Parte 2: malaria e sua prevençao. Revista Medica de Moçambique 5(1):16-19.

Dgedge, M., Streat, E., Mabunda, S., Fumane, J., Mavale, S. e Gomes, A. (1994b). Avaliaçao da sensibilidade *in vivo* do *P. falciparum* a cloroquina em Moçambique. Revista Medica de Moçambique supl. 2:S34.

Dgedge, M. (1994c). Principal diseases reported at the Boane Health Center (unpublished).

Dgedge, M., Mabunda, S., Enosse, S. and Sreat, E. (1998). Avaliação *in vivo* da Eficácia terapeutica e da sensibilidade do *P. falciparum* a cloroquina e sulfadoxina-pirimetamina no tratamento da malaria não complicada em Moçambique-1998 (unpublished report)

Dgedge, M., Novoa, A., Macassa, G. and Cliif, J. (1999). The burden of disease in Maputo City: registered deaths in 1994. (unpublished).

Diamond, P. and Hausman, J. (1994). Contingent valuation: Is some number better than no number? Journal of Economic Perspectives 8(4):45-64.

Direcção Nacional de Saúde (1999). Plano estratégico nacional de combate a DTS/HIV/SIDA em Moçambique para o período 2000-2002. (unpublished report).

Donaldson, C., and Shackley, P (1997). Does "process utility" exist?. A case study of willingness to pay for laparoscopic cholecystectomy. Social Science and Medicine 44(5): 699-707.

Donaldson, C., Shackley, P and Abdalla, M.. (1997). Validity of open-ended and payment scale approaches for eliciting WTP. Applied Economics 29:79-84.

Donaldson, C. (1999). Valuiting the benefits of publicity-provided health care: does "ability to pay" preclude the use of "willingness to pay"?. Social science and Medicine 49(4):551-563.

Drummond, M., O'Brien, B., Stoddart, G. and Torrance, G. (1997). Methods for the economic evaluation of health care programmes. New York, Oxford University Press.

Ettling, M., Steketee, R., Schultz, L, Nyasulu, Y. and Chitsulo, L. (1994). Malaria knowledge, attitudes and practices in Malawi: survey population characteristics. Tropical Medicine and Parasitology 45:57-60.

Evans, P. (1994). Community knowledge, attitudes and practices - urban mosquitoes and sustainable mosquito control. Ph.D Thesis, LSHTM, University of London, London.

Feilden, R. (1996). The implementation experience. In Net Gain: operational aspects of a new health intervention for preventing malaria. (eds C. Lengler, J. Cattani and D. de savingny) IDRC, Canada and WHO, Switzerland.

Forsythe, S. Mangkalopakorn, C., Chitwarakorn, A. and Masvichian, N. (1998). Cost of providing sexually transmitted disease services in Bangkok. AIDS. **12** Suppl 2: S73-80

Fox-Rushby, J. (1993). Appraising the use of contigent valuation: a note in response. Health Economics 2:361-362.

Fraser, H and Lyimo, E. (1998). Insecticide-treated nets and treatment service: a trial using public and private sector channels in rural United Republic of Tanzania. Bulletin of the World Health Organisation 76(6): 607-15

Gabinete de Epidemiologia (1998). VI Seminario Nacional de epidemiologia. (Unpublished report).

Genton, B., Hii, J., Al-Yaman, F., Paru, R., Beck, H., Ginny, M., Dagoro, H., Lewis, D. and Alpers, M. (1994). The use of untreated bednets and malaria infection, morbidity and immunity. Annals of Tropical Medicine and Parasitology 88(3):263-270.

Gilles, M. and Coetzee, M. (1987). A supplement to the *Anophelinae* of Africa South of the Sahara (Afrotropical Region). Publications of the South Africa Institute of Medical Research Publications, No 55. Johannesburg, 143pp.

Gilson, L., Mkanje, R., Grosskurth, H., Mosha, F., Picard, J., Gavyole, A., Todd, J., **Mayaud**, P., Swai, R., Fransen, L., Mabey, D., Mills, A. and Hayes, R. (1997). Cost-effectiveness of improved treatment services for sexually transmitted diseases in preventing HIV-1 infection in Mwanza Region, Tanzania. The Lancet **350**:1805-1809.

Gold, R., Siegel, E., Russel, B. and Weinstein, C. (1996). Cost-effectiveness in health and medicine. Oxford University Press, New York.

Goodman, C. and Mills, A. (1999). The evidence base on the cost-effectiveness of malaria control measures in Africa. Health Policy and Planning **14**(4):301-312.

Goodman, C., Coleman, P. and Mills, A. (1999). Cost-effectiveness of malaria control in Sub-Saharan Africa. The Lancet **354**:378-385

Gray, C. (1986). State-sponsered primary health care in Africa: the recurrent cost of performing miracles. Social Science and Medicine **22**(3):361-368

Greenwood, B. (1997) What's new in malaria control? Annals of Tropical Medicine and Parasitology. **91**(5): 523-31.

Groomsman, M. (1972). On the concept of health capital and the demand for health. Journal of Political Economy **80**:223-255.

Grytten, J., Rongen, G. and Sorensen, R. (1995). Can a public health care system achieve equity? The Norwegian experience. Medical -Care. **33**(9): 938-51

Gunning, S., Schepers, L. and Stronks, K. (1999). Inequalities in health--future threats to equity. Acta of Oncology. **38**(1): 57-61

Gyapong, M., Gyapong, J., Amankwa, J., Asedem, J. and Sory, E. (1996). Introducing insecticide impregnated bednets in an area of low bednet usage: an exploratory study in north-east Ghana. Tropical Medicine and International Health **1**(3):328-333.

Habluetzel, A., Diallo, D., Esposito, F., Lamizana, L., Pagnoni, F., Lengeler, C., Traore, C., and Cousens, S (1997) Do insecticide-treated curtains reduce all-cause child mortality in Burkina Faso? Tropical Medicine and International Health **2**(9): 855-62

Hanson, K. and Kumaranayake (2000). Ends versus means: what is the role of markets in expanding access to contraceptives? (forthcoming Health Policy and Planning)

Hedberg, K, Shaffer, N, Davachi, F., Hightower, A., Lyamba, B., Paluku, K., Nguyen-Dinh, P and Breman, J (1993). *Plasmodium falciparum* – associated anemia in Children at a large urban hospital in Zaire. American Journal of Tropical Medicine and Hygiene **48**(3):365-371.

Hii, J., Vun, Y., Chin, K., Chua, R., Tambakau, S., Binisol, E., Fernadez, E., Singh, N. and Chan, M. (1987). The influence of permethrin-impregnated bednets and mass drug administration on the incidence of *Plasmodium falciparum* malaria in children in Sabah, Malasia. Medical and Veterinary Entomology. **1**:397-407.

Huailu, C., Wen, Y., Wuanmin, K. and Chongyi, L. (1995). Large-scale spraying of bednets to control mosquito vectors and malaria in Sichuan, China. Bulletin of the World Health Organisation **73**: 321-328.

Husein, K., Adeyi, O., Bryant, J. and Cara, N. (1993). Developing a primary health care management information system that supports the persuit of equity, effectiveness and affordability. Social Science and Medicine **36**(5):585-596.

Instituto Nacional de Estatistica (1997). II Recenseamento geral da população e habitação- resultados defitivos: provincia de Maputo.ed. Instituto Nacional de Estatistica, impressão: Artes Graficas, Maputo, Moçambique.

Instituto Nacional de Estatistica (1998). Inquerito demografico e de saude – Mocambique 1997. Instituto Nacional de Estatitistica, Maputo, Mocambique.

Jamjoom, G., Mahfouz, A., Badawi, I., Omar, M., Al-Zoghaibi, O., Al-Amari, O., Ibrahim, M. and Siam, I. (1994). Acceptability and usage of permethrin-impregnated mosquito bednets in rural Soutwestern Saudi Arabia. Tropical and Geographical Medicine **46**: 355-357.

Jawara, M., McBeath, J., Lines, J., Pinder, M., Sanyang, F., Greenwood, B. (1998) Comparison of bednets treated with alphacypermethrin, permethrin or lambdacyhalothrin against *Anopheles gambiae* in The Gambia. Medical and Veterinary Entomology **12**(1): 60-6.

Johannesson, M (1993). The contigent valuation method-appraising the appraisers. Health Economic **2**:357-359.

Johannesson, M. (1996). A note on the relatioship between *ex ante* and expected willingness to pay for health care. Social Science and Medicine **42**(3):305-11.

Johnson, F. (1998). Eliciting stated health preferences: An application to willingness to pay for longevity. Medical Decision Making **18**(2)S57-67.

Kachur, S., Philips-Howard, P., Odacha, M., Ruebush, T., Oloo, A. and Nahlen, B. (1999). Maintenance and sustained use of insecticide-treated bednets and curtains three years after a controlled trial in western Kenya. Tropical Medicine and International Health 4(11):728-735

Kang, W., Gao, B., Jiang, H., Wang, T, Yu, P., Xu, B. and Curtis, C. (1995). Tests for possible effects of selection by domestic pyrethroids for resistance in *culicine* and *anopheline* mosquitoes in Sichuan and Hubei, China. Annals of Tropical Medicine and Parasitology **89**(6):677-684

Kartman, B., Anderson, F. and Johannesson, M. (1996). Willingness to pay for reductions in angina pectoris attacks. Medical Decision Making **16**(3): 248-253.

Kere, J. and Kere, N. (1992). Bed-nets or spraying? Cost analysis of malaria control in the Solomon Islands. Health Policy and Planning 7(4):382-386.

Kirigia, J., Snow, R., Fox-Rushby, J. and Mills, A. (1998). The cost of treating paediatric malaria admissions and the potential impact of insecticide-treated mosquito nets on hospital expenditure. Tropical Medicine and International Health 3(2): 145-50

Klein, R., Weller, S., Zeissig, R., Richards, F, and Ruebush, T. (1995). Knowledge, beliefs and practices in relation to malaria transmission and vector control in Guatemala. American Journal of Tropical Medicine and Hygiene 52(5):383-388

Koffi, A., Darriet, F., N'Guessan, R., Doannio, J. and Carnevale, P. (1999).Laboratory evaluation of alpha-cypermethrin insecticide efficacy on *Anopheles gambiae* populations of Cote d'Ivoire resistant to permethrin and deltamethrin. Bulletin de la Societe Pathologie Exotique. 92(1): 62-6

Krasnik, A. (1996). The concept of equity in health services research. Scandinavian Journal of Social Medicine 24(1): 2-7

Kroeger, A., Mancheno, M., Alarcon, J. and Pesse, K. (1995). Insecticide-impregnated bed nets for malaria control: varying experiences from ecuador, colombia and Peru concerning acceptability and effectiveness. American Journal of Tropical Medicine and Hygiene 53(4):313-323.

Kroeger, A., Meyer, R. Mancheno, M., Gonzalez, M. and Pesse, K. (1997) Operational aspects of bednet impregnation for community-based malaria control in Nicaragua, Ecuador, Peru and Colombia. Tropical Medicine and International Health. 2(6):589-602.

La Fond, A. (1995). Sustaining primary health care. Earthscan Publications Lttd. London, UK.

Langlois, N. and Donaldson, C. (1998). Application of the principle of marginal analysis to sampling practice using prostatic chippings as a model. Journal of Clinic Pathology 51(2):104-7.

Lengeler, C and Snow, R (1996). From efficacy to effectiveness: insecticide-treated bednets in Africa. Bulletin of the World Health Organisation. 74(3): 325-32

Lengeler. C., Lines, J., Cattani, J., Feilden, R., Zimicki, S. and Savigny, D. (1996). Promoting operational research on insecticide-treated netting: a joint TDR/IDRC initiative and call for research peoposals. Tropical Medicine and International Health 1(2):273-276.

Lengeler, C., Armstrong-Schellenberg, J., D'Alessandro, U., Binka, F. and Cattani, J. (1998). Relative versus absolute risk of dying reduction after using insecticide-treated nets for malaria control in Africa. Tropical Medicine and International Health 3(4): 286-90

Lengeler, C. (1998). Insecticide treated bednets and curtains for preventing malaria (Cohrane Review). In The Cochrane Library issue 3, Oxford: Update Software.

Lengeler, C. (1999). From Rio to Iragua – sustainability versus efficiency and equity for preventive health interventions. Tropical Medicine and International Health 4(6):409-411

Liambila, W., Hill, J. and Kubasu, D. (1994). A Practical guide to the planning and implementation of the Bamako Initiative at the District level. Ministry of Health/ UNICEF Kenya Country Office (unpublished).

Lines, J., Myamba, U. and Curtis, C. (1987). Experimental hut trials of permethrin-impregnated mosquito nets and eave curtains against malaria vectors in Tanzania. Medical and Veterany Entomology. 1:37-51.

Lines, J. and Armstrong, J. (1992). For a few parasites more: inoculation size, vector control, and strain specific immunity to malaria. Parasitology Today 8:381-383.

Lines, J. (1996). Mosquito nets and insecticides for net treatment: a discussion of existing and potential distribution systems in Africa. Tropical Medicine and International Health 1(5):616-632.

Lipsey, R. and Chrystal, K. (1995). An introduction to positive economics. Eds Oxford University Press, Oxford.

Loomes, G. and Sugden, R. (1982). An alternative theory of rational choice under uncertainty. Economic Journal 92:805

Louis, J., Goff, G., Trebucq, A., Migliani, R., Louis, F., Robert, V. and Carnevale, P. (1992a). Faisability de la strategie de lutte par moustiquaires de lit impregnees d'insecticide remanent en zone rurale au Cameroun. Annales de la Societe Belge de Medicine Tropicale. 72:189-195.

Louis, J., Trebucq, a., Gelas, H., Fondjo, E., Manga, L., Toto, J. and Carnevale, P. (1992b). Le paludisme-maladie dans la ville de Yaounde (Cameron). Prise en charge et lutte antivectorielle au niveau familial. Bulletin de la Societe Patholgie Exotique. 85:26-30.

MacComark, C. and Snow, R. (1986). Gambian cultural preferences in the use of insecticide-impregnated bed nets. Journal of Tropical Medicine and Hygiene 89:295-302

Magbity, E., Marbiah, N., Maude, G., Curtis, C., Bradley, D., Greenwood, B., Petersen, E., and Lines, J. (1997). Effects of community-wide use of lambdacyhalothrin-impregnated bednets on malaria vectors in rural Sierra Leone. Medical and Veterinary Entomology **11**(1): 79-86

MacComarck, C., Snow, R. and Greenwood, B. (1989). Use of insecticide-impregnated bed nets in Gambian primary health care: economic aspects. Bulletin of the World Health Organisation. **67**(2):209-214.

Macdonald, M and McGuire, D. (1999). Commercial sector partnerships for malaria control. Tropical Medicine and International Journal Health **4**(5):319-321.

