DESIGN AND ACCEPTABILITY OF A MODIFIED INSECTICIDE TREATED NET FOR MALARIA CONTROL IN SEASONAL MIGRANT FARMERS IN IKWIRIRI, RUFIJI DISTRICT, TANZANIA

BY

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A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT FOR THE DEGREE OF MASTER OF PUBLIC HEALTH (MPH) OF THE UNIVERSITY OF DAR ES SALAAM

2000

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Certification

The undersigned certify that he has read and hereby recommend for acceptance by the University of Dar es Salaam dissertation titled "DESIGN AND ACCEPTABILITY OF A MODIFIED INSECTICIDE TREATED NET FOR MALARIA CONTROL IN SEASONAL MIGRANT FARMERS IN IKWIRIRI, RUFIJI DISTRICT, TANZANIA" in partial fulfillment of the requirements for the degree of master of Public health (MPH)

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DECLARATION

I hereby declare that this dissertation is my original work and this is the first time it is being presented for a degree to this University.

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DEDICATION:

In loving memory of my revered father,

(The fountain of inspiration)

Mzee Wilson Kasesela Tongorah Eseko (mzee Masatu)

(1922 to 25th May 2000).

ABSTRACT

An explorative study on design and acceptability of modified ITNs for seasonal migratory farmers was conducted in the Rufiji flood plains, Ikwiriri Ward, Rufiji District, Tanzania from June to July 2000. The study involved initial situation analysis in the flood plains in December 1999 to assess whether the migratory farmers would accept the use of modified ITNs (shamba nets) in their relatively smaller temporary houses to replace the traditional sleeping bag (*mtuti*) and smoking of the traditional repellents in their temporary houses which are so porous that they do not bar mosquitoes from entering the houses for their blood meals. Burning of the mosquito repellents in the shamba houses is dangerous since the whole thatch-house can catch fire and end up in disaster in terms of human life and economic and agricultural produce.

The main objectives of the study was to design modified shamba ITNs and determine factors that are associated with acceptability among the seasonal migratory farmers in Ikwiriri. The study revealed that 33.3% of the study population are women in the childbearing age and 60.8% of the households in the flood plains had at least one underfive child. Although migration to the flood plains corresponds with the rainy season and the peaking up of mosquito densities, only11.8% of households have ever used nets in their permanent houses before.

In this study, 54.9% of the studied population had formal education which was found to have no significant influence on the use of ITNs to prevent malaria. 96.1% of the participants identified malaria as the major health problem, and 84.3% of the participants knew that mosquito densities increased during rainy seasons, the time when malaria episodes peaks up.

About 91.25% knew that malaria was transmitted through mosquito bites, nevertheless less than 1% were aware that not all types of mosquitoes transmit malaria.

In this study, though there is dual use of medical care, 98% consult health facilities or go to drug shops first when they get sick from malaria. The study revealed that 64.7% of the population used the traditional sleeping bag (*mtuti*) and the rest used traditional repellents to protect themselves from mosquito bites. After experiencing the shamba ITNs, knowledge about ITNs effectiveness increased to 85.3% from 0% at the start.

Preference for colours revealed that 53.9% of the population prefer green, 24.5% blue, and only 9.8% do prefer white coloured nets. About 76.5% became aware that nets need a regular three monthly retreatment for optimal effectiveness against mosquitoes. About 78.4% of the population preferred household net treatment and 15.7% communal dipping, the rest being indifferent.

Findings from this study show that the 99% of the farmers accepted the because: they demonstrated mosquito repellent effects, the shamba ITNs fitted the shamba houses sleeping places, vision is not compromised, can have a dual use in the homes and in the permanent homes and are relatively cheaper. So the shamba ITNs have demonstrated that they are potential essential public health goods, which are cost effective in prevention of malaria which should be made suistainably readily available (going to scale) especially in population at great risk of malaria.

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ACRONYMS AND ABREVIATIONS.

BC	Before Christ.
DALYS	Disability adjusted life years.
DDT	Diethyl Diethnomide.
DFID	Department for International Development (UK).
DHMT	District Health Management Team.
IDRC	International Development Research Centre.
ITNs	Insecticide Treated Nets.
MARA	Malaria Risk in Africa.
MCH	Maternal and Child Health.
MOH	Ministry of Health.
PAHO	Pan American Health Organization.
PATH	Program for Appropriate Technologies in Health,
PIB	Permenthrin Impregnated Bednets.
PSI	Population Service International.
RBCs	Red Blood Cells.
REMP	Rufiji Environmental Management Project
TEHIP	Tanzania Essential Health Intervention Package.
TMTL	Textile Manufacturers of Tanzania Limited.
UNICEF	United Nations Children's Fund.
USAID	United States Agency for International Development.
WHO	World Health Organization.

1. INTRODUCTION.

Fatal fevers, probably malaria have been recorded since the beginning of the written word (6000-5500 BC). References about fevers which are thought to refer to malaria as we know it today can be found in the verdic writing of 1600 B.C. in India and by Hippocrates some 2500 years ago (Connor. & Thomson. 1999: Anderson, *et al*, 1996).

Since ancient times, malaria has continued to undermine the welfare of many people in the world. The Chinese mythology describes three malaria demons: the first with the hammer, the second with a pail of cold water, and the third with the stove, representing the characteristic head aches, chills and fevers observed in malaria respectively. In West African animist religious beliefs, malaria is associated with excessive exposure to the sun and the excessive consumption of peanuts and palm oil (Russel. *et al.* 1946). This illustrates how lack of knowledge and traditional beliefs have led humans to take years to move from the concept of witchcraft and evil spirits to abstract thinking on malaria (Russell. *et al.* 1946).

The linkage between disease and environment is an old one. *Paludisme*, the old French term for malaria derives its meaning from the word *Paludal*: of the marshes. Interestingly, mosquitoes in the marshland were not associated with the disease until the 19th century when in 1880, the French army physician, Charles-Lois-Alphonce-Laveran who at that time worked in Algeria, for the first time identified malaria parasites while

viewing blood slides under the microscope. By the end of 1897 Dr. Ronald Ross discovered malaria cysts in the stomach wall of Anopheles mosquitoes that had fed on a malaria patient. It was left to the Italian scientist, Giovan Batista Grassi who in 1898 established malaria transmission through the mosquito, thus proving that human malaria was transmitted by species of Anopheles mosquito (Desowitz, 1991).

The use of the term malaria in the English language is attributed to Horace Walpole who in 1740, writing from Rome, used the word borrowed from Italian which means bad or evil air to describe marsh fevers (Connor. & Thomson, 1999).

The fight against malaria is historical; from the time in memorial when it was attributed to witchcraft, evil spirits and traditional priests, traditional healers acted as consultants till 350 years ago when the Jesuit missionaries in South America learned of the anti-malarial properties of the bark of the cinchona tree, which was later introduced in Europe in the 1630s and in India in 1657. Quinine was synthesised in 1934 by a German company and chloroquine in 1943 by the Americans (Russell, *et al*, 1946).

In the 1950s, the pilot project for control of malaria by spraying with DDT was launched, and in 1955, the WHO initiated strategies for the global eradication of malaria. The two very cheap and cost-effective malaria control tools had become available, the insecticide DDT and the anti-malaria drug chloroquine, which

hypothetically promised a simple technical solution to malaria. Fortunately this led to a dramatic disappearance of malaria in North America and Europe. Unfortunately, continental Sub-Saharan Africa was never part of the global malaria eradication program. The severity of the disease, the density and efficiency of *Anopheles gambiae*, the problem of eradicating the disease over such a large land mass with recurrent reinvasion, high costs, poor health infrastructure and little indigenous capacity is claimed to have contributed to lack of will to undertake the eradication program in Africa (Connor & Thomson, 1999; Bruce-Chwatt, 1980; Anderson, *et al*, 1996; Fivawo, 1993; UNICEF, 2000).

In the 1960s chloroquine resistant strains of *Plasmodium falciparum* started to be reported, and this was thought to be a result of over usage and probably under dosage of patients and the inherent mechanism for survival of the parasite under adverse conditions. At the time there was no drug to treat chloroquine resistant malaria except the ancient anti-malarial, quinine. In 1967, WHO reported that the global eradication of malaria was impossible for a variety of reasons among them being development of parasite resistance to chloroquine and the vector resistance to the "miracle" insecticide DDT, which is now a widely discredited and prohibited chemical due to its harmful effects on the environment (UNICEF, 2000). Major funders, USAID, UNICEF and PAHO withdrew much of their funding and therefore in 1972, the global eradication

program was formally declared dead (WHO, 1996; Connor & Thomson, 1999; Bruce-Chwatt, 1980; Anderson, *et al*, 1996).

In Africa, malaria accounts for an estimated 25 percent of all childhood mortality below the age of five. The disease kills 2800 children a day in Africa before they build enough immunity against the disease. Overall risk of child mortality was reduced by 17 to 63 percent in controlled ITNs trials in different parts of Africa like The Gambia and Kenya (Binka, *et al*, 1996; Nevil, *et al*, 1996; Curtis, 1996; Alonso, *et al*, 1994; D'Alessandro, *et al*, 1995).

MALARIA IN TANZANIA

In Tanzania, health statistics show malaria as the number one disease among the top ten, and the most widely spread infection causing considerable morbidity and mortality (MOH, 1997). Expert opinion maps based on contemporary observation on altitude and rainfall produced in 1950s and 1960s for Uganda, Kenya and Tanzania, show that 75% of the country consist of hyper-endemic to holo-endemic malaria (Clyde, 1967). Formally, areas like Kilimanjaro, Iringa, Arusha, Rungwe and Lushoto were malaria free zones, but in recent epidemiological reports, malaria is being reported from these areas (Dahoma, 1983). Parasite development ceases at 16°C, but transmission below18°C is unlikely because very few adult mosquitoes survive the 56 days required for sporogeny at this temperature. At 22°C sporogeny is completed in less than three

weeks and mosquito survival is great enough for transmission of malaria. A temperature of above 32°C is reported to cause high vector population turn over, weak individuals and high mortality (le Sueur. 1991: Maharaj, 1995). Inadequate health infrastructure and poor socio-economic conditions with increasing resistance to the drugs have aggravated the problem of malaria control in Sub-Saharan Africa. Malaria has been documented to be governed by a large number of environmental factors. which affect the distribution, transmission intensity, and disease outcome. The major environmental factors that affect malaria transmission are temperature and rainfall. Rainfall provides mosquito breeding sites and increases humidity that enhances mosquito survival. An average of 80mm of rainfall per month, for at least three to five months is reasonable requirement for annual malaria transmission (Craig. *et al.* 1998; de Meillon, 1934: Leeson, 1931).

By extrapolation from the 1988 population census. Tanzanians are estimated to be around 33.8 millions in 2000. of whom 31.7 millions (93.7%) are exposed to the risk of malaria (de Savigny, 1999).

The distribution of malaria according to the reports is as follows:

> 6 months (stable. perennial) 14.0 million or 41.5% of the population.

4-6 months (unstable. seasonal) 11.3 million or 33.5% of the population.

1-3 months (strongly seasonal or epidemic) 2.6 million or 7.8% of the population.

Less than 1 month (epidemic or no malaria in average year) 5.8million or 17.2% of the population.

MALARIA VECTORS:

Malaria vectors commonly seen in Tanzania are *Anopheles gambiae* complex and *Anopheles funestus* both recognised by their "tail in the air" posture, dappled wings in most tropical species and long pair of palps beside the proboscis in the female. Mosquitoes of the genus Anopheles lay their eggs in relatively clean sun lit water such as in marshes, puddles, irrigation water, and paddy fields. The mosquito have four distinct stages in their life history; the egg, the larva, the pupa and the adult, whereby the first three stages occur in water. The egg is laid single on the water surface and hatches into larval stage within one to three days. After ten days the larva moults into the pupa, from which after one to four days the adult emerges. The life span of mosquitoes varies from a day to months (MOH, 1990; Bruce-Chwatt, 1980).

The population of *Anopheles gambiae* complex peaks in April and June during the long rain seasons and the population of *Anopheles funestus* peaks after June-July during the dry season. One bite from an infected mosquito may be enough to cause the deadly disease that claims an estimated 1.5 to 2.7 million lives a year and 90 percent of malaria cases are documented from Sub-Saharan Africa each year (WHO, 2000: UNICEF, 2000). Anopheles have generally night biting behaviour. Hardest hit are young children

who have not yet developed immunity to the disease and pregnant mothers (Jones, *et al;* 1997: Lengeler, *et al*, 1996: Bourgoing, 1997; UNICEF, 2000). Therefore, malaria is a disease of public health importance.

In areas where transmission is high, the population gradually develops immunity to the disease. Children remain highly vulnerable to mortality until they acquire such protective immunity (MOH, 2000, Dondorp, *et al*, 2000). Pregnant mothers, in whom the naturally acquired immunity is compromised due to pregnancy, and are increasingly susceptible to malaria infection. The vast majority of malaria death occurs among young children in tropical Africa, especially in remote rural areas with poor access to health services (Makemba, *et al*, 1995; Kondrachine, *et al*, 1995; D'Alessandro, 1995; Kondrashin, 1992; UNICEF, 2000; MOH, 2000). In areas of endemic malaria, the pattern of severe malaria disease has been shown to vary according to intensity of the transmission. In areas with lower levels of endemicity the disease pattern is dominated by cerebral disease forms in older children above 2 years of age. Severe malaria anaemia is seen in young children and infants who are residents in areas of very high malaria transmission (Snow, *et al*, 1997; MOH, 2000; Dondorp, *et al*, 2000).