Magesa, S., Wilkes, T., Mnzava, A., Njunwa, K., Myamba, J., Philip, M., Hill, N., Lines, J. and Curtis, C. (1991). Trial of pyrethroid treated bednets in an area holoendemic for malaria. Part 2: Effects on the malaria vector population. Acta Tropica **49**:97-108.

Makemba, A., Winch, P., Kamazima, S., Makame, V., Sengo, F., Lubega, P., Minjas, J. and Shiff, C. (1995). Community-based sale, distribution and insecticide impregnation of mosquito nets in Bagamoyo District, Tanzania. Health Policy and Planning **10**(1):50-59.

Marbiah, N., Petersen,E., David, K., Magbity, E., Lines, J. and Bradley, D. (1998) A controlled trial of lambda-cyhalothrin-impregnated bed nets and/or dapsone/pyrimethamine for malaria control in Sierra Leone. American Journal of Tropical Medicine and Hygiene **58**(1): 1-6

Marsh, V., Mutemi, W., Some, E., Haaland, A. and Snow, R. (1996). Evaluating the community education programme of an insecticide-treated bed net trial on the Kenyan coast. Health Policy and Planning **11**(3):280-291.

Miller, J., Buriyo, A., Karugila, A. and Lines, J. (1999). A new strategy for treating nets: Part I: formulation and dosage. Tropical Medicine and International Health **4**(3):160-166.

Mills, A., Fox-Rushby, Aikins, M., D'Alessandro, Cham,K. and Greenwood, B. (1994). Financing mechanisms for village activities in The Gambia and their implications for financing insecticide for bednet impregnation. Journal of Tropical Medicine and Hygiene 97:325-332.

Mills, A. (1998). Trials of the impact of impregnated bed nets on child mortality – guidelines for estimating costs (unpublished).

Mitchell, R. and Carson, R. (1993). Using surveys to value public goods: the contigent valuation method. Publishers Resources for the Future

Modiano, D., Petrarca, V. Sirima, B., Nebie, I., Luoni, G., Esposito, F. and Coluzzi, M. (1998). Baseline immunity of the population and impact of insecticide-treated curtains on malaria infection. American Journal of Tropical Medicine and Hygiene 59(2): 336-40

Mooney, G (1992). Key issues in health economics. New York, London Harvester Wheatsheaf.

Morrison, G., and Gyldmark, M. (1992). Appraising the use of contingent valuation. Health Economics 1:233-243.

Muller, O., Cham, K.; Jaffar, S. and Greenwood, B. (1997) The Gambian National Impregnated Bednet Programme: evaluation of the 1994 cost recovery trial. Social Science and Medicine 44(12): 1903-9

Munguti, K. (1998). Community perceptions and treatment seeking for malaria in Baringo District, Kenya: implications for disease control. East African Medical Journal 75(12):687-691.

Nabarro, D. and Tayler, E. (1998). The "Roll Back Malaria" campaign. Science **280**: 2067-2068.

National Oceanic Atmospheric Administration (1993). Report of the NOAA Panel on Contingent Valuation. Federal Register **58**:4601-4614.

Neng, W., Liexin, Q., Guolhou, L., Weimin, Z., Wenkui, G., Yuming, S., Yi, T. and Kuanren, Z. (1993). Field evaluation of bednets impregnated with deltamethrin for malaria control. Southeast Asian Journal of Tropical Medicine and Public Health **24**(4):664-671.

Nevil, C., Some, E., Mung'ala, V., Mutemi, W., New, L., Marsh, K., Lengler, C. and Snow, R. (1996). Insecticide-treated nets reduce mortality and severe morbidity from malaria among children on the Kenyan coast. Tropical Medicine and International Health. 1(2):139-146.

Njunwa, K., Lines, J., Magesa, S., Mnzava, A., Wilkes, T., Alilo, M., Kivumbi, K. and Curtis, C. (1991). Trial of pyrethroid impregnated bednets in an area of Tanzania holoendemic for malaria. Part 1. Operational methods and acceptability. Acta Tropica **49**:87-96.

Nosten, F., Luxemburger, C., Kyle, D., Ballou, R., Wittes, J., Wah, E., Chongsuphajaisiddhi, T., Gordon, D., White, N., Sadoff, J., Heppner, G. and Shoklo SPf66 Malaria Vaccine Trial Group (1996). Randomised double-blind placebo-controlled trial of SPf66 malaria vaccine in children in northwestern thailand. The Lancet **348**:701-707.

O'Brien, B., and Viramontes, J. (1994). Willingness to pay: a valid and reliable measure of health state preference?. Medical Decision Making **14**(3):289-297.

Ongore, D., Kamunvi, F., Knight, R. and Minava, A. (1989). A study of knoweledge, attitudes and practices (KAP) of a rural community on malaria and mosquito vector. East African Medical Journal February: 79-90.

Onori, E (1982) (a). Report on a mission in Mozambique (unpublished).

Onori, E., Payne, D., Grab, B., Horst, H.I., Franco, J.A., and Joia, H. (1982)(b) Incipient resistance of *Plasmodium falciparum* to chloroquine among a semi-immune population of the United Republic of Tanzania. 1. Results of in vivo and in vitro and of an ophthalmological survey. Bulletin of World Health Organization, **60**: 77-87.

Onwujekwe, O. (1999). Willingness to pay for insecticide-treated nets in five Nigerian communities. Book of Abstracts. MIM African Malaria Conference. Durban, South Africa:B-77.

Packard, R. (1998) 'No other logical choice': global malaria eradication and the politics of international health in the post-war era. Parassitologia. **40**(1-2): 217-29

Pannarunothai, S. and Mills, A. (1997). The poor pay more: health-related inequality in Thailand.. Social Science and Medicine **44**(12): 1781-90

Parkin, M, Powell, M. and Matthews (1997). Economics. Eds Addison-Wesley Publishing Company. England.

Parsonage, M. and Neuburger, H. (1992). Discounting and health benefits. Health Economics **1**: 71-6.

Pavignani, E. and Durao, J. (1999). Managing external resources in Mozambique: building new aid relationship on shifting sands? Health Policy and Planning. **14**(3):243-253.

Pereira, J. (1990). Equity objectives in Portuguese health policy. Social Science and Medicine **31**(1): 91-4

Petersen, E., Marbiah, N., Magbiti, E. et al (1993). Controlled trial of lambda-cyhalothrin impregnated bednets and Maloprim chemo suppression to control malaria in children living in a holoendemic area of Sierra Leone, West Africa. Study design and preliminary results. Parassitologia 35 suppl:81-85

Picard, J., Aikins, M., Alonso, P., Armstrong, J., Greenwood, B. and Mills, A. (1993). A malaria control trial using insecticide-treated bed nets and targeted chemoprophylaxis in a rural area of The Gambia, west Africa. 8. Cost-effectiveness of bed net impregnation alone or combined with chemoprophylaxis in preventing mortality and morbidity from malaria in Gambian children. Transactions of the Royal Society of Tropical Medicine and Hygiene. 87(suppl 2):53-57

Popkin, B. (1982). A household framework for examining the social and economic consequences of tropical diseases. Social Science and Medicine **16**: 533-543.

Programa das Nacoes Unidas para o Desenvolvimento (1998). Mocambique: paz e crescimento economico - oportunidades para desenvolvimento. PNUD - Maputo, Mocambique.

Quinones, M. (1996). Effects of permethrin-treated bednets on *Anopheles gambiae s.l.* in The Gambia. Ph.D Thesis, LSHTM, University of London, London.

Quinones, M., Lines, J., Thomson, M., Jawara, M. and Greenwood, B. (1998) Permethrin-treated bed nets do not have a 'mass-killing effect' on village populations of Anopheles gambiae s.l. in The Gambia. Transactions of the Royal Society and Tropical Medicine Hygiene 92(4): 373-8

Ratcfile, J., Donaldson, C and Macphee (1996). Programme budgeting and marginal analysis: a case study of maternity services. Journal of Public Health Medicine 18(2):175-182.

Richards, F., Klein, R., Flores, R., Weller, S., Gatica, M., Zeissig, R. and Sexton, J. (1993). Permethrin-impregnated bednets for malaria control in Northen Guatemala: epidemiologic impact and community acceptance. American Journal of Tropical Medicine and Hygiene **49**(4):410-418.

Robert, V. and Carnevale, P. (1991). Influence of deltamethrin treatment of bed nets on malaria transmission in the Kou valley, Burkina Faso. Bulletin of the World Health Organisation **69**(6):735-740.

Robertson, R., Castro, C., Gomez, L., Gwynne, G., Tinajero, B. and Zschock, D. (1991). Primary health services in Ecuador: comparative costs, quality, and equity of care in Ministry of Health and rural social security facilities. Social Science and Medicine **32**(12): 1327-36.

Roll Back Malaria (1999). Establishing a global partnership to Roll Back Malaria. First Partner's Meeting (not published)

Rosen, M. (1999). Data needs in studies on equity in health and access to care-ethical considerations. Acta of Oncology **38**(1):71-5

Rosenthal, G., and Newbrander, W. (1996). Public policy and private sector provision of health services. International Journal of Health Planning and Management **11**:203-216.

Rowley, J. (1997). Affordability: Summary of the presentation by Jane Rowley (MRC Laboratories, Gambia). Proceedings Report: International Conference on Bednets and Other Insecticide-Treated Materials for the Prevention of Malaria (October 29-31), Washington, D.C.

Russell, S., Fox-Rushby, J. and Arhin, D. (1995). Willingness and ability to pay for health care: a selection of methods and issues. Health Policy and Planning **10**(1):94-101.

Russel, S. (1996). Ability to pay for health care: concepts and evidence. Health Policy and Planning **11**(3):219-237.

Ryan, M. (1996). Using willingness to pay to assess the benefits of assisted reproductive techniques. Economic Evaluation **5**:543-558.

Sauerborn, R., Bodart, C.and Essoba, R. 91995). Recovery of recurrent health service costs through provincial health funds in Cameroon. Social Science and Medicine. **40**(12):1731-1739.

Schapira, A. and Schwalbach, J. (1988). A malaria resistente em Mocambique – epidemiologia e controlo ate 1987. Instituto Nacional de Saude, Maputo, Mocambique.

Schellenberg, A., Abdulla, S., Minja, H., Nathan, R., Mukasa, O., Marchant, T., Mponda, H., Kikumbih, N., Manchester, T., Tanner, M. and Lengeler, C. (1999). KINET: a social marketing programme of treated nets and net treatment for malaria control in Tanzania, with evaluation of child health and long-term survival. Transactions of the Royal Society of Tropical Medicine and Hygiene **93**:225-231.

Schulman, C., Dorman, E., Talisuna, A., Lowe, B., Nevill, C., Snow, R., Jilo, H., Peshu, N., Bulmer, J., Graham, S. and Marsh, K. (1998) A community randomized controlled trial of insecticide-treated bednets for the prevention of malaria and anaemia among primigravid women on the Kenyan coast. Tropical Medicine and International Health **3**(3): 197-204.

Service, M. (1993). Community participation in vector-borne disease control. Annals of Tropical Medicine and Parasitology **87**(3):223-234.

Servico Nacional de Saude (1998). Informacao Estatistica Sumaria – Janeiro a Dezembro 1998. (Ministerio da Saude, Mozambique, Unpublished report).

Sexton, J. (1994). Impregnated bednets for malaria control: biological success and social responsibility. American Journal of Tropical Medicine and Hygiene 50(6):72-81.

Shepard, D., Ettling, M., Brinkmann, R., Sauerborn, R. (1991). The economic cost of malaria in Africa. Tropical Medicine and Parasitology. 42:199-203.

Shretta, R. (1999). Netmark briefing book: insecticide treated materials in Mozambique. (unpublished)

Snow, R. Rowan, K. and Greenwood (1987). A trial of permethrin-treated bednets in the prevention of malaria in Gambian children. Transactions of the Royal Society of Tropical Medicine and Hygiene. 81:563-567.

Snow, R. and Marsh, K. (1995). Will reducing *Plasmodium falciparum* transmission alter malaria mortality?. Parasitology Today ii:188-190.

Snow, R., Craig, M., Deichman, U. and Marsh, K. (1999). Estimating mortality, morbidity and disability due to malaria among Africa's non-pregnant population. Bulletin of the World Health Organisation 77(8):624-640.

Snow, R., McCabe, E., Mbogo, C., Molyneux, C., Some, E., Mun'ala, V and Nevil, C. (1999). The effect of delivery mechanisms on the uptake of bednet re-impregnation in Kilifi District, Kenya. Health Policy and Planning 14(1):18-25

Stalhammar, N. (1996). An empirical note on willingness to pay and starting point bias. Medical Decision Making 16:242-247.

Stephens, C. Masamu, E., Kiama, M., Keto, A., Kinenekejo, M., Ichimori, K. and Lines, J. (1995). Knowledge of mosquitos in relation to public and domestic control activities in the cities of Dar es Salaam and Tanga. Bulletin of the World Health Organisation 73(1):97-104.

Streiner, D. and Norman, G. (1995). Health measurement sales. Practical guide to their development and use. Second edition. New York; Oxford University Press.

Stuart, B. and Grana, J. (1998). Ability to pay and the decision to mediate. Medical Care **36**(2):202-211.

TDR news (1996). Megatrials show impregnated mosquito nest could save 500,000 African children a year - at very low cost. TDR News **50**:1-2.

Thomson, M., D'Alessandro, U., Bennet, S., Connor, S., Langerock, P., Jawara, M., Todd, J. and Greenwood, B. (1994). Malaria prevalence is inversely related to vector density in The Gambia, West Africa. Transactions of the Royal Society of Tropical Medicine and Hygiene **88**(6):638-43.

Trape, J. and Rogier, C. (1996). Comabating malaria morbidity and mortality by reducing transmission. Parasitology Today **12**:236-240.

Vulule, J., Beach, R., Atieli, F., Roberts, J., Mount, D. and Mwangi, R. (1994). Reduced susceptibility of *Anopheles gambiae* to permethrin associated with the use of permethrin-impregnated bednets and curtains in Kenya. Medical and Veterinary Entomology **8**:71-75.

Vulule, J., Beach, R., Atieli, F., Roberts, J., Mount, D. and Mwangi, R. (1996). Long-term use of permethrin-impregnated nets does not increase *Anopheles gambiae* permethrin tolerance. Medical and Veterinary Entomology **10**:71-79.

Weaver, M., Ndamobissi, R., Kornfield, R., Blewane, C., Sathe, A., Chapko, M., Bendje, N., Nguembi, E., Senwara-Defiobona, J. (1996). Willingness to pay for child survival: results of a national survey in Central African Republic. Social Science and Medicine **43**(6):985-998.

Whittington, D., Pinheiro, A., and Cropper, M. (1996). The economic benefits of malaria control: a contigent valuation study in Marracuene, Mozambique. (unpublished report).

Winch, P., Makemba, a., Kamazima, S., Lwihula, G., Lubega, P., Minjas, J. and Shiff, C. (1994). Seasonal variation in the perceived risk of malaria: implications for the promotion of insecticide-impregnated bed nets. Social Science and Medicine 39(1):63-75.

Winch, P., Makemba, A., Makame, V., Mfaume, M., Lynch, M., Premji, Z., Minjas, J. and Shiff, C. (1997) Social and cultural factors affecting rates of regular retreatment of mosquito nets with insecticide in Bagamoyo District, Tanzania. Tropical Medicine and International Health 2(8): 760-70

Woodruff, A., Andell V., Petitt, L (1979). Cause of anaemia in malaria. The Lancet ii:1055-1057.

World Bank (1998). World development report 1998. Oxford Univ Press for World Bank. New York.

World Health Organisation (1975). Manual on Practical Entomology in Malaria. World Health Organisation, Geneva.

World Health Organisation (1995). Vector control for malaria and other mosquito-borne disease. WHO Technical Report Series, 854.

Xu, B., Xiao, X., Webber, R. and Lines, J. (1998). Comparison of the effect of insecticide-treated bed nets and DDT residual spraying on the prevalence of malaria transmitted by *Anopheles anthropophagus* in China. Transactions of the Royal Society of tropical Medicine and Hygiene. 92(2): 135-6

Zandu, A., Malengreau, M., Wery, M. (1991). Pratiques et depenses pour la protection contre les moustiques dans les menages a Kinshasa, Zaire. Annales de la Societe Belge de la Medicine Tropicale **71**:259-266.

Zetharaeus, N. (1998). Willingness to pay for hormone replacement therapy. Economic Evaluation 7:31-38.

Ziba, C., Slusker, L., Chitsulo, L., Steketee, R. (1994). Use of malaria prevention measures in Malawian households. Tropical Medicine and Parasitology **45**:71-73.

Zimicki, s. (1996). Promotion in Sub-Saharan Africa. . In Net Gain: operational aspects of a new health intervention for preventing malaria. (eds C. Lengler, J. Cattani and D. de savingny) IDRC, Canada and WHO, Switzerland.

Appendix 3.1: Pre-implementation study questionnaire

REPUBLICA DE MOÇAMBIQUE
INSTITUTO NACIONAL DE SAUDE
DEPARTAMENTO DE PARASITOLOGIA DE SANGUE

IMPLEMENTAÇAO DE REDES MOSQUITEIRAS IMPREGNADAS PARA A PREVENÇAO DA MALARIA - BOANE 1995

FICHA 1: INFORMAÇAO SOCIAL, ECONOMICA, MOSQUITO, REDES

INFORMAÇAO GERAL: IDENTIFICAÇAO

1. N. FICHA ________ 2. DATA ___/___/___ 3. BAIRRO ________

4. QUART. ____________ 5. NUMERO DA CASA DO C. EXECUTIVO _______

6. NUM. CASA DO ESTUDO.........[___|___|___|___].[___|___|___]

7. NOME DO ENTREVISTADO____________________________________

7/A. POSIÇAO NA FAMIL.__________ 8. HORA DO INICIO DA ENTREV. ___

INFORMAÇAO SOCIO-ECONOMICA

9. DESDE QUE ANO VIVE NO DISTRITO . . . . |___|___|

10. QUAL FOI A SUA PROVENIENCIA . . . . . [________________________]

11. PORQUE FIXOU RESIDENCIA EM BOANE . . . . [_____]
    1. SEMPRE VIVEU EM BOANE
    2. FOI TRANSFERIDO PELO SERVIÇO
    3. VEIO COM OS PAIS
    4. VEIO DESLOCADO POR CAUSA DA GUERRA (SE SIM DONDE) [_____]
    5. PROCURA DE EMPREGO
    6. OUTROS . . . . [______________________________]

12. QUANTAS PESSOAS TRABALHAM NO SEU AGREGADO FAMILIAR . [________]

13. QUEM É O CHEFE DA FAMILIA . . . . [_____]
    1. MARIDO
    2. ESPOSA
    3. PAI
    4. MAE
    5. TIO/TIA
    6. AVO
    7. FILHO/FILHA
    8. IRMAO/IRMA
    9. OUTRO ....[____________________]

Pag.: 1

14. ONDE TRABALHAM OS MEMBROS DA SUA CASA . . . .
    1. EMPREGO NO ESTADO . . . . [______]1
    2. EMPREGO NO PRIVADO . . . . [______]2
    3. COMERCIANTE (TEM LOJA) . . . . [______]3
    4. OPERARIO POR CONTA PROPRIA . . . . [______]4
    5. MACHAMBEIRO (CONTA PROPRIA) . . . . [______]5
    6. VENDEDOR NO DUMBA NENGUE . . . . [______]6
    7. VENDEDOR NO BAZAR . . . . [______]7
    8. CURANDEIRO . . . . [______]8
    9. OUTROS (INDIQUE) [______________________________]9

15. TEM MACHAMBA . . . . [______]
    1. SIM; 2. NAO

15/A. SE TEM MACHAMBA, O QUE PRODUZ
    1. MILHO............[______]1
    2. ARROZ............[______]2
    3. FEIJAO...........[______]3
    4. MANDIOCA.........[______]4
    5. HORTICULAS.......[______]5
    6. OUTROS...........[______________________]6

15/B QUAL O TIPO DE PRODUÇAO QUE POSSUI (1: SIM; 2:NAO)
    1. SUBSISTENCIA FAMILIAR.... [______]1
    2. PRODUÇAO PARA VENDA.......[______]2
    3. OUTROS....................[____________________]3

15/C. EM QUE MES É QUE TEM COLHEITAS [____________________]

15/D. TEM GADO . . . . [______]
    1. SIM; 2. NAO

15/D.1 SE SIM QUE TIPO DE GADO [____________________]
    1. BOVINO
    2. CAPRINO/OVINO
    3. SUINO
    4. OUTROS

15/D.2 QUANTAS CABEÇAS POSSUI . . . . [______]

16. QUAL À SUA RELIGIAO . . . . [____________________]

DADOS DA CASA

17. QUANTAS CASAS TEM O AGREGADO FAMILIAR (ONDE A FAMILIA DORME[____]

18. TIPO DA PAREDE DA CASA PRINCIPAL . . . . [____]
    1. PALHOTA MATICADA
    2. PALHOTA NAO MATICADA
    3. CANIÇO
    4. ALVENARIA
    5. PEDRA
    6. OUTRO [______________________]

Pag.: 9

19. TIPO DO TECTO DA CASA PRINCIPAL . . . . [______]
1. CAPIM/CANIÇO
2. ZINCO/TELHA/PLACA DE CIMENTO
3. OUTRO.....[______________________]

20. NUMERO DE QUARTOS DE DORMIR NA CASA PRINCIPAL . . . . . [______]

21. TEM LUZ ELECTRICA . . . . [______]
1. SIM; 2. NAO

22. TEM AGUA CANALISADA . . . . [____]
1. SIM; 2. NAO

23. TEM RADIO QUE FUNCIONE . . . . [____]
1. SIM; 2. NAO

24. TEM GELEIRA QUE FUNCIONE . . . . [____]
1. SIM; 2. NAO

25. TEM TELEVISAO QUE FUNCIONE . . . . [____]
1. SIM; 2. NAO

26. COSTUMA LER JORNAL . . . . [____]
1. SIM; 2. NAO

26/A SE SIM, DURANTE QUANTOS DIAS LEU O JORNAL NA SEMANA PASSADA_

27. COSTUMA ASSISTIR A TELEVISAO . . . . [____]
1. SIM; 2. NAO

27/A. SE SIM DURANTE QUANTOS DIAS ASSISTIU À TELEVISAO NA SEMANA PASSADA . . . . |___|___|

INFORMAÇAO SOBRE MOSQUITO

28. QUAIS É QUE SAO AS PRINCIPAIS DOENÇAS QUE AFECTAM AS CRIANÇAS AQUI NO SEU BAIRRO . . . . [______]
1. MALARIA
2. DIARREIA
3. CONSTIPAÇAO
4. ASMA
5. TRAUMATISMO
6. NAO SABE
7. OUTROS (ESPECIFIQUE)......[______________________]

29. COSTUMA HAVER MOSQUITOS NA SUA CASA . . . . [______]
1. MUITOS (PASSA A NOITE TODA SER PICADO)
2. MAIS OU MENOS
3. NENHUM (NUNCA É PICADO POR MOSQUITO)

Pag.: 3

29/A EM QUE ALTURA DO ANO HA MAIS MOSQUITOS NA SUA CASA[______
1. DURANTE A ESTAÇAO QUENTE E DE CHUVAS
2. DURANTE A ESTAÇAO FRIA
3. TODO O ANO

30. ONDE É QUE CRESCE O MOSQUITO . . . .
1. NAO SABE......[___]
2. NA AGUA.......[___]
3. NO LIXO.......[___]
4. OUTROS (ESPECIFIQUE)..........[______________________]

31. QUAIS SAO AS DOENÇAS QUE PODEM SER TRANSMITIDAS PELO MOSQUITO [__
1. NAO SABE
2. MALARIA
3. OUTRO ....[______________________]

32. COMO VOCE COSTUMA PROTEGER-SE CONTRA O MOSQUITO . . . .
1. NAO SE PROTEGE ....[___]1
2. MATANDO OS MOSQUITOS COM INSECTICIDA EM LATA........ [___]2
3. MATANDO OS MOSQUITOS COM INSECTICIDA EM SERPENTINA...[___]3
4. PONDO REDES NAS JANELAS..............................[___]4
5. ELIMINANDO AGUAS PARADAS............................ [___]5
6. DORMINDO NUMA REDE MOSQUITEIRA.......................[___]6
7. QUEIMANDO SUBSTANCIAS (QUAL).[______________________]7
8. OUTROS...[______________________]8

33. O QUE É QUE VOCE COSTUMA COMPRAR PARA SE PROTEGER DO MOSQUITO
[______________________]

33/A. QUANTO CUSTAM . . . . [__________]

34. EXISTEM OUTROS INSECTOS NA SUA CASA? . . . . [______]
1. SIM; 2. NAO

34/A. SE SIM QUAL
1. PERCEVEJO.....[___]
2. PIOLHO........[___]
3. BARATAS.......[___]
3. OUTROS........[______________________]

INFORMAÇAO SOBRE REDES DE CAMA

35. ONDE DORMEM AS PESSOAS NA SUA CASA . . . .
1. CAMAS.......(QUANTAS)....[_____]
2. ESTEIRAS....(QUANTAS)....[_____]
3. BERÇO.......(QUANTOS)....[_____]

36. JA OUVIU FALAR DA REDE DA CAMA MOSQUITEIRA . . . . . . [______]
1. SIM; 2. NAO

37. PARA QUE SERVE A REDE MOSQUITEIRA . . . . [______]
1. NAO SABE
2. PREVENIR-SE DA PICADA DO MOSQUITO
3. PREVENIR-SE DA MALARIA
4. OUTROS (ESPECIFIQUE).....[________________________]

38. TEM REDE DE CAMA MOSQUITEIRA EM CASA . . . . [______]
1. SIM; 2. NAO

38/A. SE SIM, QUEM USA A REDE [________________________]
1. PAI
2. MAE
3. PAI E MAE
4. FILHOS
5. OUTROS (ESPECIFIQUE)...[________________________]

38/B. QUANTO CUSTOU A REDE...[________________________]

INFORME O ENTREVISTADO O QUE É UMA REDE, E MOSTRE AS 3 DIFERENTES CORES

39. QUAL DESTAS CORES DAS REDES PREFERE . . . . [______]
1. BRANCO
2. VERDE
3. CASTANHO

40. UMA CAPULANA CUSTA 20.000.00MT, POR QUANTO PAGARIA UMA REDE ______

41. ESTARIA INTERESSADO A COMPRAR UMA REDE MOSQUITEIRA . [______]
1. SIM; 2. NAO

REPUBLICA DE MOÇAMBIQUE
INSTITUTO NACIONAL DE SAUDE
DEPARTAMENTO DE PARASITOLOGIA DE SANGUE

IMPLEMENTAÇÃO DE REDES MOSQUITEIRAS IMPREGNADAS PARA A PREVENÇAO DA MALARIA - BOANE 1995

FICHA 2: RECENCEAMENTO DA POPULAÇÃO

INFORMAÇAO GERAL: IDENTIFICAÇAO

1. N. FICHA ________ 2. DATA ___/___/___ 3. BAIRRO ________

4. QUART. __________ 5. NUMERO DA CASA DO C. EXECUTIVO ________

6. NUM. CASA DO ESTUDO __________ 7. NOME DO ENTREVISTADO ______

7/A. POSIÇAO NA FAMIL. __________

42. NUMERO TOTAL DO AGREGADO FAMILIAR[__________]

N.FAMIL.	1	2	3	4
NOME 1º NOME APELIDO				
L.NASC. PROV DISTRI				
DATA NASCIM				
SEXO(1=M; 2=F)				
LING.MATERN				
EST. CIVIL				
Nº FILHOS				
PARENTESCO				
HAB. LITERAR				
FALA PORTUG				
1ª PROFISSAO				
2ª PROFISSAO				
TIPO PRESENÇA				

Pag.: 6

FICHA DE RECENSEAMENTO: CONT. (2)

1. N. FICHA ________ 2. DATA ___/___/___ 3. BAIRRO ________

4. QUART. ____________ 6. NUM. CASA DO ESTUDO ____________

N.FAMIL.	9	10	11	12
NOME 1º NOME APELIDO				
L.NASC. PROV DISTRI				
DATA NASCIM				
SEXO				
LING.MATERN				
EST. CIVIL				
Nº FILHOS				
PARENTESCO				
HAB. LITERAR				
FALA PORTUG				
1ª PROFISSAO				
2ª PROFISSAO				
TIPO PRESENÇA				

ESTADO CIVIL
1. CASAMENTO OFICIAL
2. LOBOLO
3. MARITALMENTE
4. SOLTEIRO
5. VIUVO
6. SEPARADO/DIVORCIADO

PARENTESCO
1. MARIDO
2. ESPOSA
3. PAI
4. MAE
5. TIO/TIA
6. AVO
7. FILHO
8. NETO
9. ENTEADO
10. PRIMO
11. IRMAO
12. OUTROS

FALA PORTUGUES
1. MUITO BEM
2. MAIS OU MENOS
3. POUCO
4. NADA

TIPO DE PRES
1. PRESENT
2. PRES/ AUSEN MOMENT
3. AUSENT < 1 MES
4. AUSENT >=1 < 6 MESES
5. AUSENT > 6 MESES

Pag.: 1

FICHA DE RECENSEAMENTO: CONT. (3)

1. N. FICHA ________ 2. DATA ___/___/___ 3. BAIRRO ________

4. QUART. ________ 6. NUM. CASA DO ESTUDO ________

N.FAMIL.	13	14	15	16
NOME 1º NOME APELIDO				
L.NASC. PROV DISTRI				
DATA NASCIM				
SEXO				
LING.MATERN				
EST. CIVIL				
Nº FILHOS				
PARENTESCO				
HAB. LITERAR				
FALA PORTUG				
1ª PROFISSAO				
2ª PROFISSAO				
TIPO PRESENÇA				

ESTADO CIVIL
1. CASAMENTO OFICIAL
2. LOBOLO
3. MARITALMENTE
4. SOLTEIRO
5. VIUVO
6. SEPARADO/DIVORCIADO

PARENTESCO
1. MARIDO
2. ESPOSA
3. PAI
4. MAE
5. TIO/TIA
6. AVO
7. FILHO
8. NETO
9. ENTEADO
10. PRIMO
11. IRMAO
12. OUTROS

FALA PORTUGUES
1. MUITO BEM
2. MAIS OU MENOS
3. POUCO
4. NADA

TIPO DE PRES
1. PRESENT
2. PRES/ AUSEN MOMENT
3. AUSENT < 1 MES
4. AUSENT >=1 < 6 MESES
5. AUSENT > 6 MESES

Pag.: 9

Appendix 3.2: Census Card

MINISTERIO DA SAUDE
INSTITUTO NACIONAL DE SAUDE
DEPT. DE PARASITOLOGIA DE SANGUE

IMPLEMENTACAO DE REDES MOSQUITEIRAS IMPREGNADAS
PARA A PREVENCAO DA MALARIA - BOANE - 1996

CARTAO DE IDENTIFICACAO DO AGREGADO FAMILIAR

Agregado fam. no.______________ Data do recenseamento ____/____/____

Bairro ______________ Quart. ______ No. de Casa ______________

Nome do Chefe da fam. ______________ No. total do agreg. fam. ______

Actualizacao do recenseamento No. total do agreg. fam.