THE MALARIA PARASITES

Mammalian plasmodia are said to have originated from an evolutionary process and adaptation of the coccidia, which usually invades the epithelium of the intestinal tract. The invasion of the free cells in the blood paved the way for transmission from one animal to another by the blood sucking arthropod vector. Over a 100 parasite species similar to those of man are found in wide range of vertebrates. Due to high host specificity, none of the other parasites, except for those found in monkeys, are able to infect man (Bruce-Chwatt, 1980).

Plasmodia found in man are *Plasmodium falciparum*, *P. vivax*, *P. ovale*, and *P. malariae*. *Plasmodium falciparum* is the most wide spread and the most dangerous. The Plasmodia develop in the gut of a mosquito and are passed on in the saliva of an infective mosquito each time it sucks blood. The parasite enters the victim's liver where they invade the hepatocytes and multiply. After 9-16 days, they migrate and penetrate the red blood cells where they multiply again and thereby break down the red blood cells (RBCs). This induces bouts of fever and anaemia in infected individuals, or may sometimes cause cerebral malaria when infected cells obstruct the cerebral blood vessels. Other vital organs can be affected also with different manifestations (Bruce-Chwatt, 1980; Dondorp, *et al.* 2000).

MALARIA CONTROL IN TANZANIA

Sub-Saharan Africa carries the largest per capita burden of disease in the world. Of this, malaria is the single most important disease, being responsible for nearly 1.5 to 2.7 million deaths and 300 to 500 million clinical cases every year (WHO, 2000; UNICEF, 2000). After decades of neglect, several countries have now designed more appropriate strategies for the control of malaria taking into account factors which may affect the control such as endemicity of the disease, vector species and behaviour, seasonality, disease patterns and health service infrastructure against a background of increasing drug resistance, poor communication and weak health services (Lengeler, *et al*, 1996; White, *et al*, 1999; Greenwood, 1999; UNICEF, 2000, WHO, 2000).

Malaria control in Tanzania began during the German colonial rule, when the two methods employed in the control were: 1) mass quinine treatment to destroy the parasite directly, recommended by Dr. Robert Koch, was applied in Dar es Salaam, Kilwa and Tanga from 1901 (MOH, 1990). 2) In addition Koch was advocating environmental manipulation through construction of drainage canals together with filling up of all known and accessible ponds and applying larvicidal oils on stagnant waters and ponds. This method of control was abandoned in 1913 for the reason that it was expensive to undertake. Nevertheless, malaria is documented to have declined among the immune populations from 45% in 1903 to 30% in 1907 probably due to the aforementioned efforts (MOH, 1990).

In 1913, legislation to promote mosquito control was introduced, and demanded the emptying of containers or pouring kerosene on stagnant water and draining of water by property owners. Intra-domicilialy spraying with pyrethrum was also extended. In 1926 the mosquito control activities were extended to Moshi, Lindi, Mwanza, Morogoro and Kigoma under the supervision of sanitary superintendents(MOH, 1990).

The Tanganyika Malaria Service established in 1951, was involved mainly in supervision of anti-malarial measures in all urban areas and studies on the use of insecticides and anti-malarials (MOH, 1990).

Over the years, particularly after World War Two, larviciding was the main urban mosquito control activity. Source reduction especially drainage filling and other engineering works were also among the main measures applied in urban mosquito control.

From independence in 1961 to 1983, the Mosquito Control Unit was later transformed into the Malaria Unit, was integrated into the general urban health services in 1963. During the years from 1966 to 1980 the unsuccessful malaria control by medicated salt was operational in "*Mto wa Mbu*" in Arusha. It was abandoned due to increasing malaria parasite resistance to the amodiaquine used (MOH, 1990).

In 1973 to 1979, the Concurrent Multipath Approach method was introduced. The programme was mainly dealing with indoor residual insecticide spraying in malarious rural areas and larviciding in urban areas coupled with selective chemosuppresion to the vulnerable groups covering six regions. The programme was withdrawn due to financial constraints (MOH, 1990)..

The previous measures of malaria vector control are considered poor because it has not succeeded in reducing the mosquito density or morbidity and mortality to an appreciable level. The control of malaria in Tanzania has been ineffective mainly due to:

1. Lack of cost-effective means of vector (mosquito) control; There is no planned vector control strategy in place currently. Past attempts at vector control in urban areas were unsuccessful to reduce vector density or entomological inoculation rate. Vector control in rural areas is even less cost-effective.
2. Improper use of chemoprophylaxis; Indiscriminate and irrational prescription of drugs for prophylaxis.
3. Chloroquine resistance; incorrect prescription and misuse of anti-malarial drugs for care management.
4. Poor management (operative and administrative); Lack of planning process, insufficient funding and poor monitoring and evaluation systems.

In order to realise effective malaria control in Tanzania, the Malaria Control Programme in the Ministry of Health was established in 1990 with objectives of establishing;

1. Strong national commitment for adequate resource allocation.
2. Establish and update technical guidelines for malaria control.
3. Proper and adequate manpower deployment.
4. Integrated and co-ordinated approach to malaria control.
5. Community mobilisation and participation.

THE INSECTICIDE TREATED NETS.

In the last 10 to 15 years there has been renewed interest in barrier methods to control malaria. Essentially in the past bed-nets were used to prevent mosquitoes from biting, however in the recent past, it has been realised that impregnating net fabrics with pyrethroid insecticides is a cost effective measure towards malaria control in Sub Saharan Africa. This method repels mosquitoes and has been found to reduce entomological inoculation rate (Lengeler, *et al*, 1996). In control trials ITNs have shown to reduce childhood mortality by 18% to 33% and it has shown a significant impact on morbidity parameters such as reduction of malaria episodes by 50%, reduction of severe malaria, resolution of anaemia and even weight gain in under-fives (Lengeler, *et al*, 1998; MOH, 2000).

It should be remarked that ITNs could only be a public health tool if high utilisation coverage is reached within communities. Studies indicate that 70% of the population should be sleeping under the ITNs to achieve an impact on the transmission, short of this ITNs will remain an individual protection method (Chavasse, *et al*, 1999).

In Sub-Saharan Africa ITNs are still in the project phase. National Malaria Control programmes are yet to implement this strategy on a wide scale. The reason is mainly due to;

-Lack of public knowledge of the advantages of ITNs.

-Lack of national scale demand creation and promotion.

-Underdeveloped system of distribution of information and ITNs materials to the population.

- Lack of modalities to enable all households to afford the ITNs.

-Lack of understanding of the extent to which bed-nets, fabrics and insecticides need to be subsidised.

-Scarce resources to enable an efficient public sector-private sector alliance.

-Lack of a promotive, regulatory and legislative environment (e.g. taxation).

-Inadequate scientific research and development on operational and policy issues.

-Lack of multisectoral collaboration, co-ordination with relevant non-health sectors.

-Weak transport infrastructure and other weaknesses in the health care delivery system.

The ITNs are less expensive compared to the combined cost of other preventive measures and treatment including anti-malarial drugs, insecticide sprays, coils and other traditional control methods (Guyatt, *et al*, 1999; Verle, *et al*, 1999). A household spends between five and twenty percent of the income on these less effective methods to control and treat malaria (PSI, 1995). Besides being cost effective, ITNs provide much more than a physical barrier; they deter mosquitoes from feeding and drive them from their resting places. The life span of mosquito nets is five years. Even if in the course of its use, it develops holes, the protective effect remains the same provided the net is regularly treated (Lengeler, *et al*, 1996; Binka, *et al*, 1996; Nevil, *et al*, 1996; Curtis, 1996).

So based on this premise, treated nets (ITNs) have proved to be the most promising malaria-control technology available in terms of cost effectiveness and use. The need for their promotion is a global responsibility (WHO, 2000; MOH, 2000).

During migration to the flood plains during rainy seasons and peaking of mosquito density, the farmers have been using the traditional sleeping mat *(mtuti)* and burning/ smoking leaves which are believed to have mosquito repelling effects to protect them

from mosquito bites. Lighting fire inside the all thatched small hut is very dangerous as the hut can catch fire and cause catastrophies in terms of human life and properties.

Malaria is a major health problem in Rufiji as reported from the health facilities (Gasarasi, *et al*, 2000), especially in the migratory farmers who are much exposed to the mosquito bites. The shamba (*dungu*) houses in which they live in the flood plains are so porous that they offer no hindrance to mosquito entry into the shamba houses. The underfive children and pregnant mothers who migrate to the flood plains with their families are exposed to extreme dangers in life as their immunity is either still low or compromised. Since in the flood plains there is neither health infrastructure nor the tradition of using ITNs due to limited understanding of malaria risk and transmission, knowledge and awareness on the potential benefits of ITNs should be promoted and the community enculturated to regard ITNs as essential household commodities (de Savigny, 1999).

In Rufiji, as in most parts of Sub Saharan Africa, most of the cases of illness are managed at home or in the community by traditional medical practitioners first before going to a health facility or drug shop. It is not exactly known how many people die at home before seeing a medical practitioner in the health facilities since there is no legislative laws of registering birth and deaths (and their causes) in Tanzania but the number is estimated to be higher.

ITNs have the potential to make a significant impact on the global malaria problem. So creating an environment where everyone in malarious area enjoys access to ITNs with consequent reduction in mosquito bites is a tremendous step towards reducing the disease burden among the farmers in Rufiji and eventually in other communities with similar circumstances in Tanzania. To achieve this goal, nets which are acceptable should be designed and introduced in this community which has no tradition of net use, limited understanding of malaria risk, transmission and low awareness of the potential benefits of ITNs (de Savigny, 1999).

2. REVIEW OF LITERATURE.

Malaria is a leading cause of morbidity afflicting 40% of the world population. It is estimated that the global malaria burden is 300-500 million cases occur in sub-Saharan Africa annually, with an overwhelming proportion (90%) occurring in Africa (Lengeler, *et a*l, 1996; Collins, *et al*, 1995; WHO, 1988, 2000).

Malaria is ranked by the world Bank and WHO as the first cause of life years lost (DALYS) in Sub-Saharan Africa, and the calculations indicate that annually, there is a loss of 35 million future life years from disability and premature mortality (Gwatkin, 2000; Najera, *et al*, 1993). Apart from being the largest single component of disease burden in Africa, the anti-malarial chloroquine to which formerly the parasites were highly susceptible, there is growing body of evidence showing that chloroquine is becoming less effective in malaria chemotherapy and other alternative drugs are not readily available and are expensive. (Lengeler, *et al*, 1996; Connor, *et al,* 1999; White, *et al*, 1999; WHO, 2000; Murray, *et al*, 1994; Najera, *et al,* 1993; Gwatkin, *et al,* 2000).

Large scale spraying of insecticides was effected in the Malaria Global Eradication Programmes hoping that eventually Malaria was going to be eradicated. Subsequently, malaria was eliminated from Europe, some countries of Asia and America thus benefiting an estimated population of 400 million people. Unfortunately in this programme, Africa, though with the highest burden of disease, was not involved and the

disease has continued to claim people's health and lives (Fivawo, 1993, Najera, *et al*, 1993). It has therefore continued to undermine the development efforts of governments in the tropics and has remained a challenge to public health worldwide.

Countries like China have succeeded in the control of malaria after introduction of a sustainable use of ITNs, with consequent decrease in malaria prevalence. In other countries, the overall situation of malaria has remained stable, while countries in the Sub- Saharan Africa have been experiencing a worsening situation due to poverty, poor health infrastructure, and inability to conduct effective control measures coupled with an effective surveillance system (WHO, 1987).

The ecological advantage enjoyed by the mosquito vector in Sub-Saharan Africa, has rendered the control a dreadful face in terms of technical operations, administrative and financial constraints (WHO, 1987). This has led to small-scale control programmes being carried in Sub-Saharan Africa. ITNs have been shown to have the potential to improve the situation of the burden of disease in Africa where 150 million people are estimated to be chronically infected and one million children die approximately each year due to *P. falciparum* malaria (WHO, 1974, 2000; Russel, 1946, Najera, *et al*, 1993). Recent public health technologies, have come to offer the real opportunities for reduction of disease burden in the African context.

New drugs and improved formulations and packaging is gradually improving symptomatic treatment at household level. ITNs have been shown to reduce overall child mortality by between 14 and 63% in various settings, making this intervention a cost-effective public health technology (MARA, 1998).

Anopheles mosquitoes prefer to breed in clear water, and therefore the disease is profoundly found more in rural areas than urban areas where *Culex spp.* prefer to breed in dirty polluted waters as in drainages. Therefore malaria often affects residents in rural areas more than urban dwellers. Thus agricultural production is affected due to reduced effective working days in the fields and the general health of the population is also undermined and production reduced.

In Africa most health facilities are concentrated in towns despite comprising only 20% of the population. The people in rural areas have been experiencing poor health infrastructure and some of them have resorted to the attention of traditional healers for medical attention. So the farmers can be helped to improve their health effectively by primary prevention, by enculturating the people to use ITNs to prevent malaria episodes (WHO, 1998; Sabatinelli, 1995; MARA, 1998).

For the brief time that the insecticide DDT and anti-malarial drug-chloroquine was introduced as the agents for conquering malaria in 1943, eradication of malaria seemed

possible. The WHO led an international malaria eradication campaign from 1955 to 1969. The programme involved spraying houses with DDT in known mosquito resting places, running side by side with early detection and treatment of malaria cases. Malaria eradication in Sub-Saharan Africa was not considered feasible in many areas due to intense transmission, lack of human and economic resources, the primitive state of development, and the limited health infrastructure to support the health system. The eradication programmes proved successful in large areas of North America, Southern Europe, former Soviet Union, the Middle East and some territories of Asia and South America (WHO, 1998, Najera, *et al*, 1993).