1. ____/____/____ ______________
2. ____/____/____ ______________
3. ____/____/____ ______________

COMPRA DE REDES

Data	No. total de redes vendidas			
	Solteiro	Casal	Total	Cores
__/__/__				
__/__/__				
__/__/__				

COMPOSICAO DO AGREGADO FAMILIAR

	Nome	Data Nasc.	Sexo	Observacoes*
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

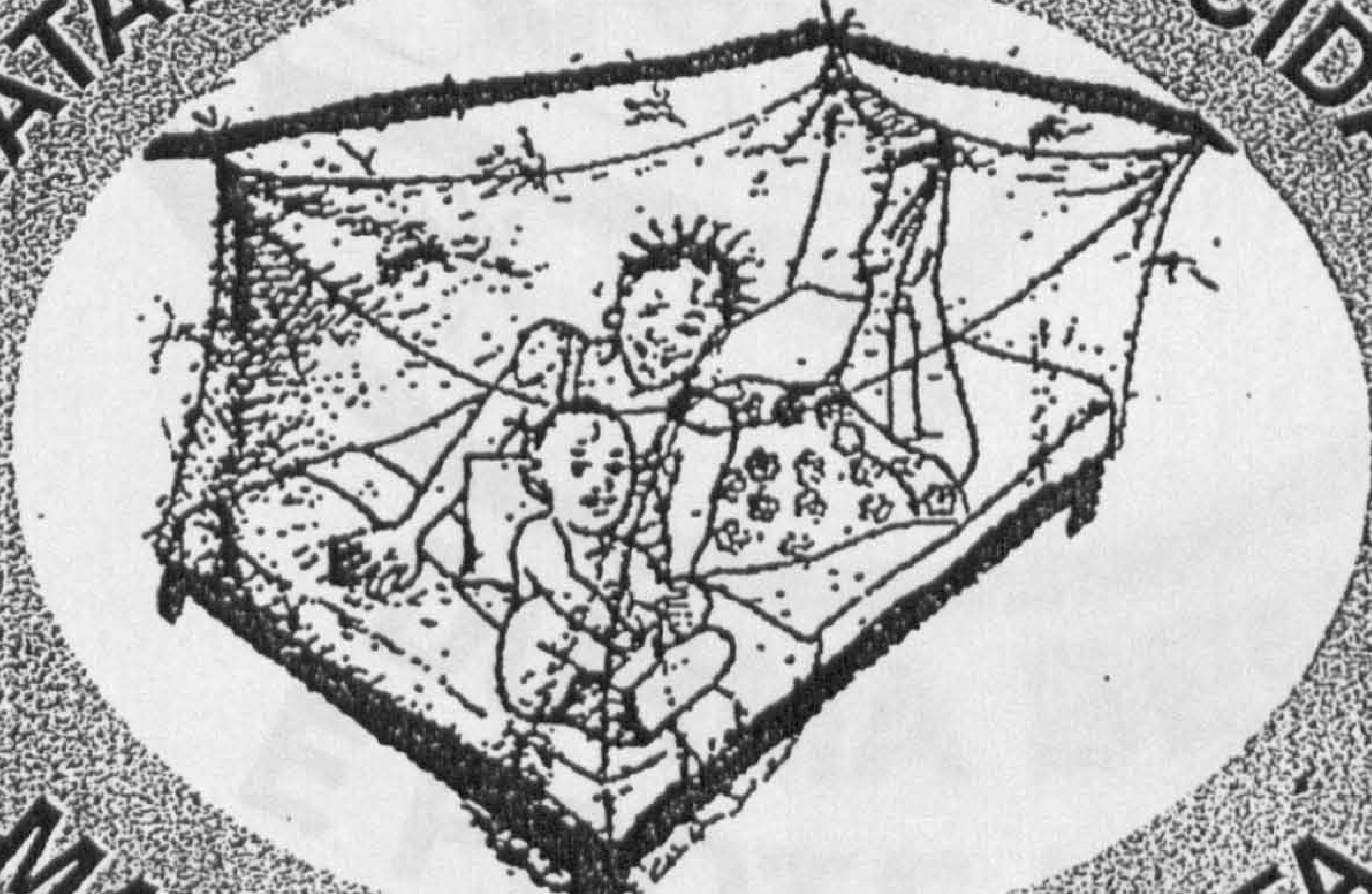
* incluir a data de entrada ou saida do agregado familiar

Appendix 4.1: Training manual for activist (first page)

REPÚBLICA DE MOÇAMBIQUE
MINISTÉRIO DA SAÚDE
INSTITUTO NACIONAL DE SAÚDE

REDE MOSQUITEIRA

TRATADA COM INSECTICIDA



MANUAL DO ACTIVISTA

MALÁRIA-INS

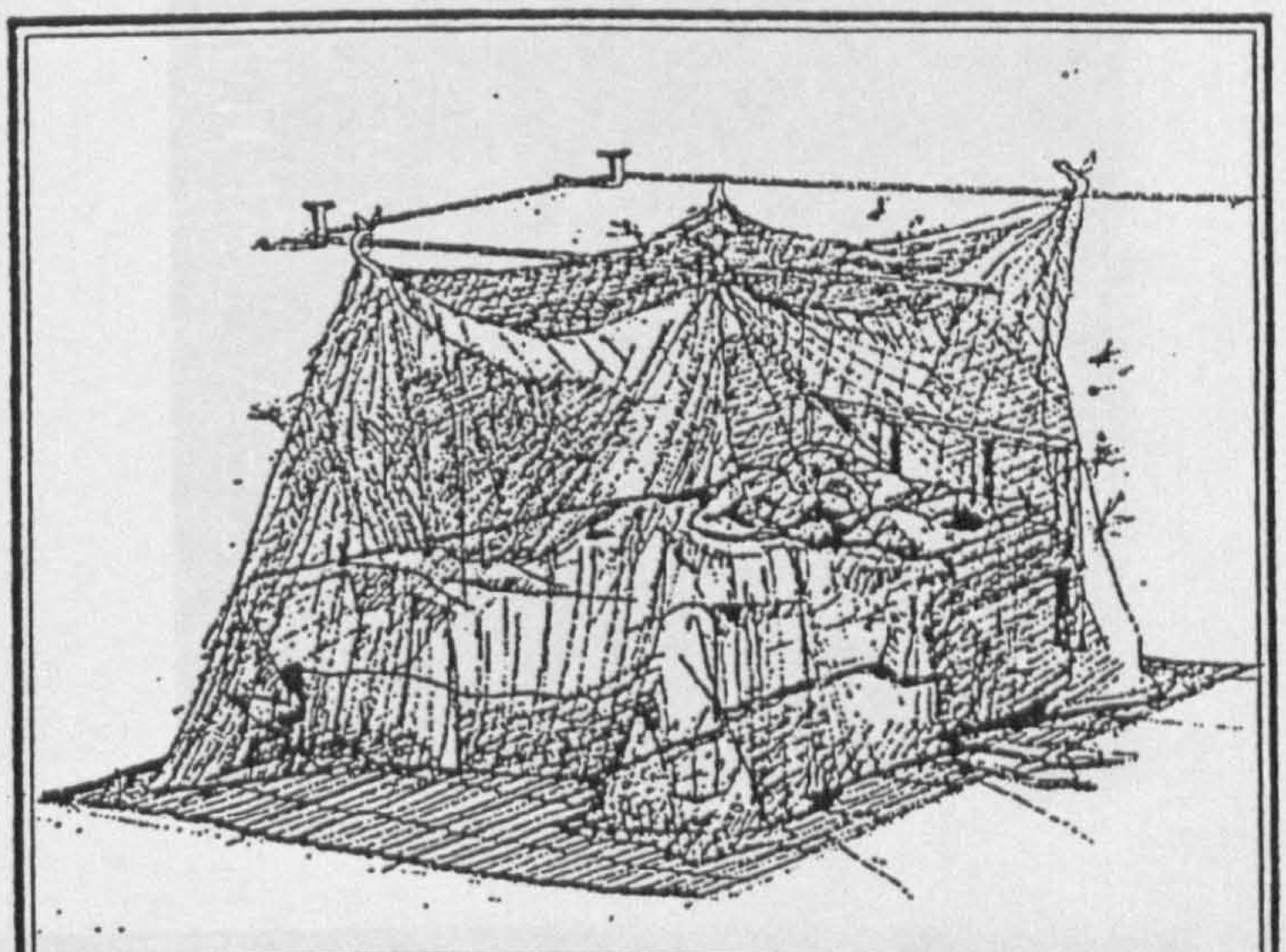
Appendix 4.2: Poster – *MUXIQUITELA*

Appendix 4.3: training manual for health workers (first page)

MALÁRIA- Prevenção Manual do Enfermeiro

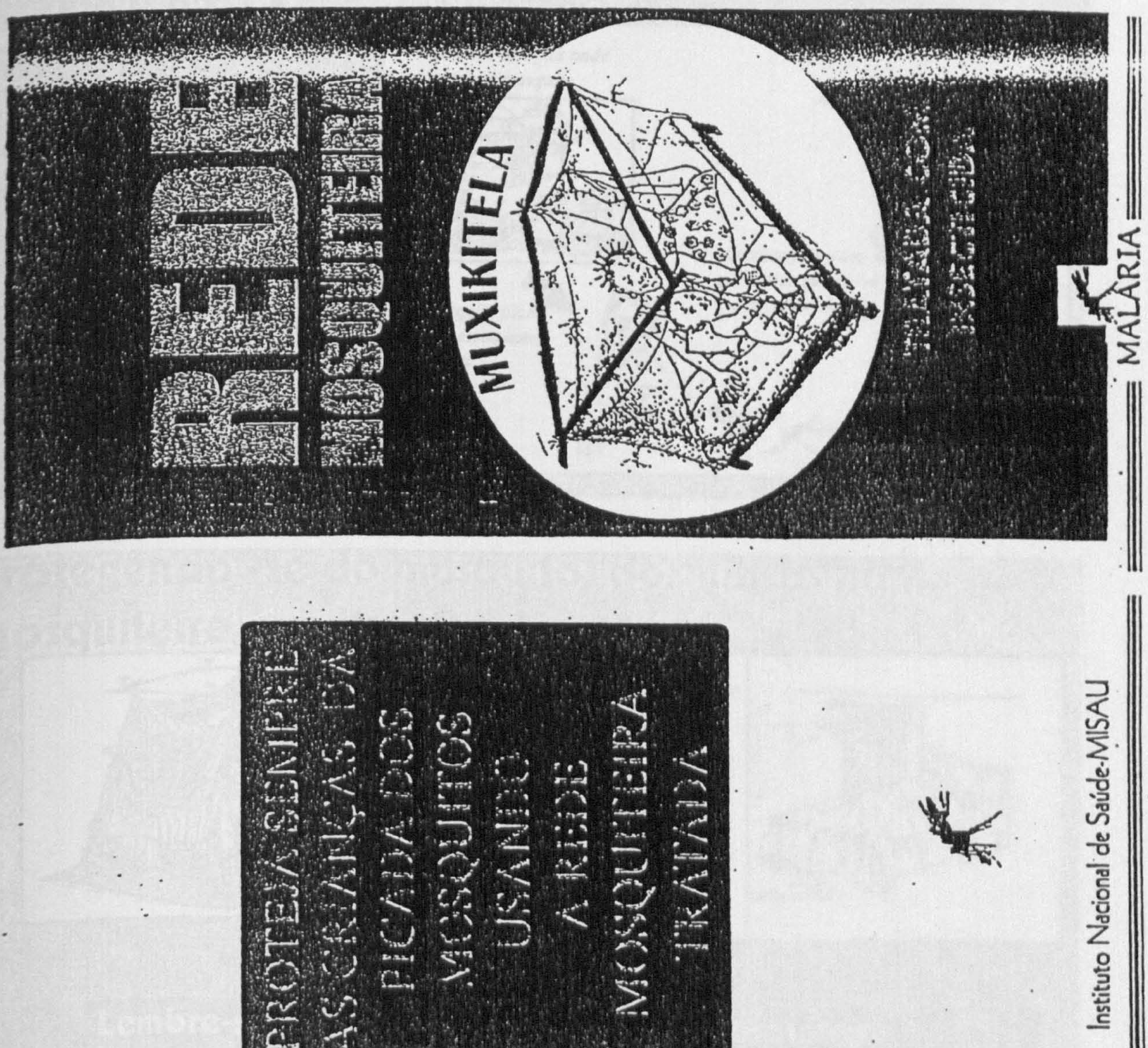
REPÚBLICA DE MOÇAMBIQUE
MINISTÉRIO DA SAÚDE
INSTITUTO NACIONAL DE SAÚDE

REDE
MOSQUITEIRA



MANUAL DO PROMOTOR DE SAÚDE

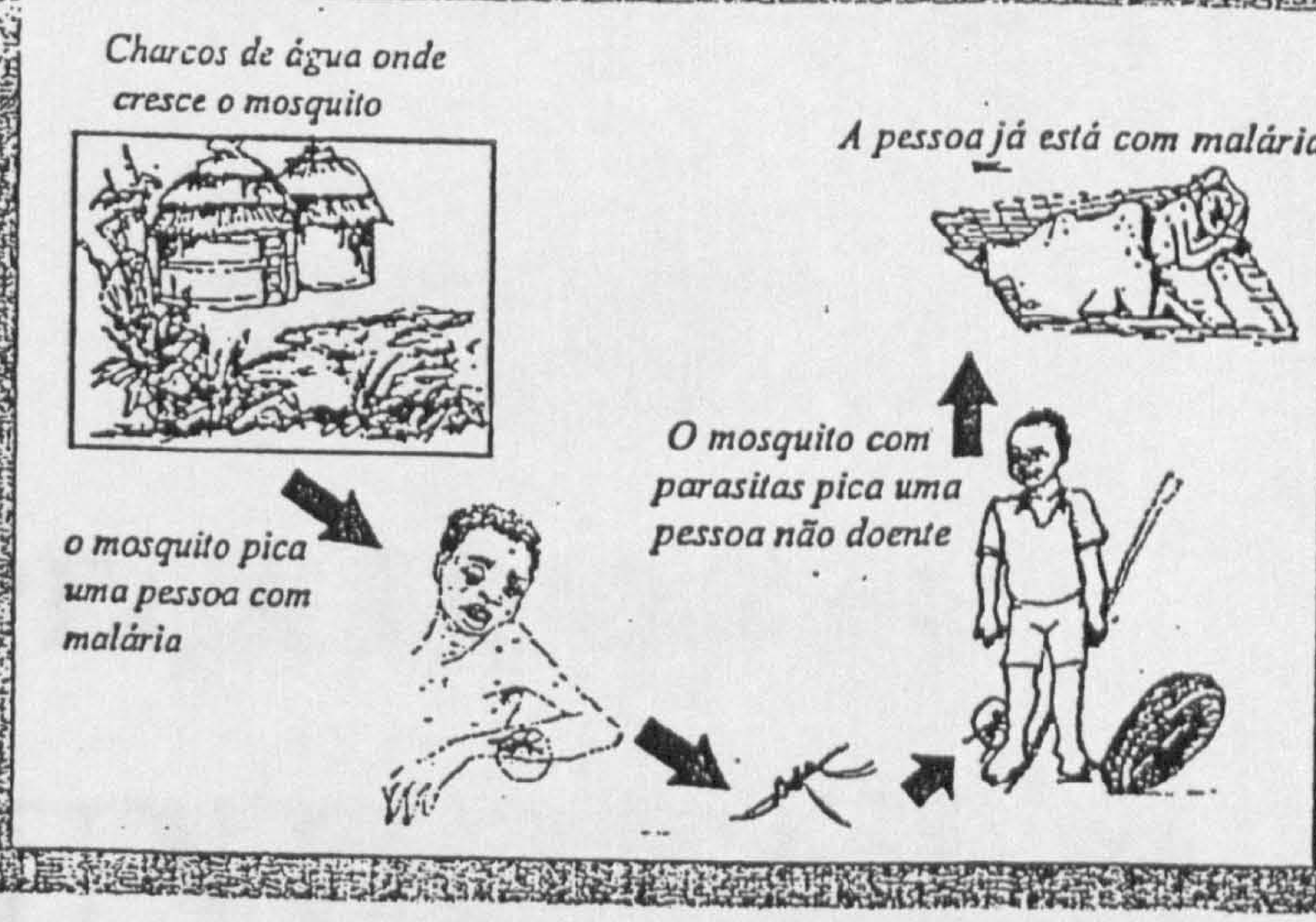
Appendix 4.4: ITN booklet



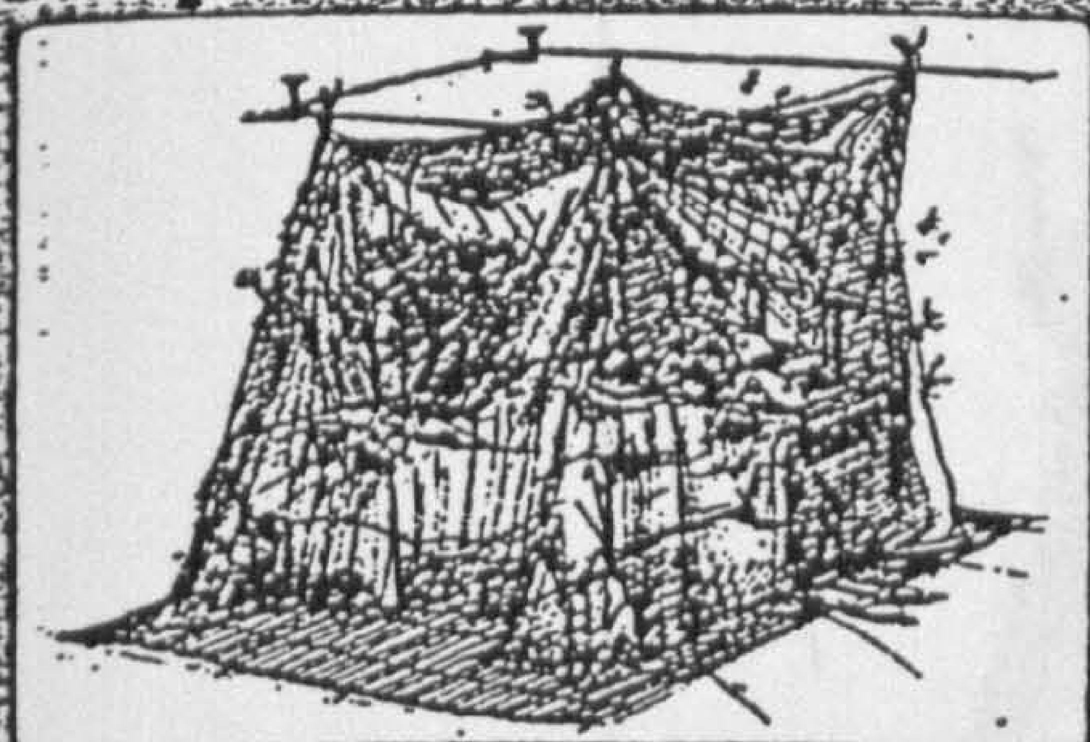
(ITN booklet, reverse side)

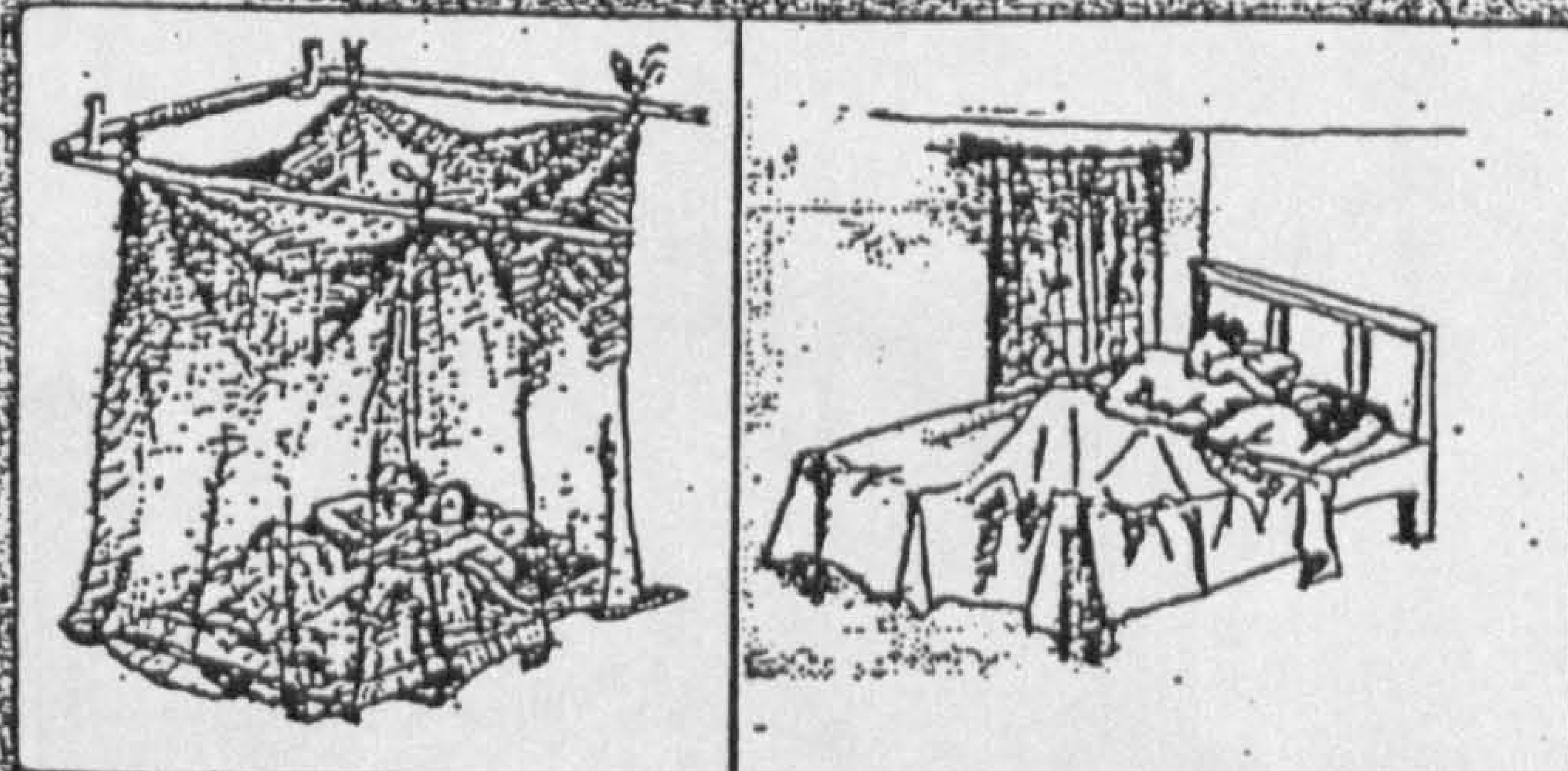
MALÁRIA

A malária é uma doença perigosa que se apanha pela picada de mosquito



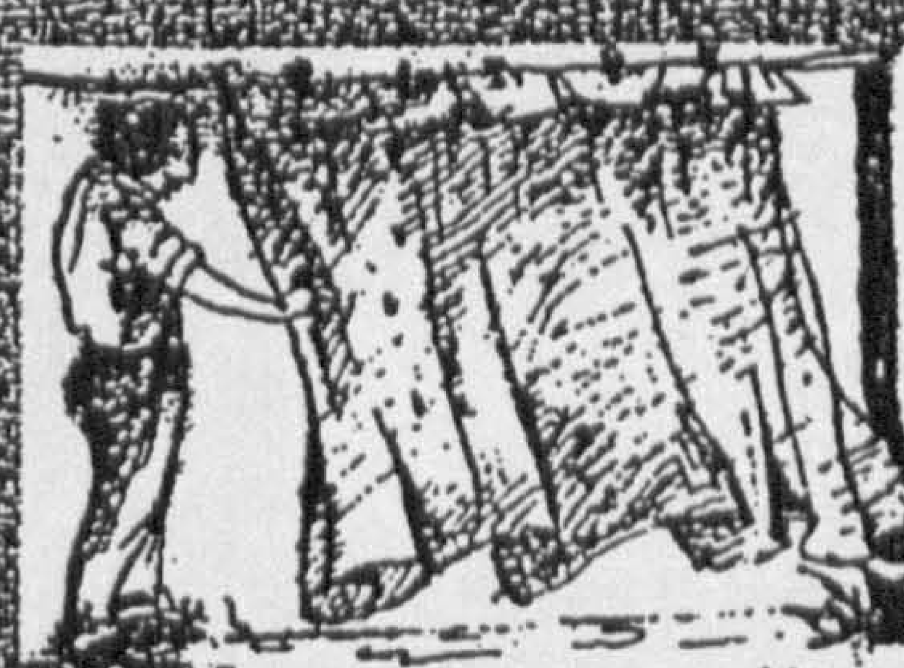
Protegendo-se do mosquito, dormindo numa rede mosquiteira é evitar a malária





Lembre-se: durma sempre numa rede mosquiteira

Atenção: Trate com insecticida a sua rede mosquiteira sempreque a lavar.



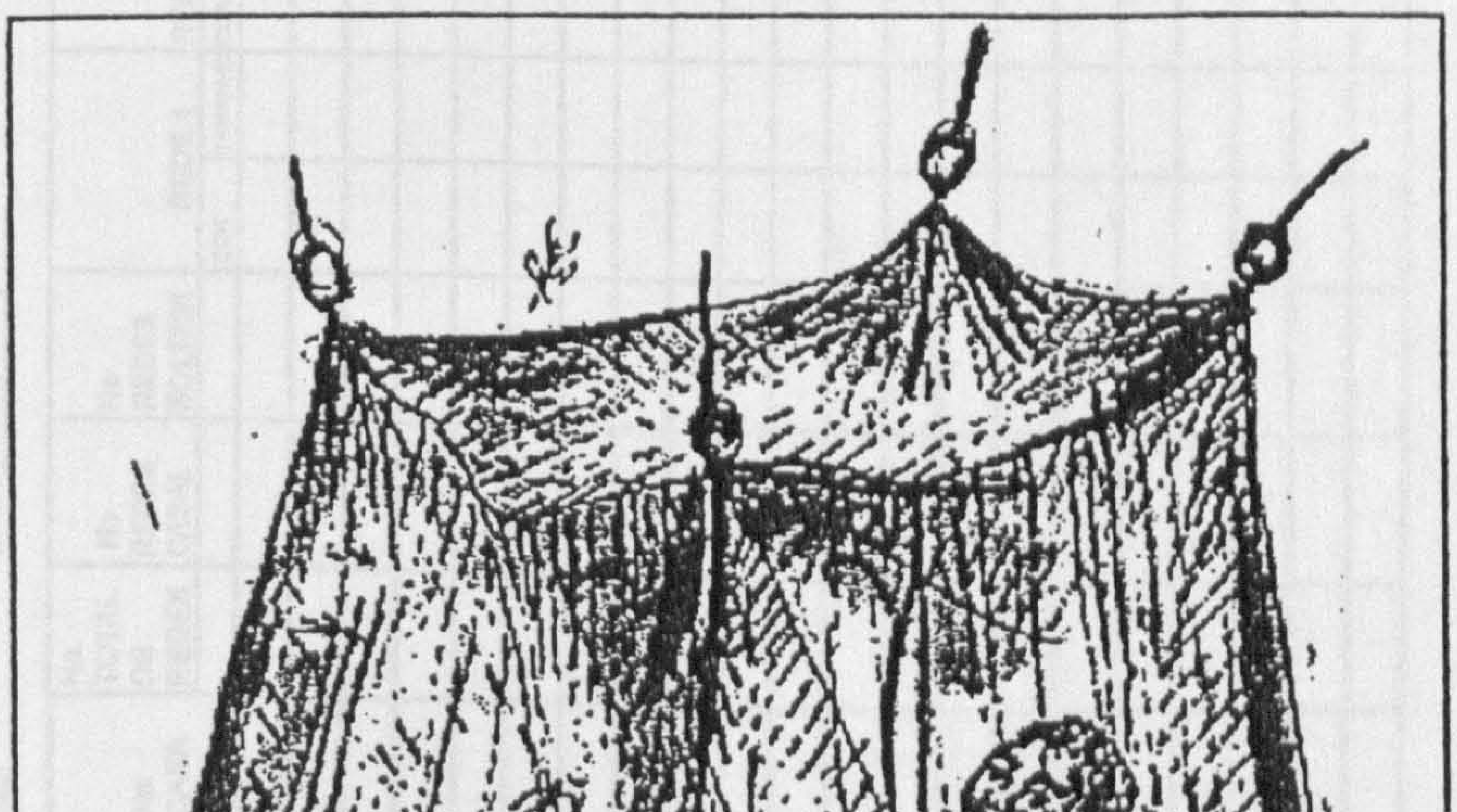
Não se esqueça: trate a sua rede mosquiteira pelo menos uma vez por ano