Other areas demonstrated varied result with varying degree of malaria reduction. The main areas of persistent transmission remained and were to become the main sources of epidemics as the one that occurred in Sri Lanka in 1968 where malaria has been almost eradicated (Najera, *et al*, 1993). The WHO abandoned the eradication campaign in favour of prevention and control with emphasis on local situation and available resources (WHO, 1998; Najera, *et al*, 1993; WHO, 2000).

Disease reduction was supposed to have been conducted alongside other socio-economic development activities such as agriculture, health, sanitation and education sector. In 1992, a Ministerial Conference endorsed the Global Malaria Control Strategy which

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calls for strengthening of local and national capabilities for disease control, with more emphasis on community involvement in disease control (WHO, 1998; 2000).

In 1997 it was estimated that Africa has been losing about two billion dollars due to malaria each year. Worse still, the circle is vicious. Disease causes ill health resulting in low productivity and therefore poverty and ignorance which has an influence on behaviour change characteristics (WHO, 1998). With reduced malaria burden, communities will be able to live a socially productive life. It has been declared that through the principles of primary health care, control of malaria will be achieved (WHO, 1984,1998) The goal of malaria control is to prevent mortality, reduce morbidity and socio-economic losses by proper planning, and applying sustainable preventive measures by involving the communities (MOH, 2000).

MALARIA PREVALENCE IN TANZANIA.

In Tanzania, Malaria, is by far the commonest of the communicable diseases, and a leading cause of morbidity and mortality in the country. Malaria is the number one cause of hospital attendance (10-15%) and admission (10-25%) and is a leading cause of death in hospitals (about5%). In this respect, it's an important cause of much ill health (morbidity) and mortality in the country, therefore, of much public health importance (Sabatinelli, 1995; WHO, 1984, 2000; Najera, *et al*, 1993; MOH, 2000).

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In Tanzania malaria is highly endemic and only a few areas indeed are free of malaria. Transmission in most areas occurs throughout the year although the heaviest intensity is seen during the rainy seasons where humidity and temperature influences mosquito breeding. The burden of disease with seasonal variation is commonly observed along the low-lying coastal areas, regions bordering the Great Lakes (Kyela, Kigoma, Mwanza and some of the districts in Mara and Kagera regions). Almost the remaining areas covering the central and southern highlands, Kilimanjaro and Arusha regions are experiencing mostly hypo to mesoendemic malaria with seasonal transmission (Sabatinelli, 1995), With overall experience of the highest endemicity of the disease.

People living in high altitude areas like Kilimanjaro and Lushoto, do experience less episodes of malaria. Since people are mobile, the act of travelling from one place to another, especially from high altitude areas to low lying coastal belt, expose themselves to high transmission of malaria, and they suffer from severe malaria attacks. The populations with the greatest risks are children and pregnant mothers due to physiological reason related to body immunity. Its estimated that 10-15% of all childhood mortality in the first five years of life in endemic areas is directly due to malaria (WHO, 1984; 1998; Sabatinelli, 1995, MARA, 1998).

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Malaria disease has evolved into a more challenging problem as far as the anti-malarial drug resistance is concerned. The distance needed to be covered to the nearest health facility is a challenge towards improving the health infrastructure. Increased community awareness on malaria as the number one public health problem will anable the community to participate in sustainable prevention and control measures and improve health status of the people in the community (Nakajima, 1998; Najera, *et al,* 1993; WHO, 2000; MOH, 2000). In order to reduce malaria morbidity and mortality, multi-sectoral collaboration must be used (MOH, 2000; WHO, 200; Chavasse, *et al*, 1999).

MALARIA MORBIDITY AND MORTALITY.

Malaria has plagued mankind since human settlements created the right environmental conditions for mosquito breeding sites and easy contact with man. Its by far the most wide spread tropical parasitic disease threatening at least four out of every ten persons in the world. In Africa, especially in Sub-Saharan Africa where 90 % of the world cases occur, it tops up the list of all diseases and it is an important Public Health problem in terms of morbidity and mortality.

Most people understand the clinical manifestations of malaria in the vulnerable groups; pregnant mothers and the under-five children in endemic malaria areas. People from different areas of the world with different cultures, beliefs, and customs have tended to describe the disease differently (socio-cultural construction of the disease conditions).

The ethno-medical classification of disease in the community may break down diseases into smaller disease entities which may instil a different concept in the community and it has sometimes been found to be a cause of poor compliance towards treatment and control strategies. The most severe manifestations of malaria are not regarded as complications of malaria but attributed to different things according to local cultural disease construction. In these areas, poor knowledge of the disease and the link between mosquitoes and malaria has tended to put all their energy towards reduction of the mosquito nuisance of biting.

Malaria has the ability to inflict severe anaemia in pregnant mothers and children due to compliment mediated haemolysis and bone marrow depression. Acute attacks especially in pregnant mothers and the under five children may result in renal or heart failure and consequently death. Other complications of malaria are pulmonary oedema, liver failure, disseminated intravenous coagulopathy and derangement of body fluid balances. *Plasmodium malariae* infection may lead to nephrotic syndrome. During rain seasons, most under-fives who are infected, present at the health facilities with fever and respiratory tract infections, anaemia and some are found to be in dire need of blood transfusion. Apart from aggravating the physiological anaemia of pregnancy, malaria also can be complicated by hyperpyrexia, abortions, low birth weights and intra-uterine foetal deaths. (Sabatinelli, 1995; Snow, *et al*, 1997; Najera, *et al,* 1993; Dondorp, *et al*, 2000).

In pregnancy the placenta acts as an extra site for parasite proliferation (parasitisation) and therefore may lead to placental insufficiency due to compromised blood circulation (Sabatinelli, 1995; Najera, *et al*, 1993), resulting in intra-uterine foetal growth retardation and low birth weights. Babies with low birth weigh due to premature delivery or small for dates, may have a reduced survival rate during the neonatal period.

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The total burden of malaria is partially reflected in total attendance and hospital bed occupancy rate, cost of drugs, and human and financial resources, which potentially could have been invested in the fight against malaria. Malaria is responsible for many lost school days for pupils and poor economic production for adults (Najera, *et al*, 1993; UNICEF, 2000).

Tanzania being a poor country only spends 3.6% of its national budget on health services. Tanzania, like other developing countries, continues to face severe economic constraints despite all the efforts to rescue the situation. Foreign exchange insufficiency has featured prominently in most government service provision system including health (MOH, 1990). This means that our health facilities are unable to offer quality services and one may find a hospital or health facility lacking most of the essential drugs, and therefore, prudence should be emphasised in the control of the disease in the community. In one community randomised controlled trial in Kilifi district in Kenya, it was demonstrated that, intervention with ITNs could reduce paediatric malaria admission by 40% at the Kilifi district hospital. Despite several limitations, based on

informed estimates of the geographic burden of malaria and it's fatal consequences in Kenya, it's documented that daily, 72 and 400 children below the age of five either die or develop clinical malaria respectively (Snow, *et al*, 1998). Other studies done in Kenya, Burkina Faso, The Gambia and Ghana found that 6.9 lives could be saved per 1000 children protected by ITNs per year in both low and high malaria transmission areas (Lengeler, *et al*, 1998). Findings from other large-scale trials of ITNs effectiveness against malaria indicate that the lives of 500,000 African children could be saved annually from loss of malaria if ITNs were regularly and properly used (Lengeler, *et al*, 1998; Anonymous, 1996a, 1996b).

Therefore, with increased malaria intensity looming, a better solution to combat malaria should be designed in order to curtail the disease trend. The health of population or community should be improved so that we start a sure way towards the desired developmental goals: better health and improved economic productivity (Gwatkin, *et al*, 1999).

MALARIA TRANSMISSION:

Human malaria is only transmitted by Anopheles mosquitoes. The vector also transmits filariasis and some viral diseases. nevertheless, other species of mosquito apart from the Anopheles mosquito, are more important vectors in the transmission of the two later disease conditions (Lawson & Stewart, 1967).

Anopheles belongs to order *Diptera,* sub order *Nematocera,* Family *culicidae,* sub-family *Culicinae* and tribe *Anophelini* in the zoological classification and genus *Anopheles* (Bruce-Chwatt, 1980). About 400 species of Anopheles mosquito are found throughout the world, but only 60-70 species are vectors of malaria under natural conditions. Among those, 30 species have been found to be of major importance. The mean longevity of the local population of mosquito species and their density in relation to man, are factors, which determine whether a particular species of Anopheles is an important vector or not (Bruce-Chwatt, 1980). *Anopheles gambiae* complex and *Anopheles funestus* still remain the only known vectors of importance in East Africa. *Anopheles gambiae* complex comprises siblings namely *Anophele merus*, a salt water breeding species, confined to East Africa; *A .melas*, another salt water breeding vector confined to west Africa, *A .arabiensis*, fresh water breeding species distributed over most of the continent of Africa, and *Anopheles gambiae* ssp, identified along the Uganda and the Democratic Republic of the Congo, where the vector breeds in the mineral swampy waters in the forests (Bruce-Chwatt, 1980).

Typically *Anopheles gambiae* complex breeds in the shallow sunlit pools with unpolluted water, or flooded rice fields when the rice is still low and the paddy fields contains water and enough sun light (Petterson, 1963).

An. merus a sibling of the *An. gambiae* complex, commonly breed in brackish lagoons, swamps, pools and puddles that are flooded during high and subsequently diluted by rainfall (Gilles, 1953).

The larval habitat of Anopheles mosquitoes is usually well defined, with the majority found in fresh water pools or fresh marshes. *Anopheles gambiae* complex, may sometimes adapt their habits to various existing conditions, but usually breed in fresh waters ranging from very small temporary collections to large pools. The population of this species can build up very rapidly during the rain seasons when they are the most important vectors. *Anopheles funestus* on the other hand breeds in shaded permanent water bodies, especially the edges of slow moving streams, lakes and swamps as found in the Rufiji delta. This vector is of greatest importance during the dry seasons. Artificial containers such as pots or tubs are generally unsuitable for *Anopheles species*, except for *Aedes aegypti* which may breed in cisterns, wells, tins, cans broken earthen wares pots and other man made receptacles. Large expanses of open water, free from vegetation, seldom support Anopheline mosquito larvae although breeding may occur in quite pools and pockets of relatively sill water along the grass margins of lakes, streams, and rivers (Sabatinelli, 1995; Bruce-Chwatt, 1980). Feeding of mosquito on humans takes place between dusk and dawn, though may feed during day light hours in densely shaded woodlands of dark interior of shelters and houses. Anthropophilic species exclusively

feed on man while others species, even though the human host is available prefer to feed on animals (zoophilic).

Resting places of Anopheles mosquito are frequently inside houses, the female mosquito which enters a house after dark to have its blood meal, becomes heavily engorged after a meal, thus flies to nearby wall or ceiling to rest during the daylight, and in most instances prefer the lower portion of the interior of the house where temperatures are lower and humidity high. House resting is of special importance in relation to control methods using residual insecticides (Bruce-Chwatt, 1980).

An. gambiae complex and *An. funestus* are important vectors of malaria, their long life span, renders them efficient vectors of Malaria. *Anopheles gambiae* complex is associated with highest degree of anthropophily particularly on the East African coast where cattle are few. They bite mainly indoors at night and in Africa they bite between mid-night and 04.00 hours. House entry is earlier than the biting activities (Marsh, *et al*, 1996; Richards, *et al*, 1994). In coastal Tanzania, malaria is generally perennial and seasonally intense. A study done in Muheza district in Tanzania revealed that ITNs use, reduce mosquito bitings tremendously and the mean survival of mosquito vectors was markedly reduced (Lyimo, *et al*, 1988).

THE INSECTCIDE TREATED NETS FOR MALARIA CONTROL:

The discovery of DDT with its residual effect, the vector control activities involved repeated applications in the targeted areas. The residual type of insecticide exerts their insecticidal effect on contact with the external surface of insects, which absorb the insecticide through the pores and nerve endings. There are types of insecticides, which act through contact, and emission of vapour, nevertheless the lethal effect of the later disappears early, nevertheless insecticides exert their effect by killing, repelling the mosquitoes or making the mosquito unable to feed (Lengeler, *et al*, 1996). The surface of an impregnated net kills mosquitoes on contact.

The use of bednets is not new in Africa, especially in the tropics where nets have been used for protection against mosquito nuisance. The impregnated bednets were first used in World War Two by the Russians, Germans and American armies after discovery of DDT, which was effective in reducing nuisance biting. Widespread treatment of nets became a practical proposition in the 1970s, with the development of synthetic pyrethroids, which are safe to humans but effectively kill and repel mosquitoes (Chavasse, *et al*, 1999; Desowtz, 1991; Lengeler, *et al*, 1996). The treated bednets assure personal protection against inoculation rates and malaria episodes in the community.

This method is simple and safe to use by farmers in the communities. The epidemiological effect is comparable to that of house spraying and more, for it exerts a prolonged effect. With the ITNs, the community based malaria control in Africa is likely to be given a new impetus (Lengeler, *et al*, 1996; Premji, *et al*, 1995), for ITNs have highly effective insecticidal effect. The risk of adverse effects depend on the type and formulation of the insecticide, concentration and degree of exposure. Reported side effects are nasal irritation and sneezing, skin itching, eye burning, headaches, dizziness and paraesthesia (Chavasse, *et al*, 1999., Lengeler, *et al*, 1996).