Appendix 4.5: ITN play manual (first page)

REPÚBLICA DE MOÇAMBIQUE
MINISTÉRIO DA SAÚDE
INSTITUTO NACIONAL DE SAÚDE

PEÇA TEATRAL

MUXIKITELA



MALÁRIA - INS

Appendix 4.6: Selling file

MINISTERIO DA SAUDE
INSTITUTO NACIONAL DE SAUDE
DEPARTAMENTO DE PARASITOLOGIA DE SANGUE

IMPLEMENTACAO DE REDES MOSQUITEIRAS IMPREGNADAS PARA A PREVENCAO DA MALARIA - BOANE

FICHA DE REGISTO DIARIO DO MOVIMENTO DE VENDA DE REDES

LOCAL DE VENDA________________ DATA___/___/___ RESPONSAVEL PELA VENDA________________

CONFERIDO PELA SECRETARIA________________ DATA___/___/___

N	No. de AGREG. FAM.	NOME DO CHEFE DO AGREGADO FAMILIAR	NOME DA PESSOA QUE COMPROU A REDE	SEXO	BAIRRO	QUA	No. CASA	No. TOTAL DE REDES	No REDES CASAL	No REDES SOLTEIR	REDE 1		REDE 2		REDE 3		VALOR TOTAL	OBSERV
											COR	TAMANHO	COR	TAMANHO	COR	TAMANHO		
1																		
2																		
3																		
4																		
5																		
6																		
7																		
8																		
9																		
10																		
11																		
12																		
13																		
14																		
15																		
16																		
17																		
18																		
19																		
20																		
	TOTAL																	

Appendix 4.7: Acceptability and usage of ITNs questionnaire (first page)

INSTITUTO NACIONAL DE SAÚDE
DEPARTAMENTO DE PARASITOLOGIA DE SANGUE

IMPLEMENTAÇÃO DE REDES MOSQUITEIRAS IMPREGNADAS PARA A PREVENÇÃO DA MALARIA – BOANE – 1998

INQUÉRITO SOBRE COBERTURA E ACEITAÇÃO DAS REDES TRATADAS COM INSECTICIDA NO DISTRITO DE BOANE – 1998

1.HORA DE INICIO..|__|__|.|__|__|

2.No. DA ORDEM..|________|

3.AGREGADO FAMILIAR No..|________|

4.DATA..___/___/___

5.BAIRRO..|________|

6.QUARTEIRÃO..|________|

7.No DA CASA..|________|

8.SEXO DO CHEFE DA FAMILIA (1.MASCULINO; 2.FEMININO)..|________|

9.NOME DO ENTREVISTADO..|________|

10.POSIÇÃO NA FAMILIA (EM RELAÇÃO AO CHEFE)..|________|

(1.chefe; 2:esposa; 3:irmão; 4:filho: 5:outro (especifique)..|________|

11. DATA DE NASCIMENTO DO ENTREVISTADO..___/___/___

12. CLASSE MAIS ALTA COMPLETADA..|________|

12.1 OUTROS (ESPECIFIQUE)..|________|

DADOS SOBRE A CASA

13. A SUA CASA É..|________|

1.PRÓPRIA; 2.ALUGADA A APIE; 3.ALUGADA A OUTREM; 4.OUTROS........|________|

14. TIPO DE PAREDE DA CASA PRINCIPAL..|________|

1.PALHOTA; 2.PAU A PIQUE; 3.PEDRA; 4.A;VENARIA; 5.OUTROS........... |________|

15.NÚMERO DE DIVISÕES DA CASA PRINCIPAL..|________|

16.NÚMERO DE QUARTOS DE DORMIR DA CASA PRINCIPAL..|________|

17.TEM LUZ ELETRICA..(1.SIM; 2.NAO)...|________|

18.TEM AGUA CANALIZADA..(1.SIM; 2.NAO)...|________|

19.TEM TELEVISÃO QUE FUNCIONA..(1.SIM; 2.NAO)...|________|

20.TEM RADIO QUE FUNCIONA..(1.SIM; 2.NAO)...|________|

21.TEM GELEIRA QUE FUNCIONA..(1.SIM; 2.NAO)...|________|

22.TEM BICICLETA PROPRIA DO AGREGADO QUE FUNCIONA..(1.SIM; 2.NAO)....|________|

23.TEM MOTORIZADA PROPRIA DO AGREGADO QUE FUNCIONA..(1.SIM; 2.NAO)...|________|

24.TEM VIATURA PROPRIA DO AGREGADO QUE FUNCIONA..(1.SIM; 2.NAO)...|________|

25.TEM TXOVA XITA DUMA (CARROCA)..(1.SIM; 2.NAO)...|________|

26.QUE TIPO DE RETRETE POSSUI A SUA CASA..|________|

(1:autoclismo; 2:latrina e usa; 3:latrina e não usa; 4:ar livre; 5:outro .... |________|

27.QUAL A RELIGIÃO QUE PROFESSA O CHEFE DO AGREGADO..|________|

Appendix 5.1: Willingness to pay questionnaire

INSTITUTO NACIONAL DE SAUDE

DEPARTAMENTO DE PARASITOLOGIA DE SANGUE

IMPLEMENTACAO DE REDES MOSQUITEIRAS IMPREGNADAS PARA A PREVENCAO DA MALARIA - BOANE - 1998

INQUERITO SOBRE RECEITAS E DESPESAS DOS AGREGADOS FAMILIARES DO DISTRITO DE BOANE - 1998.

1. HORA DO INICIO DA ENTREVISTA.. |__|__|.|__|__|
2. No. DA ORDEM .... |______|
3. AGREGADO FAMILIAR No.. |______|
4. DATA.. ___/___/___
5. BAIRRO.. |______|
6. QUARTEIRAO .... |______|
7. No. DE CASA .... |______|
8. SEXO DO CHEFE DA FAMILIA (1.MASCULINO: 2. FEMININ |______|
9. NOME DO ENTREVISTADO.. |______
10. POSICAO NA FAMILIA (EM RELACAO AO CHEFE)............ |______|
(1: chefe: 2:esposa; 3:irmao; 4:filho; 5:outro (especifique)
11. DATA DE NASCIMENTO DO ENTREVISTADO .... ___/___/___
12. CLASSE MAIS ALTA COMPLETADA .... |______|
12.1. OUTROS (ESPECIFIQUE) |______|

DADOS SOBRE A CASA

13. A SUA CASA E:.. |______|
1. PROPRIA: 2. ALUGADA A APIE; 3. ALUGADA A OUTREM; 4. OUTROS
14. TIPO DE PAREDE DA CASA PRINCIPAL.. |______|
1. PALHOTA: 2. PAU A PIQUE; 3. PEDRA; 4. ALVENARIA; 5. OUTROS (______________)
15. NUMERO DE DIVISOES DE CASA PRINCIPAL .... |______|
16. NUMERO DE QUARTOS DE DORMIR DA CASA PRINCIPAL .... |______|
17. TEM LUZ ELECTRICA.. (1. SIM; 2. NAO) |______|
18. TEM AGUA CANALIZADA.. (1. SIM; 2. NAO) |______|
19. TEM TELEVISAO QUE FUNCIONA.. (1. SIM; 2. NAO) . |______|
20. TEM RADIO QUE FUNCIONA.. (1. SIM; 2. NAO) . |______|
21. TEM GELEIRA QUE FUNCIONA.. (1. SIM; 2. NAO) |______|
22. TEM BICICLETA PROPRIA DO AGREGADO QUE FUNCIONA...........(1. SIM; 2. NAO)... |______|
23. TEM MOTORIZADA PROPRIA DO AGREGADO QUE FUNCIONA....(1. SIM; 2. |______|
24 TEM VIATURA PROPRIA DO AGREGADO QUE FUNCIONA...............(1. SIM; 2. |______|
24.1. TEM TXOVA XITA DUMA (CARROCA) ....(1. SIM; 2. NAO)... |______|
24.2. QUE TIPO DE RETRETE POSSUI A SUA CASA... |______|
(1:autoclismo; 2:latrina e usa; 3:latrina e nao usa; 4:ar livre; 5:outro______________)
24.3. QUAL A RELIGIAO QUE PROFESSA O CHEFE DO AGREGADO |______|

Gostaria de falar com o chefe da família e/ou com a esposa para saber alguns aspectos relacionados com redes mosquiteiras ou "muxiquitela".

Como sabe a malária é uma doença que pode matar.A malaria é transmitida pelo mosquito Uma das maneiras de evitar a malária é usar a rede mosquiteira tratada com insecticida.A rede mosquiteira tratada com insecticida mata e afugenta o mosquito que se aproxima da sua rede. Para que a rede mosquiteira tenha efeito as pessoas devem dormir debaixo de uma rede todas as noites para não serem picados pelo mosquito. Todas as pessoas da sua casa devem dormir numa rede mosquiteira. No entanto se as redes mosquiteiras não forem suficientes para todos, as crianças e as mulheres grávidas devem ter prioridade, porque são estas as pessoas que apanham mais malaria na sua família.

O Instituto Nacional de saude está a desenvolver um projecto de redes mosquiteiras tratadas para a populaçao de Boane. As redes mosquiteiras e o insecticida, bem como a propria venda das redes custa dinheiro. As pessoas devem comprar as redes para se prevenirem da picada dos mosquitos e da malaria.

Com este inquérito pretendemos saber qual é o valor máximo que as pessoas gostariam de pgar para ter uma rede mosquiteira tratada com insecticida em sua casa.

Gostaria em primeiro lugar saber alguns aspectos relacionados consigo e sua familia."

24.4 Quantas pessoas (de todas as idades) vivem nesta casa .... |___|

24.5 Quantas dessas pessoas (de ambos os sexos) tem menos de 5 anos de idade?........................ |______|

24.6 Quantas dessas pessoas (de ambos os sexos) tem mais de 5 anos de idade?........................ |_____|

(controlador. confirme os totais)

24.7 Desde que ano a sua família vive nesta casa?.. |_____|

24.8 Quantas redes mosquiteiras a sua família possui até hoje.. |___|

24.9 Quantas redes mosquiteiras a sua família comprou no programa de venda de Boane. ....|___|

24.10 Data da compra da primeira rede..|__/__/__|

24.11 Quanto pagou pela primeira rede mosquiteira comprada em Boane..............|________________|

I. DISPONIBILIDADE PARA PAGAR A PRIMEIRA REDE MOSQUITEIRA DO TAMANHO CASAL

Agora gostaríamos de perguntar qual seria o valor máximo que voce estaria disposto para pagar para comprar a sua primeira rede mosquiteira casal.

DIGA AGORA:

24.12 Estaria disposto a pagar 150.000,00 meticais para comprar uma rede mosquiteira? .... [____]
(1: sim; 2: Nao; 3: hesitante; 4: nao sabe)

24.13 Estaria disposto a pagar 90.000,00 meticais para ter uma rede mosquiteira? .... [____]
(1: sim; 2: Nao; 3: hesitante; 4: nao sabe)

24.14 Estaria entao disposto a pagar 65.000,00 meticais para ter uma rede mosquiteira? .... [____]
(1: sim; 2: Nao; 3: hesitante; 4: nao sabe)

24.15 Porque é que nao gostaria de pagar nenhum dos valores acima mencionados? .... [____]
1 não têm dinheiro
2 E muito caro
3 Quem sabe é o marido
4. É pobre
5 Outros..[________________________]

24.16 Entao qual é o máximo de que gostaria de pagar? .... [________]

24.17 SE COMPROU UMA REDE POR 65.000MT E NÃO QUER PAGAR OUTRA VEZ, JUSTIFIQUE PORQUÊ.....[________________________]

24.18 SE NÃO COMPROU UMA REDE POR 65.000MT E QUER PAGAR PELO MENOS 65.000,00MT, JUSTIFIQUE PORQUÊ NAO COMPROU AINDA A REDE....[________________________]

24.19 PORQUE PRETENDE COMPRAR UMA REDE MOSQUITEIRA..[________________________]

II. DISPONIBILIDADE PARA PAGAR A SEGUNDA E OUTRAS MAIS REDES MOSQUITEIRAS CASAIS

Agora gostaríamos de perguntar qual seria o valor máximo que voce estaria disposto para pagar para comprar a sua segunda e outras mais redes mosquiteiras casais

DIGA AGORA:

24.20 Entao qual é o máximo de que gostaria de pagar por uma segunda ou mais redes mosquiteiras?, [________]

24.21 SE COMPROU UMA REDE POR 65.000MT E NÃO QUER PAGAR OUTRA VEZ, JUSTIFIQUE PORQUÊ.....[________________________]

24.22. PORQUE PRETENDE COMPRAR A SEGUNDA REDE MOSQUITEIRA..[________________________]

III: REIMPREGNAÇÃO DA SUA REDE MOSQUITEIRA

Agora gostariamos de falar sobre a reimpregnação da sua rede mosquiteira. Como sabe as suas redes são impregnadas com um insecticida que serve para matar e afastar os mosquitos da rede. As suas redes devem ser reimpregnadas pelo menos uma vez por ano durante antes da época das chuvas. Tambem devem ser impregnadas sempre que elas forem lavadas, porque ao lavar as suas redes o insecticida desaparece e a rede deve ser novamente reimpregnada. O insectida e a operação para reimpregnar as suas redes custam dinheiro e as pessoas com rede mosquiteira devem pagar os custos referentes a reimpregnação.

24.23 Quantas redes mosquiteiras a sua familia possui hoje.. [____]

24.24 Quantas redes a sua familia reimpregonou este ano.........[____]

IV. DISPONIBILIDADE PARA PAGAR A REIMPREGNAÇÁO DA PRIMEIRA REDE MOSQUITEIRA

Agora gostariamos de perguntar qual seria o valor máximo que voce estaria disposto para pagar para reimpregnar a sua primeira rede mosquiteira.

DIGA AGORA:

24.25 Estaria disposto a pagar 15.000,00 meticais para reimpregnar a sua primeira rede mosquiteira?....... [____]
(1: sim; 2: Nao; 3: hesitante; 4: nao sabe)

24.26 Estaria disposto a pagar 10.000,00 meticais para reimpregnar a sua primeira rede mosquiteira?....... [____]
(1: sim; 2: Nao; 3: hesitante; 4: nao sabe)

24.27 Estaria entao disposto a pagar 5.000,00 meticais para reimpregnar a sua primeira rede mosquiteira? [____]
(1: sim; 2: Nao; 3: hesitante; 4: nao sabe)

24.28 Porque é que nao gostaria de pagar nenhum dos valores acima mencionados?.................................. [____]
1 Nao tem dinhiro
2 E muito caro
3 Quem sabe é o marido
4 Outros [____________________]

24.29 Entao qual é o máximo de que gostaria de pagar?[__________]

24.30 SE REIMPREGNOU UMA REDE POR 5.000MT E NÃO QUER PAGAR OUTRA VEZ, JUSTIFIQUE PORQUÊ.....[______________________________]

24.31 SE NAO REIMPREGNOU UMA REDE POR 5.000MT E QUER PAGAR JUSTIFIQUE PORQUÊ NAO REIMPREGNOU.....[______________________________]

24.32 PORQUE PRETENDE REIMPREGNAR A SUA REDE MOSQUITEIRA.[______________________________]

Agora gostariamos de perguntar qual seria o valor máximo que voce estaria disposto para pagar para reimpregnar a sua segunda e outras mais redes mosquiteiras.

DIGA AGORA:

24.33 Entao qual é o máximo de que gostaria de pagar para reimpregnar a sua segunda e outras mais redes mosquiteiras?.. [______]

24.34 SE REIMPREGNOU A SUA REDE POR 5.000MT E NÃO QUER PAGAR OUTRA VEZ, O MESMO VALOR JUSTIFIQUE PORQUÊ....[________________________________]

24.33 QUEM SAO OS MEMBROS DO SEU AGREGADO FAMILIAR

PRIMEIRO NOME	SEXO	DATA NASC	N. EDUC	OCUPAÇÃO	DORME NA REDE (SIM/NAO)	PARENTESCO (CHEFE)
1.A[__________]	1.B[__]	1.C[__/__/__]	1.D[____]	1.E[______________]	1.F[______]	1.G[______]
2.A[__________]	2.B[__]	2.C[__/__/__]	2.D[____]	2.E[______________]	2.F[______]	2.G[______]
3.A[__________]	3.B[__]	3.C[__/__/__]	3.D[____]	3.E[______________]	3.F[______]	3.G[______
4.A[__________]	4.B[__]	4.C[__/__/__]	4.D[____]	4.E[______________]	4.F[______]	4.G[______]
5.A[__________]	5.B[__]	5.C[__/__/__]	5.D[____]	5.E[______________]	5.F[______]	5.G[______]
6.A[__________]	6.B[__]	6.C[__/__/__]	6.D[____]	6.E[______________]	6.F[______]	6.G[______]
7.A[__________]	7.B[__]	7.C[__/__/__]	7.D[____]	7.E[______________]	7.F[______]	7.G[______]
8.A[__________]	8.B[__]	8.C[__/__/__]	8.D[____]	8.E[______________]	8.F[______]	8.G[______]
9.A[__________]	9.B[__]	9.C[__/__/__]	9.D[____]	9.E[______________]	9.F[______]	9.G[______]
10.A[__________]	10.B[__]	10.C[__/__/__]	10.D[____]	10.E[______________]	10.F[______]	10.G[______]
11.A[__________]	11.B[__]	11.C[__/__/__]	11.D[____]	11.E[______________]	11.F[______]	11.G[______]
12.A[__________]	12.B[__]	12.C[__/__/__]	12.D[____]	12.E[______________]	12.F[______]	12.G[______]
13.A[__________]	13.B[__]	13.C[__/__/__]	13.D[____]	13.E[______________]	13.F[______]	13.G[______]
14.A[__________]	14.B[__]	14.C[__/__/__]	14.D[____]	14.E[______________]	14.F[______]	14.G[______]
15.A[__________]	15.B[__]	15.C[__/__/__]	15.D[____]	15.E[______________]	15.F[______]	15.G[______]
16.A[__________]	16.B[__]	16.C[__/__/__]	16.D[____]	16.E[______________]	16.F[______]	16.G[______]
17.A[__________]	17.B[__]	17.C[__/__/__]	1.D[____]	17.E[______________]	17.F[______]	17.G[______]

RECEITAS DO AGREGADO FAMILIAR NO ULTIMO MES (Todos os maiores de 18 anos)

25. NUMERO TOTAL DE MEMBROS DO AGREGADO FAMILIAR .... |___|___|
26. NUMERO TOTAL DE MEMBROS DO AGREGADO FAMILIAR QUE TRABALHAM COM RENUMERACAO NO MES ANTERIOR..................... |___|___|
27. NUMERO TOTAL DE MEMBROS COM MAIS DE 18 ANOS .... |___|

INFORMACAO SOBRE A OCUPACAO E O SALARIO NA ULTIMA SEMANA (TODOS MAIORES DE 18 ANOS E OS MENORES QUE TRABALHAREM)

OCUPACAO PRINCIPAL

	28 NOME	29. SEXO (1=MASC 2=FEM)	30 DATA DE NASCIM	31. CLASSE MAIS ALTA ATINGIDA	32. SITUACAO NA ULTIMA SEMANA	33. QUANTO GASTOU EM TRANSPORTE DURANTE A SEMANA PARA SE DESLOCAR AO SERVICO (MTS)	34 OCUPACAO PRINCIPAL	35. ONDE REALIZOU A ACTIVIDADE NA ULTIMA SEMANA	36. SALARIO MENSAL (MTS)
					1.TRABALHOU 2.CONTA PROP 3.DESEMPREG 4.REFORMADO 5.DOMESTIC 6.ESTUDANTE 7.DESMOBILIZADO 8.FERIAS 9.OUTROS		Ex: ENFERMEIRO, PROFESSOR, PADRE, CANALIZADOR, ETC	1.CASA 2.RUA 3.MACHAMBA 4.SERV PUB 5.PRIVADO 6.FABRICA 7.OUTROS	
1									
2									
3									
4									
5									
6									
7									

SEGUNDA OCUPACAO

	37 NOME	38. SEXO (1=MASC 2=FEM)	39 DATA DE NASCIM	40. CLASSE MAIS ALTA ATINGIDA	41. SITUACAO NA ULTIMA SEMANA	42. QUANTO GASTOU DURANTE A SEMANA PARA SE DESLOCAR AO SERVICO (MTS)	43 SEGUNDA OCUPACAO	44. ONDE REALIZOU A ACTIVIDADE NA ULTIMA SEMANA	45. SALARIO MENSAL (MTS)
					1.TRABALHOU 2.CONTA PROP 3.DESEMPREG. 4.REFORMADO 5. DOMESTIC 6.ESTUDANTE 7.DESMOBILIZADO 8.FERIAS 9.OUTROS		Ex: ENFERMEIRO, PROFESSOR, PADRE, CANALIZADOR, ETC	1.CASA 2.RUA 3.MACHAMBA 4.SERV PUB 5.PRIVADO 6.FABRICA 7.OUTROS	
1									
2									
3									
4									

TERCEIRA OCUPACAO

	46 NOME	47. SEXO (1=MASC 2=FEM)	48 DATA DE NASCIM	49. CLASSE MAIS ALTA ATINGIDA	50. SITUACAO NA ULTIMA SEMANA	51. QUANTO GASTOU DURANTE A SEMANA PARA SE DESLOCAR AO SERVICO (MTS)	52 TERCEIRA OCUPACAO	53. ONDE REALIZOU A ACTIVIDADE NA ULTIMA SEMANA	54. SALARIO MENSAL (MTS)
					1.TRABALHOU 2.CONTA PROP 3.DESEMPREG. 4.REFORMADO 5. DOMESTIC 6.ESTUDANTE 7.DESMOBILIZADO 8.FERIAS 9.OUTROS		Ex: ENFERMEIRO, PROFESSOR, PADRE, CANALIZADOR, ETC	1.CASA 2.RUA 3.MACHAMBA 4.SERV PUB 5.PRIVADO 6.FABRICA 7.OUTROS	
1									
2									
3									

55. O SEU AGREGADO FAMILIAR TEM MACHAMBA ....(1. SIM; 2. NAO)....[___]
SE SIM CONTINUA COM A PERGUNTA SEGUINTE, SE NAO, SALTA PARA A PERGUNTA.....76

56. QUANTAS MACHAMBAS POSSUI O AGREGADO FAMILIAR ....[___]

57. LOCAL DE MACHAMBA)	58. QUANTAS PESSOAS TRABALHARAM NA MACHAMBA NA ULTIMA CAMPANHA AGRICOLA	59. TIPO DE POSSE DE TERRA	60. CONDICOES DE CULTIVO	61. QUAL FOI USO DESTA MACHAMBA NOS ULTIMOS 12 MESES
		Cedida pelas autoridades tradicionais.....1 Cedida pelas autoridades formais ....2 Cedida por parentes..............................3 Arrendada...4 Emprestada..5 Ocupada..6 Comprada ....7 Herdada..8	Sequeiro.......1 Regadio.......2	Cultivada.........1 Pousio............2 Pastagem.........3 Abandonada.....4 Outros.......5
1				
2				
3				
4				

NB: ULTIMA CAMPANHA AGRICOLA: OUTUBRO/96-JUNHO/97

62. FEZ CULTURAS DE HORTICULAS DURANTE O ULTIMO ANO (1. SIM; 2. NAO)..........................

SE SIM CONTINUE COM A PERGUNTA SEGUINTE; SE NAO SALTE PARA A PERGUNTA..69

	63. DE HORTICULAS TIPO	64. MES/ANO DO FIM DA ULTIMA COLHEITA	65 NUMERO DE CANTEIROS	66. QUANTIDADE COLHIDA (Kg) NA ULTIMA EPOCA DE COLHEITA	67. QUANTIDADE VENDIDA (Kg) NA ULTIMA EPOCA DE COLHEITA	68. VALOR RECEBIDO PELA VENDA (MTS) NA ULTIMA EPOCA DE COLHEITA
1						
2						
3						
4						
5						
6						
7						

69. FEZ CULTURAS BASICAS E DE RENDIMENTOS DURANTE O ULTIMO ANO(1. SIM, 2 NAO).....

SE SIM CONTINUE COM A PERGUNTA SEGUINTE; SE NAO SALTE PARA A PERGUNTA 76

	70. DE CULTURAS BASICAS TIPO staples	71. MES/ANO DO FIM DA ULTIMA COLHEITA	72. NUMERO DE SACOS	73. QUANTIDADE COLHIDA (Kg) NA ULTIMA EPOCA DE COLHEITA	74. QUANTIDADE VENDIDA (Kg) NA ULTIMA EPOCA DE COLHEITA	75. VALOR RECEBIDO PELA VENDA (MTS) NA ULTIMA EPOCA DE COLHEITA
1						
2						
3						
4						
5						
6						

76. TEVE ARVORES DE DE FRUTA DURANTE O ULTIMO ANO(1. SIM; 2. NAO)........................ |___|

SE SIM CONTINUE COM A PERGUNTA SEGUINTE; SE NAO SALTE PARA A PERGUNTA.......81

	77. DE ARVORES DE FRUTA TIPO	[redacted]	NUMERO TOTAL DE ARVORES A PRODUZIREM	78. QUANTIDAE COLHIDA (Kg)	79. QUANTIDADE VENDIDA (Kg)	80. VALOR RECEBIDO PELA VENDA (MTS)
1						
2						
3						
4						
5						

ESPECIFIQUE AS DESPESAS EFECTUADAS COM A MACHAMBA NA ULTIMA EPOCA AGRICOLA |

PERIODO DE GASTOS: 81.INICIO : 1. MES ________ 2. ANO ________ 82.FIM : 1.MES ________ 2. ANO ________	VALOR (MTS)
83. SEMENTES OU PLANTAS	
84. FERTILIZANTES (Adubo, Estrume.Quimicos)	
85. SACOS, LATAS etc.	
86. PAGAMENTO AOS TRABALHADORES	
87. COMBUSTIVEL OU LUBRIFICANTES	
88. COMPRA DE INSTRUMENTOS AGRICOLAS	
89. GASTOS COM LAVOURA (TRACTOR, BOIS, ETC.)	
90. ARRENDAMENTO DAS TERRAS	
91. TRANSPORTE	
92. AGUA	
93. OUTROS (ESPECIFIQUE)	
94. OUTROS (ESPECIFIQUE)________________	
95.OUTROS (ESPECIFIQUE)	

PRODUCAO ANIMAL

96. NOS ULTIMOS 12 MESES O AGREGADO FAMILIAR TEVE ANIMAIS OU AVES? (Sim..1, Nao...2).. [ ]

SE SIM CONTINUA COM A PERGUNTA SEGUINTE, SE NAO SALTA PARA A PERGUNTA.....108

97. QUAIS DOS SEGUINTES ANIMAIS TEVE O AGREGADO NO PERIODO ESPECIFICADO	1. SIM; 2. NAO	98. QUANTOS ANIMAIS TEM HOJE	99. QUANTOS COMPROU DURANTE O PERIODO ESPECIFICADO	100. QUANTO GASTOU PARA OS COMPRAR (MTS)	101. QUANTOS VENDEU DURANTE O PERIODO ESPECIFICADO	102. POR QUANTO VENDEU (MTS)
1. BOVINO (12 meses)						
2. CAPRINO (6 meses)						
3. OVINO (6meses)						
4. SUINO (6 meses)						
5. COELHOS (3 meses)						
6. GALINHAS (1 mes)						
7. PATOS (1 mes)						
8..................................						
9..................................						
10.						
11....................................						

INDIQUE AS DESPESAS QUE O AGREGADO FAMILIAR EFECTUOU NOS ULTIMOS 12 MESES COM A PRODUCAO ANIMAL

QUANTO GASTOU COM A PRODUCAO ANIMAL NOS ULTIMOS 12 MESES (VALORS EM MTS)

102 ALIMENTOS PARA ANIMAIS	103 SERVICOS VETERINARIOS	104 PRODUTOS VETERINARIOS	105 PAGAMENTO DE TRABALHADORES	106 OUTROS (ESPECIFIQUE)	107 OUTROS (ESPECIFIQUE) ____________

OUTRO TIPO DE RECEITAS

DURANTE O ULTIMO MES O SEU AGREGADO RECEBEU DINHEIRO DAS SEGUINTES ACTIVIDADES?