The use of ITNs substantially affects the frequency and severity of clinical episodes of malaria. Studies done in most parts of Africa document a reduction of 20 -63% in malaria disease rates following the introduction of ITNs. During the dry seasons when mosquito densities are low, the ITNs use has been found to be lower. The nuisance bites, which motivate people to use ITNs, apparently no longer exist. People should be educated towards understanding that primarily ITNs prevents malaria. The Anopheles mosquito transmits malaria through biting and inoculation of parasites (Lengeler, *et al*, 1996;).

Ignorance of the part played by mosquitoes in the transmission of malaria has lead to the suggestion that reducing nuisance biting should be emphasised as the reason for the advocacy on the use of ITNs in the communities. The reduction of nuisance biting is

undeniably the more immediate, frequently perceived consequence of ITNs use in the ignorant societies where there are dissimilar cultural and biomedical explanations on malaria (Lengeler, *et al*, 1996; Marsh, *et al*, 1996; Klein, *et al*, 1995). Though this explanation can help people to use ITNs during high transmission seasons, the explanation is likely to reinforce the non-ITNs use during the dry seasons when mosquito densities are lower but transmission of malaria is almost the same (Faye, *et al*, 1998).

The tendency for people to avoid using nets unless mosquitoes actually bother them, is an issue that needs addressing through health education in the community because malaria transmission can occur when mosquito density is very low (Lengeler, *et al*, 1996). Promotion on the use of ITNs should explain explicitly the advantages of reducing nuisance biting and malaria disease.

TYPES OF INSECTICIDES

There are many different types of insecticides that are marketed in the world under different names. The choice of insecticide may depend on the vector susceptibility, efficacy, availability, cost and affordability. The synthetic pyrethroids are excito-repellent, quick acting and effective. Among the commonly used are:

(1) *Permethrin:*

A pyrethroid with stable residual activity.

Recommended dose per net is 200-500 mg/m2.

Retreatment is required every six months.

With washing, about half of insecticidal activity is removed.

(2) *Deltamethrin and Lambdacyhalothrin:*

Belong to subgroup of pyrethroids characterised by an alpha-cyno group in the molecular structure.

Unlike permenthrin, exerts toxicity to animals but it is more toxic to insects. Effects on the nets can persist for one-year even when subjected to one or two washings, a major advantage especially in areas where Transmission season lasts for more than 6 months a year.

Less expensive per each individual treatment than permethrin.

Can cause sensory side effects on contact with the skin.

(3) *Etophenprox:*

Structurally different, but functionally similar to pyrethroids.

Dose similar to permethrin.

(4) *Nonpyrethroid insecticides:*

Not usually safe for ITNs use.

Do not protect from biting though kills many mosquitoes.

Synthetic pyrethroids are the only used insecticide for treated nets

The three commonly used are; Permethrin, Deltamethrin and lambdacyhalothrin.

The ITNs need regular treatment to exert optimal insecticidal effect. Nonetheless, in areas where ITNs are used, they should not be taken as complete substitutes for other control measures such as coils, and aerosols. People tend to stay outside during the evening before retiring to bed and therefore under the protection of the net (Lengeler, *et al*, 1996; Greenwood, 1999) thus they get inoculations from mosquitoes.

AFFORDABILITY AND USE OF ITNs:

In most rural societies, the cash availability is seasonal, the money being available after harvesting time. After the harvesting time the mosquito density decreases even in high transmission areas and hence the nuisance biting. The sale of harvests in rural areas gives the community the ability to buy ITNs. Unfortunately the low mosquito density makes peasants to put low priority on the need for ITNs use as protection against malaria. Less incentive events exist to acquire a net at this time (Lengeler, *et al*, 1996; Rashed, *et al*, 1999).

Studies conducted in Ghana, Sierra Leone, Gambia and Guinea Bissau, indicate that most people use nets to avoid irritant and nuisance mosquito bites, but the main constraint to the acquisition and use was the cost of the ITNs (Aikins, *et al*, 1994). In order for the rural farmers, irrespective of affordability, to buy and use ITNs, the promotion of ITNs should point out relevant and appropriate message on the relative importance of perceived reduction in nuisance mosquito biting and malaria as a

motivation for sustained use of ITNs. Capitalising on the cultural constructed disease condition of the disease in the community especially malaria and mosquito vectors. the farmers will eventually appreciate the association between the use of ITNs and the reduction of malaria. Consequently prevention of disease will become a stronger motivation for the use of ITNs than the reduction of nuisance mosquito bites (Lengeler, *et al*, 1996). When nets are used properly and regularly, they have positive impact on both the frequency of episodes in children and upon the level of infection in the mosquito population (Makemba, *et al*, 1995).

In the Rufiji delta, the farmers are one step ahead; the use of *mtuti* (the traditional sleeping bag) to protect themselves against nuisance biting. What remains is to raise their awareness on the association between mosquitoes and malaria and apply different opportunities to educate the community on the sustainable use of ITNs to control and prevent malaria. Studies conducted on ITNs in Malawi revealed that, though the use of malaria preventive measures was very low and income dependent, the educational messages increased community awareness that mosquitoes apart from the nuisance bites, transmit malaria and are the cause of malaria fever, the acquisition and use of ITNs increased (Macheso, *et al*, 1994). Trials conducted in Ghana showed that the buying of nets if available increased after the harvesting seasons when they had enough money to pay for the nets (Gyapong, *et al*, 1996). The family perception of malaria, determines peoples response to malaria control measures and health seeking behaviour (Pinikahana,

1992). One of the studies done in The Gambia on the three major tribes (Wolof, Mandika and the Fula) revealed that cultural beliefs, values and poverty may be a hindrance to some people towards acquiring and using ITNs (Pinikahana, 1992). A qualitative study using focus group discussion and semi-structured interviews conducted in Benin revealed that women's income, men's educational level and women's participation in communal organisations were the main factors in the use or non-use ITNs. Families that believed in non-western medicine associated malaria with exposure to the sun and therefore did not consider use of ITNs as a preventive measure against malaria. The study found that women were more inclined to buy ITNs even from their own incomes than men (Rashed, *et al*, 1999). So the community initiative efforts and support should be directed towards female's work, and intensive efforts to sensitise men and specific groups at risk is seen as a means to increase acquisition and use of ITNs (Rashed, *et al*, 1999).

An ethnographic study conducted in Bagamoyo District Coast region in Tanzania, demonstrated that the position of the term used to denote malaria in the local taxonomy of febrile illnesses had important implication for the design of health education interventions (Winch, *et al*. 1996), since most parents had different levels of understanding the etiological link between malaria and the mosquitoes. A similar anthropological survey conducted in Kenya extending for a period of four years found the same results when implementing the educational components of ITNs use in Kilifi

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district, Coast region in Kenya. In this study also it was found out that, although mothers understood the importance of using bednets year round, only 29% used them when it was too hot. This calls for the need for adequate resources for education to achieve behaviour change and practice in communities. Proper and relevant behaviour change communication is needed to maximise the effectiveness of messages and the methods used (Marsh, *et al,* 1996; Klein, *et al*, 1995; Karanja, *et al*, 1999).

3. PROBLEM STATEMENT AND RATIONALE OF THE STUDY:

Malaria is the number one cause of mortality in children in Sub-Saharan Africa including Tanzania and its complications accounts for much morbidity and mortality in pregnant mothers (WHO MOH, 1984, MOH, 1997). Loss of working days among the socio-economically productive population school absenteeism coupled with the bed occupancy rate, deficient drugs in health facilities and the economic loss as the result of the disease, elaborates the magnitude of the burden of disease (WHO MOH, 1984; Najera, et al, 1993).

The all round presence of malaria, the reported increasing malaria resistance, the unavailability and cost of anti-malarial drugs in the communities calls for an urgent need for an appropriate design which would be accepted and used by the people in the community (Fivawo, 1993; Molyneux, *et al*, 1999; Greenwood, 1999).

In the Rufiji flood plains, farmers migrate to their paddy fields during farming seasons, at the time when the rains humidity and temperature are high. These ideal conditions for mosquito breeding cause increased mosquito density. People are thus exposed to high transmission of malaria from intense mosquito bites due to lack of any protective measures.

The temporary shamba (stilt) houses built in the Rufiji flood plains where they migrate from their permanent residential houses are very small in size to the extent that they restrict free movements while inside. These houses have limited spaces to the extent that the conventional nets do not fit in these small shamba houses. The houses are built from planks of woods, which suspends the houses 1.5metres from the wet ground, and usually are thatched by the wild palm-like leaves and grass. The house walls, roof and basement have so many holes that mosquito easily passes through into the house. Moreover the door does not act as a deterrent against mosquitoes entering the house.

Usually adults, in most cases, man and wife and the pre-school children migrate to the shamba houses during the farming period. About 50% of the population migrate into the flood plains for cultivation and scaring away wild animals. The population which migrate into the Rufiji flood plains, are exposed to high malaria transmission due to:

High risk during season for transmission intensity.

No protection against malaria.

No health facilities.

In the Rufiji flood plain, most of the seasonal (pendular) migratory farmers inhabit the area in order to cultivate paddy and other relevant agricultural activities. The flood plain having the maximal prerequisite conditions for mosquito breeding, the farmers expose themselves to highest rates of mosquito bites and therefore malaria. Therefore the population needs to be protected while in the flood plains as when they are at their permanent residences. Unfortunately the conventional nets do not fit in these shamba houses as they are smaller and therefore can't be used in the temporary shamba houses as has been pointed out above.

For this reason 60% of farmers use the traditional mat designed as a sleeping bag, mtuti to protect themselves against mosquito bites. So there is need to enculturate the community from using *mtuti* to using ITNs that are more effective in preventing mosquito bites and malaria.

- It is difficult and expensive to design and build the normal houses in these flood prone areas in which the conventional nets would fit. Therefore a need for a cost-effective shamba ITN for malaria control, acceptable to farmers in the floodplains.

- The new ITNs technology had not reached the flood plain areas as far as their houses are concerned because nets which are supposed to fit into their houses and which do not

interfere with fast response towards repelling wild animals when they attack their shambas, are not available. Therefore almost 60% of the people have opted to use the traditional sleeping bag, *mtuti,* which actually does not confer complete protection against mosquito bites because:

Made from wild palm-like leaves locally known as *miyaa* or *mikochi*, they are heavy and poorly aerated, hot and sweaty

Given these circumstances individuals don't spend much time in the *mtuti*, they frequently come out of the *mtuti* now and then. In this way mosquitoes bite them and thus the *mtuti* does not protect them from malaria. Therefore this new intervention to be introduced in the Rufiji flood plains is intended to find out if the people will accept these new shamba ITNs as a cost-effective alternative to the *mtuti*.

The research was expected to give an insight into the acceptability of the appropriate shamba ITNs designed for the shamba (stilt) houses in the Rufiji floodplains. Being the first study of its kind on the shamba houses (*dungu*) and their requirements of ITNs, the outcomes, are envisaged to further support the current malaria preventive initiatives of the MOH.

Its against this background, the study, putting appropriate weight on malaria disease burden among the peasants who migrate into the Rufiji delta on seasonal or permanent basis, took up this challenge to design appropriate types of nets which fits in the shamba

houses and test their acceptability and use among the seasonal migratory farmers. The fact that the *dungu* huts are widely distributed among the rice farmers in Tanzania, this study is hoped to play a major step towards control of malaria in communities with similar circumstances.

4. THE STUDY QUESTION.

Currently available ITNs are not suitable for use by itenerant farmers and their families while they are at highest risk of malaria exposure during the five to six months they are residents in small permeable shamba houses situated directly in mosquito breeding sites. The research question is whether or not a specifically adapted shamba net will be accepted and used as a suitable preventive measure mosquito bites and malaria in the flood plains.

5. BROAD OBJECTIVES

(1) To design an appropriate and acceptable insecticide treated mosquito net for use in shamba houses.

(2)To determine acceptability and use of the shamba ITNs among the farmers in the Rufiji flood plain.

6. SPECIFIC OBJECTIVES:

(1) To design on appropriate and acceptable prototype shamba ITNs which could be used in the shamba houses in the primary prevention of malaria.

(2) To determine the acceptability and use of the new shamba ITNs.

(3) To identify modifications required to optimise the design of the shamba ITNs.

(4)To determine factors which influence compliance behaviour towards the use and acceptability of the shamba ITNs.

7. METHODOLOGY.

7.1. THE STUDY DESIGN.

This was an exploratory study on the pendular migratory farmers who live temporarily in the shamba houses for cultivation in areas with high transmission of malaria due to high density of mosquito populations during the rain seasons.

7.2.THE STUDY AREA:

SITE: The study was conducted in the Rufiji flood plain in Ikwiriri Ward, Rufiji District, in Coast Region, Tanzania. Rufiji district is one of the six districts that make up the Coast Region, namely Bagamoyo, Kibaha, Kisarawe, Mkuranga, and Mafia districts. Admnistratively, Rufiji district constitute of six divisions, 19 wards and 83 registered villages,

The Coast Region is located on the East coastal belt of the country, transcrossed by rivers Wami and Ruvu in Bagamoyo district and Rufiji in Rufiji District which is located in the Southern part of the region. Rufiji district is 13399 Km2, and lies between 7.47 and 8.40 latitudes South and 37.79 and 39.44 longitudes East (Matola, 1985), with an estimated population of 177,440 according to 1988 population census extrapolated to year 2000. Administratively the district has 6 divisions, 19 wards and 83 registered villages with approximately 30,272 households. Geographically the district has four distinct geographical zones, which are:

(a) Flood plains,

(b) Delta zone,

(c) Northern uplands,

(d) Southern uplands.

The indigenous tribes in Rufiji district are the Wandengereko, Wamatumbi, Warufiji, Wazaramo, and Wamakonde. The Wanyagatwa and Warufiji are subclans within the Wandengereko tribe who live along the coastal line and within the Rufiji delta respectively.

7.2.1. SELECTION OF STUDY AREA.

Ikwiriri Ward was selected in particular because Rufiji is one of the several districts introducing social marketing of ITNs in Tanzania. The work took advantage of the operational research station of TEHIP in Ikwiriri, which has been supporting behavior research on ITNs and perceptions of childhood illnesses. Also because of the TEHIP support, the Rufiji DHMT has undergone training in planning and budgeting, setting priorities, evaluation, supervision and resource allocation. This invaluable asset will continue to be utilised even when donor support in the district comes to an end. Capitalising on donor support, the DHMT and the identified village animators have been co-operating with peripheral frontline health workers to promote the use of ITNs, and encourage communities to retreat their mosquito nets.

During the rainy seasons, the farmers migrate into the river flood plain, which is a high malaria transmission area. There is no health infrastructure, no pharmacy shops and during the rain seasons the roads are impassable in the flood plain and transport in general becomes very difficult (see map). Means for environmental management is beyond the capacity of the community and the authorities.

Following floods and the increase in mosquito breeding sites, the intensity of mosquito bites is enormous, and this may explain the increased episodes of malaria in the area. The introduction of sustainable use of ITNs in the district will help to decrease the burden of disease and therefore improve the health status and the economic production.

7.2.2. ECONOMIC ACTIVITIES:

The majority of the people in Rufiji district (95%) exist on subsistence farming. Cash crops are coconuts and cashew nuts while food crops are rice, maize and cassava. Some of the income generating activities are fishing and petty trading. The household annual income is estimated to be 1,274,500 Tsh (Hogan, *et al*, 2000).

7.2.3. CLIMATE:

The climatic condition of Rufiji with an altitude of less than 500m.above sea level, can be best described as hot and humid throughout the year. The temperature ranges from 18 to 40 degrees centigrade and the maximum relative precipitation (humidity) recorded

ranges from 800-1000mm (64.7% to 85%), as being relatively high during the rainy seasons and low during the dry months of June to September. *Masika* or long rain extends from February to May, while the short rains (*vuli*) are usually from October to December (Gasarasi, *et al*, 2000., Matola, 1985).

The Rufiji river changes in width depending on the season of the year. During dry seasons the river narrows to about 40 metres in width, but during rain seasons the width may extend up to 25 km wide, and the ferry which operates across the river fails to cope with the floods, thus no reliable transport.

7.2.4. TRANSPORT:

The district derives its name from river Rufiji, which has a tendency to flood during the rain seasons. The main types of soil is sandy and clay soil in some areas. The main road (Kilwa road) from Dar es Salaam to Lindi and Mtwara regions pass through Ikwiriri which is about 186km South of Dar es Salaam. The ferry is the main means of transport to cross to either side of the river at all times except during the rain seasons when the river floods extensively.

During the long rains the clay soil becomes dumpy and slippery thus most roads become impassable rendering some of the health facilities inaccessible for supervision and supplies. The people who live on islands in the delta depend on canoes as means of

transport. During intense rains the river delta is also flooded, and it becomes impossible to travel to Utete district hospital and therefore they go to Mafia district hospital on Mafia island which is accessible by canoes.

7.2.5. HEALTH FACILITIES.

The district has two hospitals, Utete District Hospital run by the government, and Mchukwi Mission Hospital run by Pentecost Church. In total there are 49 dispensaries and four rural health centres, run by the local government and some are privately owned. Of the 49 dispensaries, only 17 are managed by the clinical officers (medical assistants) or clinical assistants (rural medical aid). The rest are run by health attendants or MCH Aids. This illustrates the acute shortage of health staff in the District. The population ratio per facility is 43,230 per health centre, and 3602 people per dispensary. The district experiences a shortage of 285 health workers of different categories. Poor health infrastructure and shortage of personnel are the main problems facing the health delivery system in the district.

From the above statistics, it is obvious that the health status of most of the people in Rufiji is poor due to poverty, high illiteracy rate and diseases like malaria. Malaria is the major health problem, as reported in the health facilities (Gasarasi, *et al,* 2000., Matola, 1985). The existing poor health infrastructure, for most part of the year is not accessible to most of the people, especially to those who live in the delta and flood plains. Therefore we need to design affordable, acceptable and cost effective ways of

controlling and preventing malaria, with the net effect of reducing the burden of diseases in Rufiji.

7.2.6. VITAL STATISTICS.

The infant mortality rate is estimated to be115/1000 live births, under-five mortality is 191/1000 live births and maternal mortality ratio is 175/100,000 live births and probably higher, because the data is health facility based and not community based (MOH, 1997).

7.3. TARGET AND STUDY POPULATION.

The sample frame was the people who have established temporary residence in the Rufiji flood plain near Ikwiriri town during this year's agriculture season. Due to the tendency of flooding during the rain seasons, there are no permanent houses in the flood plains. So the target population were families that have moved into the flood plain for cultivation within a 10-15km radius, all households in this area were registered. After a weeks work, 455 temporary households were registered. The previous sample size of 88 households calculated from the assumption that a 1000 households was the possible number of households in the flood plain within a five kilometre radius was maintained due to logistical reasons.

7.3.1. SAMPLE SIZE.

On assumption that 1000 households are within 5km radius of the flood plains in Ikwiriri, the sample size was calculated as follows:

$$n = \frac{Nz^2\ P(1-P)}{d^2\ (N-1) + Z^2\ p(1-P)}$$

Whereby:

N= total population/ number of households (1000 households)

Z= z value (corresponding to the confidence level) = 1.96

d= absolute precision (10% or 0.1).

P= expected proportion in the population (50%)

Considering a proportion of 50% of farmers will accept the shamba ITNs, since no other study has been apparently done before. Assuming the margin of error to be 10% at the 95% confidence interval, the minimum required sample size calculated was 88 households, in order to give a ± 10% precision on any estimates of the proportions in the range of 50%.

Therefore:

$$\text{Sample size} = \frac{1000 \times 1.96^2 \times 0.5\ (1-0.5)}{0.1^2 x\ (1000-1) + 1.96^2 \times 0.5\ (1-0.5)}$$

= 88 households.

7.3.3. STUDY POPULATION.

The study population was 102 household participants randomly selected from each of 455 households of the pendular migratory farmers who willingly volunteered in the

study and who lived temporarily within 10-15km radius of the study area. No participant was lost to the study.

7.3.4. SAMPLING METHODS.

The study used a simple random sampling technique for the people who lived in the flood plain (seasonal migratory farmers). These migratory farmers live under no formal administrative or organisational structure in the flood plains. During rain seasons transport is difficult, and the area is infested with wild animals due to proximity to the Selous game reserve. So the sample frame consisted of 455 households within a 10-15 km^2 radius which was sufficient to give a sample of 102 randomly selected shamba households. The sample was selected using the random sample table technique. A list of 455 households registered from the study area were given numbers from one to 455, which was used to select randomly the household for study starting from number 0016 on the random sample table.

Before starting data collection, the author travelled to Utete where the district administrative offices are located. Equipped with letters of introduction and ethical clearance the author introduced himself to the district authorities namely the District Medical Officer, The District Executive Officer and The District Commissioner. The district authorities were informed on the purpose of author's study from which the results are expected to help the district in particular and the nation as whole to identify

strategies for combating malaria among the pendular migratory farmers in Tanzania. Permission was granted from the district authorities the author travelled to Ikwiriri and did the same to the ward administrative authority and local councillors. The shamba residences lack a formal administrative structure, so during registration, the purpose of the study and the expected results were discussed with the household adult members. Each household was eager to be included in the study.

7.4. APPROACH.

The aim of the study was to design an appropriate shamba net, which could be acceptable and sustainably used by the seasonal migratory peasants of Ikwiriri, in the Rufiji flood plain. The peasants in the Rufiji flood plain and delta are exposed to a high transmission of malaria, therefore the need for intervention.

To determine acceptability and use, this study was designed to use qualitative methods in order to determine the community view, attitudes and any other obstacles towards the acceptability and use of the ITNs.

In December 1999, the author visited the flood plain for social mapping and feasibility study and was able to discuss with various groups of farmers within the flood plain. The farmers were able to identify malaria as the main health problem affecting their health and expressed the need for better barrier than *mtuti* for control of mosquitoes. Various

names were suggested for the expected nets including names like *Fahari* Nets and *Neti Poa*, names that were used during the study.

7.4.1. NET DESIGN.

After obtaining consent from the local leaders and the shamba house owners, when they had understood the objective of the study, permission was granted to take different dimensions of the shamba houses. Twenty shamba houses were randomly measured; length, width and elevations to the roof, and the mean were calculated. The mean of the 20 randomly selected shamba houses were as follows:

Length 283.6 cm.

Width 216 cm.

Height (H^1) 121 cm.

Height (H^2) 62.3 cm.

Elevation (height) from the ground to the floor 145 cm.

After taking the above measurements, taking into account the space of the shamba house, convenient activities of the farmers and limitations as mentioned above, the nets were designed in accordance with the mode suitable to fit in the small sleeping space of the shamba houses as follows (see drawings):

1) Pup tent type was named *Fahari* Nets.
2) Barrel type.
3) Triangular type named *Neti Poa.*

4) *Dungu*-mode type of nets (trapezoid).

5) Safari type.

At the end of January to mid February 2000, the net producing industries, A-Z in Arusha and TMTL in Dar es Salaam were contacted for their expertise and possible production. In mid March 2000, five types of the proto-type nets were produced but due to logistical reasons only two types, *Fahari Nets* and *Neti Poa* were selected for study. They were asked each to produce about 50 nets for the study. *Neti Poa* was produced by TMTL of Dar es Salaam and *Fahari Nets* by A-Z industries of Arusha. The nets came in different colours; white, green, blue and khaki.

7.4.2. DISTRIBUTION.

The net industries produced 100 nets in all, which were distributed to the selected households free of charge. After informed consent (see ethical consideration below), the head of the households were shown how to use the net properly. Then adult members were shown how to treat their nets with *Ngao* insecticides (deltamethrin, K-O TAB, by AgrEvo). When the whole procedure was understood the members were supervised on the net treatment. Each household provided with a net, dissolved the *Ngao* insecticide tablet (1.6 gram containing 25% deltamethrin) in a 350ml of water, in which the nets were thoroughly rinsed in the solution and then hanged in the shamba house to dry, away from sun light. The nets were hung in the shamba-house with the assistance of the principal investigator and his assistants.

7.4.3. STUDY SAMPLE.

A total of 102 households/ families were randomly selected within 10-15km radius in the study area. Proper use of the prototype ITNs and proper application of insecticide was demonstrated in each consenting shamba house. Then the prototype net was hung in the sleeping place. Then an in-depth interview was conducted using a relevant prepared questionnaire. The interview was conducted in two phases, **phase one** during distribution of the prototype nets, **phase two,** two weeks after use of the nets. During distribution the head of the household or his/ her replacement was interviewed using **phase one** open-ended questionnaire. After two weeks of use, the same respondent was again interviewed to verify acceptability of the proto-type nets using **phase two** open ended questionnaire.

7.5.1. RESEARCH INSTRUMENTS OF DATA COLLECTION.

Open-ended questionnaire was used during the interview to gain respondent's perspectives and experience on *homa ya malaria* and the possible preventive measures. The questionnaire was translated and back translated to and from Kiswahili and pretested on the applicability and relevant language axioms in Ikwiriri township. Pre-testing involved 10 households. Every response was recorded (transcribed) and analysed later.

7.5.2. TRAINING OF THE ASSISTANT.

Four indigenous assistants, with form four level education, assisted in conducting the study after a one day training. The questionnaires were translated into Kiswahili based on the local use and understanding of the idioms. The one day training reviewed each question systematically and translation done in accordance with the cultural norms of the people of the area.

Ten initial copies were used for a pilot testing to determine if there were any inconsistency and ambiguity of the sentences, words and idioms to expose weaknesses of administered questionnaires in order to make appropriate corrections.

7.5.3. STATISTICAL ANALYSIS.

All data were entered in a database program Dbase VI and analysed using the Epi Info Computer program to determine acceptance of the shamba nets by the seasonal migratory farmers in the Rufiji flood plains, Ikwiriri ward , Rufiji district.

7.5.4. ETHICAL CONSIDERATION.

According to the Nuremberg code of 1947, The Helsinki declaration of 1964, and the International Convention on civil and political rights 1966 and 1976 states that "No one should be subjected to torture or cruel, inhuman or degrading treatment or punishment.

In particular, no one shall be subjected without her / his free consent to medical or scientific experimentation".

So participants were informed that the aim of the study was to maximize benefits and the insecticides did not have any harmful effects on human beings. Each participating household was made to understand that their responses would be confidential and respected and results only used in aggregation.

So according to International Guidelines for Ethical Review of Epidemiological Studies of1991each household participant was finally selected for the study only after an informed verbal consent. All randomly selected household participants consented to the study.

7.5.5. LIMITATIONS.

(1) Interviewer bias:

Cultural and linguistic background of the interviewer may have caused a biased interpretation.

(2) interviewee bias:

Socio-cultural construction of disease conditions and local taxonomies, against the provision of free ITNs may have distorted the results.

(3) Time.

Time (eight weeks) was not enough for this study to be conducted in another similar districts to make comparative analysis.

(4) Selection bias.

Shamba houses selected were from one area close to town and may not be representative of shamba house populations far from towns or roads.

(5) Distribution of free nets and revisit after 14 days may bias acceptability results.