ITEM	1. SIM; 2. NAO	1. ESPECIFIQUE	2.QUANT. VENDIDA (ESPECIFIQUE A UNIDADE DE MEDIDA)	3. VALOR GASTO NA PRESTACAO DO SERVICO (MTS)	4. VALOR RECEBIDO (MTS)	5. VALOR DO LUCRO (MTS)
108. VENDA DE BEBIDAS TRADICIONAIS						
109. VENDA DE BEBIDAS TRADICIONAIS						
110. VENDA NO DUMBA NENGUE; ESQUINA OU MERCADO						
111. PESCA						
112. OUTROS (ESPECIF)						
113. OUTROS(ESPECIF)						

DURANTE NOS **ULTIMOS 12 MESES** O SEU AGREGADO RECEBEU DINHEIRO DAS SEGUINTES ACTIVIDADES?

BENS OU SERVICOS	1. SIM; 2. NAO	1. PERIODICIDADE ANUAL	2.VALOR
114 VENDA DE CASA			
115. VENDA DE VIATURA			
116. VENDA DE TERRENO			
117. REEMBOLSOS DE EMPRESTIMOS			
118. GANHO DE LOTARIA OU TOTOBOLA			
119 DINHEIRO DE UM FAMILIAR NA AFRICA DO SUL			
120. XITIQUE			
121. OUTROS (ESPEC)			
122. OUTROS (ESPEC.)			

DESPESAS DO AGREGADO FAMILIAR

HABITACAO E COMBUSTIVEIS DURANTE O ULTIMO MES

INDIQUE AS DESPESAS EFECTUADAS NA HABITACAO DURANTE O ULTIMO MES PELO SEU AGREGADO

BENS OU SERVICOS	1.QUANT.	2.VALOR UNITARIO	3.VALOR TOTAL
123. AGUA			
124. GAZ			
125. ELECTRICIDADE			
126. CARVAO			
127. LENHA			
128. PETROLEO			
129. VELAS			
130. RENDA DE CASA			
131. TELEFONE			
132			
133			

TRANSPORTE DURANTE O ULTIMO MES

INDIQUE AS DESPESAS EFECTUADAS DURANTE O ULTIMO MES PELO SEU AGREGADO EM TRANSPORTE

TRANSPORTE	1.QUANT.	2. VALOR UNITARIO	3. VALOR TOTAL
134. TRANSPORTE PUBLICO (Machibombo)			
135. TRANSPORTE (CHAPA 100)			
136. COMBOIO			
137. TCHOVA CHITA DUMA			
138			
139			

RECREACAO DURANTE O ULTIMO MES

INDIQUE AS DESPESAS EFECTUADAS DURANTE O ULTIMO MES PELO SEU AGREGADO EM RECREACAO

RECREACAO	1. QUANT.	2. VALOR UNITARIO	3. VALOR TOTAL
140. CINEMA			
141. ESPECTACULOS ARTISTICOS			
142. JOGOS DESPORTIVOS			
143 BARRACAS			
144. DISCOTECAS			
145			
146			

DESPESAS COM VESTUARIO DURANTE OS ULTIMOS 3 MESES

147. DURANTE OS ULTIMOS 3 MESES O SEU AGREGADO GASTOU DINHEIRO NO VESTUARIO? (1.SIM; 2NAO)____
SE SIM CONTINUE COM A PERGUNTA SEGUINTE; SE NAO SALTE PARA A PERGUNTA....168

148. GASTOU DINHEIRO EM VESTUARIO PARA HOMEM ....(1. SIM; 2.NAO) ....|______|
SE SIM CONTINUE COM A PERGUNTA SEGUINTE SE NAO SALTE PARA A PERGUNTA......155

ROUPA PARA HOMEM (ESPECIFIQUE O TIPO)	1. QUANT.	2.VALOR UNITARIO	3. VALOR TOTAL
149			
150			
151			
152			
153			
154			

155. GASTOU DINHEIRO EM VESTUARIO PARA MULHER ....(1. SIM; 2.NAO) ....|______|
SE SIM CONTINUE COM A PERGUNTA SEGUINTE SE NAO SALTE PARA A PERGUNTA......162

ROUPA PARA MULHER (ESPECIFIQUE O TIPO)	1.QUANT.	2.VALOR UNITARIO	3. VALOR TOTAL
156			
157			
158			
159			
160			
161			

162. GASTOU DINHEIRO EM VESTUARIO PARA CRIANCA ....(1. SIM; 2.NAO) ....|______|
SE SIM CONTINUE COM A PERGUNTA SEGUINTE SE NAO SALTE PARA A PERGUNTA......168

ROUPA PARA CRIANCA (ESPECIFIQUE O TIPO)	1. QUANT.	2. VALOR UNITARIO	3. VALOR TOTAL
163			
164			
165			
166			
167			

16

INSTRUCAO E EDUCACAO NOS ULTIMOS 3 MESES

168. DURANTE OS ULTIMOS 3 MES O SEU AGREGADO GASTOU DINHEIRO NA INSTRUCAO E EDUCACAO?
(1. Sim; 2. Nao) [ ]

Se Sim continua com a pergunta seguinte, se Nao salta para pergunta ...178

BENS OU SERVICOS	1. QUANT.	2. VALOR UNITARIO	3. VALOR TOTAL
169. LIVROS ESCOLARES			
170. LIVROS NAO ESCOLARES			
171. JORNAIS			
172. REVISTAS			
173. CANETA, LAPIS etc.			
174. CADERNOS			
175. PROPINAS			
176			
177			

178. DURANTE OS ULTIMOS 3 MESES O SEU AGREGADO GASTOU DINHEIRO COM A COMPRA DE UTENSILOS DOMESTICOS?
(1. Sim; 2. Nao) [ ]

Se Sim continua com a pergunta seguinte, se Nao salta para pergunta 186

BENS OU SERVICOS	1. QUANT.	2. VALOR UNITARIO	3. VALOR TOTAL
179. PRATOS			
180. COPOS			
181. GARFOS, FACAS, COLHERES			
182. PANELAS			
183			
184			
185			

DESPESAS COM HABITACAO, MOBILARIO E VEICULOS DURANTE OS ULTIMOS 12 MESES

186. EFECTUOU DURANTE OS ULTIMOS 12 MESES DESPESAS COM HABITACAO (COMO POR EXEMPLO: COMPRA DE HABITACAO; REPARACAO; PINTURA; E (1.SIM; 2.NAO).|____|

Se Sim continua com a pergunta seguinte, se Nao salta para pergunta 191

TIPO DE BENS OU SERVICOS	1.QUANT.	2. VALOR UNITARIO (MTS)	3. VALOR TOTAL (MTS)
187			
188			
189			
190			

191. EFECTUOU DESPESAS COM MOBILARIO (ex. COMPRA DE MOBILIA, REPARACAO etc.) (1. Sim; 2. Nao) |____|

Se Sim continua com a pergunta seguinte, se Nao salta para pergunta 195

TIPO DE BENS OU SERVICOS	1.QUANT.	2. VALOR UNITARIO (MTS)	3. VALOR TOTAL (MTS)
192			
193			
194			

195. EFECTUOU DESPESAS COM VEICULOS (ex. COMPRA DE VIATURA, BICICLETA, REPARACAO etc.) (1. Sim; 2. Nao) |____|

Se Sim continua com a pergunta seguinte, se Nao salta para pergunta 199

TIPO DE BENS OU SERVICOS	1. QUANT.	2. VALOR UNITARIO (MTS)	3. VALOR TOTAL (MTS)
196			
197			
198			

199. DURANTE OS ULTIMOS 12 MESES ALGUEM DO AGREGADO EFECTOU DESPESAS COM PAGAMENTO A OUTRAS PESSOAS OU GRUPOS SOCIAIS? (1. SIM; 2. NAO) |____|

Se SIM continua com a pergunta seguinte; se NAO, salta para a pergunta 204

TIPO DE PAGAMENTO	1. SIM 2. NAO	1. PERIODICIDADE	2.QUANTO PAGOU (MTS)
200. CONTRIBUICAO PARA CLUBES OU ASSOCIACOES			
201. XITIQUE			
202 (OUTROS)..			
203. (OUTROS)..			

SAUDE

201. DURANTE OS ULTIMOS 3MESES ESTEVE DOENTE OU ALGUEM DO SEU AGREGADO ESTEVE DOENTE? (1. Sim; 2. Nao) [____]
SE SIM CONTINUE NA PERGUNTA SEGUINTE, SE NAO SALTA PARA 236

205. QUANTAS PESSOAS ESTIVERAM DOENTES .... [____]

INFORMACOE : SOBRE DESPESAS COM A DOENCA (EM MTS)

	1. DOENTE 1	2. DOENTE 2	3. DOENTE3	4. DOENTE 4	5. DOENTE 5	6.DOENTE6
206. DATA DE NASCIM	/ /	/ /	/ /	/ /		
207. SEXO (1=MASC; 2=FEM)						
208. DOENCA (ESPECIFIQUE)						
209. QUANTAS VEZES ADOECEU						
210. PRIMEIRO LOCAL ONDE SE DIRIGIU PARA CONSULTA (CASA, C.SAUDE, IGREJA, CURANDEIRO, ETC.)						
211. SEGUNDO LOCAL ONDE SE DIRIGIU PARA CONSULTA (CASA, C.SAUDE, IGREJA, CURANDEIRO, ETC.)						
212. GASTOS NA CONSULTA NO SERVICO PUBLICO (ONDE___						
213. GASTOS NO INTERNAMENTO NO SERVICO PUBLICO (ONDE___						
214. GASTOS COM MEDICAMENTOS (ONDE___						
215. GASTOS COM LABORATORIO (ONDE___						
216. GASTOS COM CLINICA PRIVADA (ONDE___						
217. GASTOS COM CURANDEIRO___						
218. DESPESA COM TRANSPORTE PARA O TRATAMENTO						
219. DESPESAS COM ALIMENTACAO NO HOSPITAL (ONDE___						
220. TEMPO GASTO PARA CHEGAR A CONSULTA						
221. TEMPO DE ESPERA NA CONSULTA						

222. ALGUEM DO SEU AGREGADO COM MAIS DE 18 ANOS NAO TRABALHOU POR CAUSA DE DOENCA DURANTE OS ULTIMOS 3 MESES (1.SIM: 2.NAO)............................|______|

SE SIM CONTINUE COM A PERGUNTA SEGUINTE; SE NAO SALTE PARA A PERGUNTA.........229

EM RELACAO AO DOENTE (SO PARA DOENTES COM MAIS DE 18 ANOS)

223. DATA DE NASC	224. SEXO (1=M 2=FE	225. PROFISSAO	226. DIAGNOSTICO	227. No. DIAS EM QUE FICOU DOENTE	228. No. DIAS QUE NAO TRABALHOU POR CAUSA DA DOENCA
1					
2					
3					

229. O DOENTE TEVE ALGUEM QUE NAO TRABALHOU PARA ESTÁR COM ELE (1.SIM; 2.NAO) ..|______|

SE SIM CONTINUE COM A PERGUNTA SEGUINTE; SE NAO SALTE PARA A PERGUNTA.....236

230 DATA DE NASC	231. SEXO (1=M 2=FE)	232. PROFISSAO	233. No. DIAS QUE NAO TRABALHOU POR CAUSA DA DOENCA DO ACOMPANHADO		234. No PERIODOS DE DIA QUE NAO TRABALHOU POR CAUSA DA DOENCA DO ACOMPANHADO	235. RELACAO FAMILIAR EM RELACAO AO DOENTE
1						
2						

PREVENÇAO DA MALARIA

236. O SEU AGREGADO EFECTOU DESPESAS COM A PREVENCAO DA MALARIA DURANTE O ULTIMO MES (1:SIM; 2:NAO) ....|______|

SE SIM CONTINUA COM A PROXIMA PERGUNTA, SE NAO SALTE PARA A PREGUNTA 241

PRODUTO	1. QUANTIDADE COMPRADA	2. QUANTIDADE ACTUAL PRESENTE NO AGREGADO (OBSERVAR)	3. CUSTO/UNIDADE (MTS)	4. CUSTO TOTAL (MTS)	QUEM DORME NA REDE (PAI, MAE, FILHO, ETC.)
237. INSECTICIDA (LATA)					
238. SERPENTINA					
239 REDE MOSQUITEIRA (VERIFICAR NO CARTAO)					
OUTRAS					
240					

DESPESAS COM ALIMENTAÇAO

DURANTE O ULTIMO MES QUANTO GASTOU O AGREGADO NA ALIMENTAÇAO:

		1.QUANTIDADE COMPRADA NO MES ANTERIOR	2.VALOR UNITARIO	3.VALOR TOTAL NO FIM DO MES
241	PAO			
242	ACUCAR			
243	CHA			
244	LEITE			
245	BOLACHAS			
246	OVOS			
247	MANTEIGA			
248	BATATA DOCE			
249	MANDIOCA			
250	ARROZ			
251	FARINHA DE MILHO			
252	MASSA ALIMENTICIA (ESPARGUETE)			
253	CARNE DE VACA			
254	CARNE DE CABRITO			
255	CARNE DE GALINHA			
256	PEIXE			
257	FOLHA DE ABOBORA			
258	FOLHA DE FEIJAO			
259	FEIJAO VERDE			
260	FEIJAO NHEMBA			
261	FEIJAO MANTEIGA			
262	QUIABO (MANDANDA)			
263	AMENDOIM			
264	OLEO DE COZINHA			
265	SAL			
266	LARANJA			
267	TANJERINA			
268	BANANA			
269	MACA			
270	TOMATE			
271	ALFACE			
272	REPOLHO			
273	COUVE			
274	PIMENTA			
275	ALHO			
276	CEBOLA			
277	BATATA RENO (COMUM)			
278				
279				
280				

N.B: DEVE PREENCHER CADA ITEM

DESPESAS COM BEBIDAS

DURANTE O ULTIMO MES QUANTO GASTOU O SEU AGREGADO EM BEBIDAS:

		QUANTIDADE COMPRADA NO MES ANTERIOR	VALOR UNITARIO	VALOR TOTAL NO FIM DO MES
281	REFRESCOS			
282	SUMOS			
283	CERVEJA			
284	VINHO			
285	AGUARDENTE			
286	CHIVEMO			
287				
288				

N.B: DEVE PREENCHER CADA ITEM

289. HORA DO FIM DA ENTREVISTA ....|__|__|:|__|__|

290. O ENTREVISTADOR....|______________________|

NO FINAL DA ENTREVISTA AGRADECE O ENTREVISTADO PELA COLABORAÇAO