8. RESULTS.

A total number of 102 heads of households participated in this study during the eight weeks of June and July 2000.This samples was 16% more than the necessary minimum sample size.

Demographic characteristics of the study population.

Table 1 (a). Age and sex distribution of heads of households.

	SEX					
Age	Male	(%)	Female	(%)	Total	
18-29	4	(18.2)	18	(81.8)	22	(21.6)
30-39	22	(57.9)	16	(42.1)	38	(37.3)
50-59	4	(23.5)	13	(76.5)	17	(16.7)
60-85	15	(60.0)	10	(40.0)	25	(24.5)
Total	45	(44.1)	57	(55.9)	102	(100)

Table 1 (b) Previous use of ITNs.

Previous use of ITNs	**Frequency (%)**
Yes	12 (11.8)
No	90 (88.2)
Total	102 (100)

Table 1 (a) shows that the participant's age ranged from 18 to 85 years. Almost 58.9% of participants were between 18 and 39 years of age, and no participant belonged to age category between 40 and 49 years. Participants between 50 to 59 years comprised about

16.7% of the household participants. Among the household participants, 55.9% were women. This table shows that women are more involved as heads of household in shamba work than men as shown in the age categories between 18 and 39 years. This age group is significant in this study because it is this age which is in the reproductive age group and hence more susceptible to malaria when they conceive.

Table 1 (b) shows that prior to the introduction of the shamba nets, only 11.8% had ever used ITNs in their homes at one time or another in their lives. Among the household participants about88.2% had no history of ever using ITNs in their lives as control measures against malaria.

Table 2.Demographic characteristics of the study population.

Characteristics

Marital status	**Frequency (%)**
Married	80 (78.4)
Single	7 (6.9)
Separated	4 (3.9)
Divorced	3 (2.9)
Cohabiting	1 (1.0)
Other	7 (6.9)
Total	102 (100)

(Table 2 continued)

Ethnicity	
Wandengereko	78 (76.5)
Wamatumbi	7 (6.9)
Wamakonde	2 (2.0)
Others	15 (14.7)
Total	102 (100)
Education level	
No formal education	56 (54.9)
Adult education	10 (9.8)
Primary school education	32 (31.4)
Secondary school education	3 (2.9)
Above secondary education	1 (1.0)
Total	102 (100)
Underfives in the household	
One	34 (33.3)
Two	20 (19.6)
Three or more	8 (7.8)
None	40 (39.2)
Total	102 (100)
Occupation	
Farming with petty trading	50 (49.0)
Farming with fishing	11 (10.8)
Farming	41 (40.2)
Total	102 (100)

Table 2 shows that among the 102 household heads participated, 78.4% were married and were living with their partners. About 13% living alone either due to separation/ divorce/ widow or unmarried. Among the indigenous tribes in the Rufiji flood plain, the wandengereko consisted of 76.5% of the study population, and are the dominant group in the area. The Wanyagatwa, the coastal people and the Warufiji are sub-clans within the Wandengereko tribe. This shows that at least more than 80% of household participants had the same cultural background that may influence the use or non-use of the shamba nets. About 94% of the study population were Moslems and 6% were Christians. This table also shows that about 40% of the study population have no formal education. The rest have some level of education and can read and write. This table shows that about 60.8% of households or families live with one or more underfive children in the flood plains during agriculture while 39.2% did not have any underfive in the temporary shamba house. Though all household participants are farmers, about 49% are involved in petty trade and 10% in fishing activities.

Table 3.Duration of stay (in months) in the flood plain in the study sample.

Duration in months	Frequency (%)
Up to three months	47 (46.1)
Four to six months	10 (9.8)
More than six months	45 (44.1)
Total	102 (100)

Table 3 gives a picture of how much time is spent in the flood plain in a year. About 55.9% of the families spend six months in the flood plains away from their permanent homes. About 46.1% of the studied population spend about three months farming in plain especially during the months from April to July each year. About 44.1% of the household participating in the study spend more than six months in their temporary dwellings usually from February to July/ August. This time corresponds with high malaria transmission season and mosquito breeding during the rainy season. This means that people in the shamba huts expose themselves to mosquito bites during the time when mosquito population is high, malaria transmission is at its peak and acute disease is prevalent. Therefore the ITNs technology is important in reducing this mosquito human contact and therefore malaria episodes.

Perception regarding malaria fevers.

Table 4.Prevalence of malarial fever (*homa ya malaria*) as a major health problem among the study population

Major health problem	Frequency(%)	95% CI
Malaria	98 (96.1)	90.3-98.5%
Other illnesses	3 (2.9)	1.O-8.3%
Don't know	1 (1.0)	0.2-5.35%
Total	102 (100)	

Table 4 shows that 96.1% of the study population in the Ikwiriri flood plain identified malaria (*homa za mbu*) as the major health problem in the area. 2.9% participants indicated that diarrhoea and respiratory diseases were their major health problems. The

remaining 1% had no idea what was the major problem in the area affecting the farmer's health.

Table 5.Knowledge on seasonality of malaria among the household participants in the flood plain in Ikwiriri, Rufiji.

Season (period)	Frequency (%)
Rain season (*masika*)	86 (84.3)
Dry season (*vuli*)	9 (8.8)
All year round	3 (2.9)
Don't know	4 (3.0)
Total	102 (100)

Tables 5 shows that 87.2% of the household participants identified that malaria is a major health problem throughout the year, however 84.3% also identified that malaria peaks up during the rainy seasons. Only 3% of the participants were ignorant of the malaria seasonality.

Table 6.Knowledge on causative factors of malaria illness among household participants in the flood plain in Ikwiriri, Rufiji.

Causative factor	Frequency (%)
Mosquito bites	93 (91.2)
Overwork in the sun	4 (3.9)
Don't know	5 (4.9)
Total	102 (100)

(Table 6 continued)

Reason for occurrence of malaria	Frequency (%)
Increased breeding sites	82 (80.0)
Floods	12 (11.0)
Overstaying and working in the sun	10 (9.0)
Total	102 (100)

Table 6 shows the existence of local knowledge on factors important for transmission of malaria among the participant household respondents. About 91.2% of the study population had knowledge and were able to associate mosquito bites with transmission of malaria in the community. About 5% of the population studied had no knowledge as to what causes malaria. Those who were aware that mosquitoes transmits malaria only very few (less than 1%) were aware that not all mosquitoes transmit malaria.

Table 6 above shows that 80% of the population knew the association between mosquito density and the increased malaria attacks in the study area, while 11% associated malaria with the occurrence of floods. 9% of the population believed that too much working in the sun was the main reason behind many malaria attacks.

Table7.Action taken by participating households when they get malaria illness.

Where they go (consultation)	Frequency (%)
Health facilities	90 (88.2)
Drug shops	10 (9.6)
Traditional healers	2 (2.0)
Total	102 (100)

Table 7 provides an insight as to where people go to when they get sick. The trend above shows that the families go to health facilities first when they get sick, this accounts for 88.2% of the studied population. About 98% of the interviewees take their families to either health facilities or drug stores first when a member of their families gets sick. Only 2.0% of the interviewee responded that they consult traditional healers first for health consultation before seeking modern medicine.

Traditional healers include herbalists, sooth sayers, spiritual healers and all those who practice the traditional African ways of medical healing.

Malaria is a problem in the community even among adults. About 36.3% of household heads had suffered from malaria at least once in the past twelve months, 35.3% had attacks ranging from two to three and 18.2% had more than three attacks of malaria in the past twelve months, while the remaining 10.2% had no attack.

Perception regarding malaria prevention.

Table 8.Local knowledge on how malaria can be prevented among the participants in Ikwiriri, in Rrufiji.

Method of prevention	Frequency (%)
Plain (untreated) nets	42 (41.2)
Treated nets (ITNs)	9 (8.9)
Chemoprophylaxis	33 (32.4)
Aerosols/ repellents	6 (5.8)
Don't know	12 (11.7)
Total	102 (100)

Table 8 shows that of the household participants interviewed, 81.4% were of the opinion that malaria can be prevented and 6.9% indicated that there were no methods to prevent malaria. The rest (11.8%) did not know how to prevent malaria.

Table 8 shows that 41.2% are convinced that plain or untreated nets are the best method in prevention of malaria, while it is only 8.9% who believe that malaria can be prevented by treated nets. In this study, 32.4% of the household participants believe in chemoprophylaxis in the control of malaria. About 11.7% of the household participants did not know as to which method was the best in malaria prevention.

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Table 9.Prevalence of traditional methods of mosquito control in Ikwiriri.

Methods	Frequency (%)
Smoking/ burning traditional repellents	35 (34.3)
Traditional sleeping bag	66 (64.7)
Others	1 (1.0)
Total	102 (100)

Table 9 shows that about 34.3% of the household participants prior to this study were smoking or burning traditional repellents inside their shamba houses to keep away mosquitoes. Almost 64.7% of the household participants use the traditional sleeping bag (*mtuti*) to avoid mosquito bites. The remaining 1% depend on the home made nets sewn fron plastic sacks (*viroba*) to avoid mosquito bites.

Table 10.Health seeking behavior in the temporary farms.

Where people go when sick	Frequency (%)
Health facility	83 (81.4)
Alternative medical care (herbalists)	3 (2.9)
Spiritual healers	1 (1.0)
Dual consultation	7 (6.9)
Others	8 (7.8)
Total	102 (100)

Table 10 shows where people normally go when they get sick as observed by the interviewee in the community in the Rufiji flood plain. About 81.4% of population living in flood plain go to the health facilities. About 2.9% visit alternative medical

practitioners. It is only 6.9% of the population in the community who practice dual medical consultation. The last group, 7.8% consultation for any illness depends on local taxonomy of the disease condition and where they believe the illness can best be managed.

Post net distribution interview.

Table 11.Knowledge regarding malaria prevention after ITNs use.

Methods	Frequency (%)	CI
Treated nets (ITNs)	87 (85.3)	78.4-92.2%
Repellents	8 (7.8)	
Mtuti	5 (4.9)	
Others	1 (1.0)	
Don't know	1 (1.0)	
Total	102 (100)	

Table 11 shows different experiences as attained after recent use of ITNs compared to the usual practice of using mtuti (traditional sleeping bag) and other traditional repellents, usually applied in the community as a traditional ways of mosquito control. About 85.3% had the opinion that ITNs were superior to other methods in the protection against mosquito bites. It was only 12.7% of the household participants who were of the opinion that traditional methods were more effective than the shamba ITNs, 7.8% and 4.9% favouring repellents and the traditional sleeping bag (*mtuti*) respectively. The

other 1% was uncertain as to which method was more effective barrier against mosquito bites.

On acceptance of the shamba ITNs.

Table 12.Factors which influence farmers to buy nets in Ikwiriri

Reason	Frequency (%)
Mosquito bites	91 (89.2)
Prevention of malaria	10 (9.8)
Others	1 (1.0)
Total	102 (100)

Table 12 shows reasons that may influence farmers to buy nets. About 89.2% of the respondents were of the opinion that mosquito bites influenced greatly the people in the flood plain to buy bednets. Only 9.8% of the respondents said they bought net in order to protect themselves from malaria.

After the use of the shamba ITNs in the flood plains, the farmers experienced reduction of the mosquito bites, thereby increasing their knowledge on affectiveness of the shamba ITNs. After experiencing the shamba ITNs, about 69.6% of the study population attained the knowledge that the shamba ITNs had an advantage over the plain nets used in their permanent homes and are more effective in repelling mosquitoes than plain nets or *mtuti*. About 30.4% of the household participants did not know or were not sure yet if

the new shamba nets were more effective in mosquito control than the other methods normally used in the flood plains.

Table 13.Prevalence of respondents who after use, preferred the use of shamba ITNs over other traditional methods while in the shamba among the study sample.

Preference	**Frequency (%)**
Yes	101 (99.0)
No	1 (1.0)
Total	102 (100)

Table 13 shows overall preference of the shamba ITNs over the traditional methods as experienced by the families among the study population living in the Rufiji flood plain in Ikwiriri. About 99% of the families in the study population preferred the use of shamba ITNs to the traditional methods previously applied in the area. Among the respondents, only one respondent who makes 1% of the study population, a traditional medical practitioner thought that wearing of armlets (*hirizi*) and traditional scarification were the main protective method which should be applied in the said community to prevent individuals from any ailment, and ITNs being additive to the protective effect of the subjects.

Table 14.Factors that influence people not to buy ITNs.

Reasons	Frequency (%)
Poverty (low income)	99 (97.1)
Shamba houses	2 (2.0)
Others	1 (0.9)
Total	102 (100)

Table 14 shows that about 97.1% of the study population indicated that they could not afford to buy nets due to low income or poverty. The other 2.9% of household participants did not use nets because they were satisfied with the local methods available.

Table 15.Knowledge about retreatment of ITNs periodically.

Method	Frequency (%)
Three monthly treatment	78 (76.5)
Others	24 (23.5)
Total	102 (100)

Table 15 shows that despite the use of the shamba ITNs only 76.5% knew that retreatment was required every three months. The rest were unaware that retreatment was required every three months or after washing the nets.

Table 16.Prefered method of net treatment among the household respondents in the flood plains in Ikwiriri

Method of net treatment	Frequency (%)
Household treatment	80 (78.4)
Communal treatment	16 (15.7)
Others	6 (5.9)
Total	102 (100)

Table 16 shows that 78.4% wanted household (individual) net treatment while only 16.7% of communal dipping as a preferred method. The rest, 5.9% were indifferent to any of the methods.

Table 17.Household participant's suggested names for the shamba nets.

Suggested names	Frequency (%)
Ukombozi nets	16 (15.7)
Shamba nets	8 (7.8)
Shukrani nets	7 (6.8)
Salama nets	5 (4.9)
No change (neti poa and fahari nets)	27 (26.5)
Others	39 (38.2)
Total	102 (100)

Table 17 shows the names suggested by the study population in Ikwiriri. About 26.48% of the study population preferred the names of either *Fahari (pride) Nets* or *Neti Poa* (affordable) as brand names which indicates farmer's pride in their shamba work and affordability of the nets. About 15.7% of participants thought that the name of *ukombozi* (saviour) is a sound name for the shamba nets. Other names were *shukrani* (gratitude),

Shamba and *Salama* (safety) nets. The other remaining 38.2% of the study population interviewed suggested names that implied pride in shamba work.

Table 18.Color preference among the household participants in the flood plains.

Colour preference	Frequency (%)
White	10 (9.8)
Green	55 (53.9)
Blue	25 (24.5)
Grey/ Black	10 (9.8)
Khaki	2 (2.0)
Total	102 (100.0)

The table 18 shows the colour preference among the household participants in the flood plains in Ikwiriri. The figure shows that about 53.9% of the respondents preferred green to other colours. About 24.5% were for blue as their favourite colour and two groups both 9.8% of the study population indicated they preferred blue or white. The remaining 2% of the interviewed participants preferred khaki coloured nets. Most of the nets found in Tanzania markets are white in colour.

Table 19.Reason for preference of colours among the study group in Rufiji flood plain.

Reason	Frequency (%)
Not easy to soil/ get dirty	84 (82.4)
Easy nocturnal vision	1 (1.0)
Religious belief	17 (16.7)
Total	102 (100.0)

Table 19 above shows that most respondents preferred the darker colours to white nets because dark colours do not get easily soiled/ soiled especially as they were to be applied in the shamba area where during rain season mud may be a problem. For the 10% who preferred white to other colours were of the opinion that white nets enables them to see outside at night. Thus these factors are important to be considered, otherwise we may be making and selling items which the community do prefer.

Table 20.After exposure to the shamba ITNs what is the best method of controlling malaria/ mosquito bites in the flood plain.

Method of choice	Frequency (%)
Shamba ITNs	99 (97.1)
Mtuti	2 (2.0)
Hirizi	1 (1.0)
Total	102 (100.0)

Table 20 shows overall acceptance of the ITNs as the method of choice in the study group in the flood plain. Statistically it shows that 97.1% of the study population accepted the shamba ITNs as the method of choice in both mosquito bites and malaria

control. after the experience with the shamba ITNs. Only 3% of the household participants still believed in the traditional method of ailment control even after use of the shamba ITNs.

Table 21.After household participants experience/ use of the shamba ITNs, acceptance is as shown.

Acceptance	Frequency (%)
Yes	101 (99.0)
No	1 (1.0)
Total	102 (100.0)

Table 21 above shows that 99% of the population agreed that shamba ITNs were the most ideal for the existing conditions in the shamba area. The level of acceptance was a 99%. This takes into account the usual practice of using mtuti to avoid mosquito bites as compared to the newly introduced technology of new shamba ITNs.

The fact that these nets did not hinder their activities of chasing away animals at night, the shamba nets fitted the shamba houses and mosquitoes being repelled and therefore reducing the mosquito nuisance bites was the major reason which influenced acceptance of shamba ITNs in 99% of the migratory farmers in Ikwiriri, Rufiji.

9. DISCUSSION.

The present study was designed to look into the possible ways that can help the pendular migratory farmers can prevent malaria in their temporarily shamba houses during agricultural activities in the flood plains in Ikwiriri, Rufiji District, Coast Region, Tanzania.

The need to reduce vector human contact in this and similar areas is essential. Farmers migrate to the flood plains at the time when vector density and malaria transmission is high due to increased breeding sites during rain seasons, October to December for short rains (*vuli*) and February to May for long rains (*masika*). In these areas of the flood plains there are no health care facilities available.

The size of the shamba house (stilt) is smaller compared to the permanent houses as mentioned earlier, and thus the conventional bednets do not fit. Traditionally the migratory farmers have been using the traditional sleeping bag (*mtuti*) made from mats, to protect them from intense mosquito bites, which nevertheless does not confer the desired protective effect desired due to poor ventilation and heat, as it is the whole family which share the same *mtut*i. So the head of the family keeps on coming out from the *mtuti* to have a clear vision outside and escape from the heat inside the mat and there exposing themselves to the mosquito bites

Malaria control measures in this community living in an area with no health infrastructure necessitated the need to design new shamba ITNs that fits in the shamba houses (*dungu*) and test their acceptability.

No other similar study has been conducted anywhere therefore comparative epidemiological and ecological data are not available. Studies on ITNs have been conducted using conventional ITNs in the permanent homes so making this study unique in its attempt to address the need for prevention against malaria among the pendular (seasonal) migratory farmers in the Rufiji flood plains in Ikwiriri, Rufiji District, Coast Region, Tanzania.

Findings from this study indicate that overall women were 55.9% of the studied population, and women aged 18 to 39 (there was no woman aged between 40 and 49) comprised 33.3% of the study population. This being the reproductive age group which normally when they become pregnant, their immune system is compromised due to pregnancy and therefore susceptible to more severe malaria with its consequent complication such as anaemia, low birth weight babies, abortions and still births. Therefore this population group needs to be protected against malaria in order to reduce maternal morbidity and mortality.

In this study findings indicate that 60.8% of the studied household samples had at least one underfive child who was living with the parents/ guardian in the flood plains which

are high malaria transmission areas. About 27.4% of the studied households had more than one underfive children living in the shamba house while the remaining 33.3% of the households had no any underfive child.

As in pregnancy, the immunity against malaria in underfive children is poor or still developing and thus more prone to severe attacks of malaria and therefore higher burden of disease from morbidity and mortality (Murray, *et al*, 1990., Gwatkin, *et al*, 1999,2000., Najera, *et al*, 1993). Maternal immunity transmitted to infants from mothers in foetal life helps reduce mortality in the first three to six months of life. After this age the acquired immunity declines progressively and the protective effect wanes and children start to experience severe episodes of malaria, anaemia, cerebral malaria and other complication associated with malaria resulting in high morbidity and mortality seen in this age group (Najera, *et al*, 1993).

Findings from the studied population indicate that it is only 11.8% of the households participating in the study had at one time used plain nets in their permanent residences which nevertheless was not regular. The majority, 88.2% of the participating households have never before this study, used ITNs to protect themselves and their families against mosquito bites and malaria.

The majority of the people in Rufiji belong to one major ethnic group, the Wandengereko. They have similar cultural background and beliefs. Since most are indigenous and grow up in similar circumstances, it is possible that the population has

come to terms with the high mosquito density. The traditional method, *mtuti* has been the their main barrier control method against mosquito bites.

So it is likely that the farmers need information about ITNs to gain knowledge which will influence their behavior and produce change in their beliefs (Fivawo, 1993) and ultimately lead to sustained use of ITNs in the homes and in the flood plains.

It is important to note however that, the majority of household had married couples living together, 78.4% of the population in the flood plains and only 6.8% separated or divorced in this community which is dominantly Wadengereko.

In terms of education, 54.9% of the respondents had no formal education, 31.4% had attended primary school level of education, about 2.9% secondary education and only 1% had education level above secondary school. This indicates that 64.7%of the population had some level of education acquired from formal years of schooling, adult education or madras as they can read and write. As noted by Fivawo (1993) in her study on community response to malaria conducted in Muheza District in Tanzania, social differences especially in education did not show any significant correlation with prevention of malaria and ITNs acceptance but rather by attitudinal factors which influence compliant behaviour. This factor is reflected in the fact that only 11.8% of the study population had ever used bednets in their homes despite 59.8% of the population supplementing their agricultural incomes with incomes from petty trading and fishing

This indicates that acquisition of nets in the homes and in temporary shamba houses is not determined by the ability to pay, but rather by appropriate behaviour change communication in order to achieve a desired link between beliefs, attitude and behaviour culminating in the regular use of ITNs in the control against malaria (Fivawo, 1993.,WHO, 1998). So at the core of the issue poverty is not the real reason why farmers don't buy nets as observed in this study.

Migration to the flood plains corresponds to the long rainy seasons, which is ideal for cultivation of paddy. As water in the paddy fields is clear, the paddy fields acts as perfect mosquito breeding grounds for *Anopheles* mosquitoes. Therefore farmers migrate to the flood plains when mosquito density is high corresponding to the hazards of malaria in the population which relies traditional technology e.g. *mtuti* and smoking to waive away mosquitoes.

About 46.1% of the respondents indicated that they spend up to three months in the flood plains catering for their paddy fields. About 9.8% stay in the flood plains from four to six months and 44.1% spend more than six months in the area. Since the time spent in the fields corresponds with increased mosquito breeding sites and mosquito density, the rainy season is the time when malaria transmission is at its peak, thus malaria is more prevalent.

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Therefore the new technology is important in reducing human mosquito contact and malaria disease. In these endemic malaria transmission areas, ITNS should in the long term become normal household goods that should be affordable and accessible and at the same time addressing the plight of the poor, since they are the ones who usually affected by malaria, imposing a negative effect on their health and economic production, therefore a need for subsidising the nets (TDR News, 1996. WHO, 2000).

With increased regular use of ITNs in the households, farmers would produce more and spend less on medical consultation in terms of money, time and other scarce resources available in the community, thus enhancing their economic and social development (Najera, 1993., MOH, 1990., WHO, 2000., MARA, 1998).

Knowledge about malaria.

Findings from the study population indicate that 96.1% of the participants indicated that they recognised malaria (*homa ya malaria*) as the major health problem which affects their health peaking up during the rainy seasons, at the time when they establish temporary residence in the flood plains. About 84.3% of participants identified the rainy seasons as the time when malaria peaks up, and only 3% of the participants were ignorant of this malaria seasonality.

For most farmers it may not be easy to differentiate malaria from other kinds of fevers on the basis of symptomatology (Fivawo, 1993), however, a frequently experienced

disease is bound to show some generalisable characteristics which are usually used by the local folks, as a sign of the disease especially by the elders who usually are taken as knowledgeable in health and disease matters as found by Fivawo (1993) in Muheza District in Tanzania. In her study she found out that different names were used to describe different presentation of malaria. In Ikwiriri, the name *homa ya malaria* was used to describe uncomplicated malaria. Complicated malaria which presented as cerebral manifestations were regarded as *djini* (evil spirits), and anaemia as *safura* (Hookworm disease). Malaria was not associated with health problems like abortions, gastroenteritis, still births or low birth weights and poor child mental and physical developments, findings which agree with a study done in Muheza (Fivawo, 1993).

Studies done in West Africa and in East Africa, indicate that mosquito bites were regarded as nuisances and were not associated with malaria disease (Lengeler,et al, 1996). Findings derived from the flood plains in Ikwiriri indicate that 91.2% of the respondents knew that malaria was transmitted through mosquito bites and only 3.9% of the participants attributed the cause of malaria to staying and overworking in the sun and about 4.9% did not know the cause. Nevertheless those who were aware that mosquitoes transmit malaria, only a few (less than 1%) were aware that not all mosquitoes transmit malaria.

The existence of this local knowledge in this community can be credited to the Rufiji DHMT and TEHIP, who in the due course of promoting health and health intervention

activities in the district, have increased community awareness on disease control and management, whereby animators make regular household visits.

With existence of such knowledge in the community, communication behaviour change leading to adaptation to new ways of disease control can be discussed easily through community involvement and priority solutions implemented in a sustainable way.

The environmental conditions, which exist in the floodplains, which is the temporary residence of the farmers, health infrastructure, do not exist. Nevertheless they have to travel a distance of about 10-20 kilometres to reach a nearest health facility or drug shop at Ikwiriri. Dangers imposed by the presence of wild animal wandering from nearby Selous Game Reserve especially at night makes it impossible to travel at night. Usually the have to wait till dawn to travel to a health facility if anyone is sick and requires medical care. So reducing human exposure to mosquito bites in areas where environmental management and provision of health services are not possible in the near future, is the answer to improving health status of the population (WHO, 2000).

The farmers in the flood plains show that despite the attendance to the health facilities first when they get sick, they also do consult traditional medical practitioners. The nature, perception on symptomatology of the illness, belief, attitude and knowledge, dictate where people go first. In this study, complicated malaria which presented as cerebral malaria, was treated by traditional medical practitioners for it was associated

with evil spirits, usually called *djini* as found in Bagamoyo and Muheza studies in Tanzania (Premji, *et al*, 1995,. Fivawo, 1993). It is not known how many patients consult traditional medical practitioners since no register is kept and some do the consultation behind closed doors (secretly). So how many patients die following attendance at traditional medical clinics is not known, but the trend of patients who come to hospital late with severe complications may be indicating a tip of the whole problem. Najera (1993) reports that in Africa, only 2 to 20% of malaria cases are reported, therefore this may indicate that the remaining 80% consult the alternative medical practice or dual consultancy. The end result of this practice is deaths, which occur outside hospital settings, and end up unregistered, impeding proper planning and allocation of resources in the ministry of health.

As has been said, malaria is a problem among adults as well as children in the Rufiji flood plains as findings from the study indicate. About 36.3% of participants had suffered at least a single clinical episode of malaria in the last twelve months prior to the interview. About 35.3% had malaria episodes ranging from two to three in the same interval of time. At least 28.5% of the study population had suffered from four or more malaria attacks since last agricultural season i.e. the last twelve months.

These findings indicate that this community which is situated inside the high malaria transmission area, malaria is a health problem which affects people's health, social and economic production, therefore a need for malaria control.

Though malaria diagnosis is based on syndromic criteria without laboratory evidence, symptoms which enable to make diagnosis are straight forward and well understood in these communities (Fivawo, 1993,. Premji, *et al*, 1995). The complicated malarias are likely to be missed due to different ethnographic classification of disease in these rural communities. Therefore the extent of malaria as health problem in this community remains underestimated. Nevertheless malaria remains a major health problem on account of health statistics (MOH, 1996, Gasarasi, *et al,* 2000)

The fact that the community identified malaria as the major health problem (96.1% of participants) and were able to associate the disease with mosquito bites (91.2% of respondents) in contrast with other findings in other studies which indicate that the majority of the study population are often unaware of the association between mosquito and malaria, and mosquitoes were regarded as merely nuisance insects. The flood plains having no health infrastructure and economically disadvantaged need a cost effective malaria intervention to reduce the disease burden in the community. The conventional nets have an estimated life span of five years, likewise the shamba ITNs can last as long (Langeler,*et al*, 1996), therefore the shamba ITNs the measure of choice for the intenerant farmers in control of malaria. This indicates that the Rufiji population is primed for an ITNs intervention.

Malaria prevention.

About 81.4%of the study population had the opinion that malaria can be prevented. At least 6.9% of the interviewees were of the opinion that malaria can best be prevented by the regular and appropriate use of ITNs. The remaining 11.8%of the study population did not know how to prevent malaria. The fact that 41.2% thought that malaria can be prevented by plain or untreated bednets, needs educative sessions with the best required knowledge coming from members of the community through focus group discussions to make a choice on use the shamba ITNs in the protection against malaria as a selective mosquito control tool (WHO, 2000). This has a great potential for control of malaria and social economic development.

About 32.4% of the respondents indicated that malaria can effectively be prevented by chemoprophylaxis. This idea has evolved through the years of health education in health facilities, where traditionally people have told to take chloroquine chemoprophylaxis to prevent malaria. On the other hand, drug marketing/ advertisements have been to promoting chemoprophylaxis as the best single control measure against malaria. This entails the non realistic outdated practice of chemoprophylaxis to everyone in protecting individuals against malaria, in contrast to recently adopted practice of using chemoprophylaxis only in special groups like pregnant mothers and patients with sickle cell disease.

Regulations should be laid down to protect the health of the people despite free marketing. People should be educated or the community should be made to understand that chemoprophylaxis or any one method alone does not render complete protection against malaria as other factors also act synergistically in the disease development. Chemoprophylaxis may be ideal for some individuals in the community like pregnant mothers and individuals with sickle cell disease.

The prevalence of traditional control methods against mosquito in this community is an indicator that the community has identified that mosquito contact is a problem, which ends in malaria. Therefore have designed an intervention to protect themselves from these nuisance bites. This existing local knowledge can be used as a bridge towards introducing change in the community, by proper behaviour change communication and demand creation.

Capitalising on local knowledge, the need for protection against mosquito bites, community involvement is essential for sustainability. With appropriate knowledge, the community may be ready to acquire the shamba ITNs by prioritising them as household necessities (de Savigny, 1999., WHO, 1998, 2000., MARA, 1998).

Post distribution interview.

Before the distribution of the shamba nets, 41.2% of respondents believed that untreated nets were effective and a method of choice in malaria prevention while only 8.9% indicated ITNs, and 32.4% indicated chemoprophylaxis.

After experience of the shamba ITNs for two weeks, the farmers came to appreciate the effectiveness of the ITNs in reducing mosquito bites and indicated the need to buy nets to protect themselves against malaria and mosquito bites (89.2%). This indicates that after ITNs experience, willingness to buy nets developed in the farmer's community after proving their effectiveness against mosquito bites.

Post distribution findings indicate that 85.3% of household participants appreciated that ITNs effectively protect individuals from mosquito bites, which initially was 8.9% of the respondents at distribution interview, and none (0%) down from 41.2% who initially indicated that plain nets was a method of choice in prevention of malaria. This indicates that most of the time experience is the best teacher.

As the level of knowledge increased, preference for the ITNs to other methods increased to 99%, while only 1%preferred the other methods. About 76.5% of household participants became aware that ITNs needed retreatment every three months or after each wash for maintaining insecticide effectiveness, the rest were still unaware of the regular retreatment interval. About 78.4 of household participants wanted household or

individual retreatment of nets, 15.7% communal dipping as a method of choice, while5.9% of interviewees were indifferent to any of the method. This finding entails the need for availability of both household dipping preparations and communal insecticide preparation in order to promote ITNs compliance in the community (Lengeler, *et al*, 1996).

In the markets, there is preponderance of the white nets over the other colours. Findings in this study indicate that 53.9% of the study population preferred green nets, 24.5% were for blue nets. The preponderant white colour as seen in markets was preferred by about 9.8% of the population just as the grey or black nets. That it was difficult to soil them was the main reason why they preferred green or blue colours while those who chose white thought it was a sign of cleanness and the ability to visualise outside in case of wild animals destroying the rice at night.

Colours may play a major factor towards compliance of ITNs as for effectiveness of insecticidal properties to remain at required level, washing should be minimised otherwise it goes beyond the economic reach of most households/ individuals in the community (Lengeler, *et al*, 1996., Chavasse, *et al*, 1999). So in order to stimulate acquisition of the ITNs, industries and markets should vie predominantly for green and blue coloured nets/ ITNs in order to address the customers satisfaction rather than working on the theory of probability, and ignoring factors which influence demand.

Trade or brand names seem to have a captivating effect on potential customers though it was difficulty in this study to determine whether brand names had an effect on ITNs use. In this study in Ikwiriri, findings how that 26.5% of household participants still preferred the names *Neti Poa* and *Fahari* Nets suggested from the same community during situation analysis and social mapping to assess community needs in preparation for the study in December 1999. Post distribution names suggested included *Ukombozi* or saviour (15.7%), Shamba (7.8%), *Shukrani* or gratitide (6.8%) and *Salama* or peace (4.9%). All these names apart from identifying the farmers with the shamba nets illustrates appreciated effectiveness of the ITNs against mosquito bites.

Overall 99% of the population accepted the new designed shamba ITNs as the ideal method of choice in preventing human mosquito contact and therefore malaria in the existing environment of the floodplains in Rufiji against one percent of the total participants who persisted in believing in the perceived protective nature of the armlet, probably because she was a traditional medical practitioner. The 99% who accepted, indicated that they accepted because the new ITNs demonstrated the anti mosquito effects as experienced by the farmers and their families, were no longer disturbed by mosquitoes during sleep, nets fitted the shamba houses, does not obstruct vision or movement when inside the shamba houses. The low prevalence rate of 10% conventional nets may be due to affordability. The shamba ITNs will be cheaper and will be the only tool of malaria prevention. Depending on size, conventional nets are

sold at 3000 to 5000/= in the open markets, while the shamba ITNs will sell at 1000 to 1500/= which the farmers will afford.

The findings indicate that despite the existence of traditional technology, the farmers after trying/ experiencing the shamba ITNs, said they were ready to allocate their resources to the more effective shamba ITNs in the protection against mosquito bites and malaria.

10. CONCLUSION.

This study has shown that, seasonal migratory farmers in the Rufiji flood plains belong mainly to one ethnic group, the Wandengereko, and basically have a similar cultural background and beliefs. Shuttling between their permanent homes and the temporary residences in the flood plains, with underfives in 60.8% of households, where there is neither health infrastructure nor formal schools. It is only 31.4% of the population who have primary school level education, and about 3.9% with secondary or above secondary school education.

The study identified that despite the low level of formal education among the majority of the farmers, 96.1% of the community identified malaria as their major health problem. About 91.2% of the study population knew the association between mosquito bites and malaria and 84.3% recognised the peaking of malaria during the rainy season when the mosquito breeding sites increases. Therefore unlike in other studies, education was not a limiting factor, as the great majority of the population knew the cause of malaria.

Malaria has been found to be a problem even in adults whereby 71% of the population reported to have suffered from one to three attacks while18.2% had had more than three attacks and only 10.2% reporting no attack within a year's period. This problem may even be more in children and pregnant mothers who are more susceptible to the disease.

Before experiencing the shamba ITNs, 41.4% of the study population believed that malaria could be prevented by untreated nets and only 8.9% knew that ITNs were effective against malaria, and 32.4% expressed that chemotherapy was the best method in preventing malaria. Low level of community knowledge about malaria prevention and the benefits of ITNs was a prominent feature in this community prior to the introduction of the shamba ITNs. After introduction of the shamba ITNs, community knowledge on benefits of ITNs in prevention of malaria improved, beliefs and attitudes changed. About 85.3% of the study population came to appreciate the effectiveness of the ITNs as the method of choice in preventing mosquito bites and malaria, about 76.5% became aware that nets needed retreatment every three months or after washing. This may be an indicator for a community primed for ITNs intervention, and enculturation to ITNs use.

In this study, 89.2% of the population indicated that they wanted to buy nets in order to prevent mosquito bites, but 97.1% of the study population indicated that low income was the main reason why they failed to buy ITNs and therefore resorted to the traditional method of mosquito control namely smoking and burning of mosquito repellents in 34.3% and the use of the traditional sleeping bag, *mtuti* in 64.7% of the study population. So this finding illustrates that they were using traditional methods of mosquito bite control because conventional nets are expensive. Therefore because the shamba ITNs are going to be relatively cheaper, 1000 to 1500/= as compared to the market price for the conventional nets, the farmers community in the flood plains are

expected to afford the shamba ITNs for the purpose of control of *homa ya malaria* and mosquito bites.

On net treatment, 78.4% preferred household treatment and 15.7%were for communal dipping, indicating that both methods should be made available to meet the requirements and preferences of each household which will promote ITNs use and sustainability which eventually may end up in reducing prevalence of malaria.

Findings in this community indicate that prior to the introduction of ITNs, 32.4% of the population believed that chemoprophylaxis was the most effective method in prevention of malaria. This knowledge has been gained from different sources including health facilities, drug shops and advertisements. Since this message does not portray the facts the community should know and understand in order to prevent malaria, chemoprophylaxis messages should be regulated so that they transmit proper health messages which educate the community on the existing and recommended methods which in combination gives the desired effectiveness in malaria control instead of the profit oriented drug promotions.

In this study, 53% of the study population preferred green nets to the other colours. About 24.5% preferred blue nets while only 9.8%preferred white nets and about the same proportion preferred grey nets. This finding indicates that the net industries by manufacturing the preponderant white nets over the other colours as observed in the

markets. though ITNs are regarded as an essential public intervention and household good, supply of the nets according to colour preference and the type of net treatment are yet to be addressed in order to meet the felt needs of the customers especially those at risk of malaria.

In this study, low level of knowledge about malaria prevention and the benefits of ITNs, low income in the poor families against relatively high prices of the nets, limited the previous use of nets in the families. When knowledge and information on hazards on malaria was gained, acceptance of ITNs increased to 99% among the farmers in the flood plains. The degree of ability to visualise outside at night when guarding against wild animals, minimal limitations to movements when inside the net, proper fitting of the nets inside the shamba houses and the observed effectiveness of the shamba ITNs in expelling mosquitoes were the main reasons for the shamba ITNs acceptance. In this study, the ITNs were accepted because they addressed the community felt needs and experience helped them to contrast between the effectiveness of the traditional methods of mosquito control against superior new technology in the shamba ITNS.

Therefore a study should be conducted to determine need, promotion and demand creation of the ITNs in populations with similar circumstances like the Maasai houses (*manyata*), Wagogo houses (*nyumba za tembe*), and the Hadzapi/ Iraqw tribes who practice different sleeping patterns and different types of houses. These communities with similar characteristics, whose houses the conventional nets may not be fitting and

there is low coverage of ITNs, should be assessment, and felt needs addressed through community involvement.

11.RECOMMENDATIONS.

11.1. To the government:

1. The government should waive taxes on ITNs materials so that the poor can better afford to buy the ITNs.
2. The government should utilise the media such as radio and television to educate the community on hazards of malaria in Tanzania and advocate proper ITNs use as the most effective method in malaria control through proper and relevant ICE (Information, Communication and Education) materials.
3. The government should support more research on malaria to find the most appropriate ways of fighting against malaria in different communities in Tanzania.
4. The government should regulate market oriented messages/ advertisements geared towards maximal profit generation but not malaria prevention as the case of chloroquine chemoprohylaxis.
5. The government should promote community involvement in identifying their health problems and give support in solving them.

11.2 To the bednet manufacturing industries:

1. Production of ITNs should also prioritise those communities whose houses are not ideal for conventional bednets, as we are both partners in the fight against malaria in Tanzania.
2. The colour most people preferred was green followed by blue. Therefore nets should be produced in colours which customers prefer to increase compliance.
3. Brandnames suggested from the community may play a role in marketing the nets.
4. Production of the nets should go hand in hand with availability of insecticides, designed for household net treatment and some for communal dipping to help increase ITNs compliance.

11.3 To the Tanzania Research Community.

1. Research should be conducted to address questions which were not tackled/ emerged in this or during the study, eg. The proportion of pregnant women who migrate to the flood plains, the age structure in the households in the floodplains, comparative study in population living in more remoter areas.
2. Researches to determine (long term follow up) whether shamba ITNs users go on to become regular ITNs users

3. Research on how the poor health infrastructure affects their health seeking behaviour and the magnitude of home/ community medical care and deaths that occur at home.
4. Research to determine person time (person months/ year and person years/ year), under-five person time and women child-bearing age person months in relation to exposure to malaria risk in the flood plains.

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