



**ADDIS ABABA UNIVERSITY  
GRADUATE STUDIES PROGRAM  
BIOLOGY DEPARTEMENT**

**IMPACT OF MALARIA CONTROL MEASURES ON MALARIA  
PREVALENCE AND PUBLIC AWARENESS IN URBAN AND RURAL  
SETTINGS OF KEMISIE, OROMIYA ZONE, AMHARA REGION.**

A Thesis submitted to the School of Graduate Studies of Addis Ababa  
University in Partial Fulfillment of the Requirements for the Degree of  
Masters of Science in Biology (BioMedical Science)

HaileMariam Getaneh

Addis Ababa

June 2010

**ADDIS ABABA UNIVERSITY  
SCHOOL OF GRADUATE STUDIES**

IMPACT OF MALARIA CONTROL MEASURES ON MALARIA  
PREVALENCE AND PUBLIC AWARENESS IN URBAN AND RURAL  
SETTINGS OF KEMISIE, OROMIYA ZONE, AMHARA REGION.

**By  
HaileMariam Getaneh**

A Thesis submitted to the School of Graduate Studies of Addis Ababa  
University in Partial Fulfillment of the Requirements for the Degree of  
Masters of Science in Biology (BioMedical Sciences stream)

Approved by the Examining board:-

Dr. Amha Kebede (Examiner)

Prof, Beyene Petros (Advisor)

Dr. Dawit Abate (Chairman)

## **Acknowledgements**

First and foremost, I would like to express my deepest gratitude to my advisor Prof. Beyene Petros for his unreserved guidance and encouragement at all steps of this study. His kind approach, constructive comments, share of experience and smooth treatment are among which I appreciate. Secondly, my thanks to the School of Graduate Studies Department of Biology Addis Ababa University Science Faculty (AAUSF) for research facilities and financial support of the project.

Thirdly, my special thanks go to Kemisie Zone Administrative and Health Office, Kemisie and Dawa Chefa Woreda Health and Malaria control Office, especially, I would like to thank Yimam Muhe and Seid for offering me essential technical support and provision of the necessary data. I am also grateful to Kemisie and Woledi Health Center administration and the staff members, and health assistances of Shekila and Koladi Kebeles for their considerate follow up in mobilizing logistic support during sample collection, especially Tilahune in facilitating conditions for utilizing the laboratory setup and providing me some information regarding the status of malaria in the area.

Innumerable thanks go to my family, for all relatives and friends for their genuine moral and financial support.

## Table of Contents

	Page
Acknowledgement .....	i
Table of contents .....	ii
List of table .....	iii
List of figures .....	iv
List of abbreviation.....	v
Abstract.....	vi
1. Introduction .....	1
1.1. Malaria in Ethiopia .....	4
1.2. Life cycle of malaria parasite and the malaria vector .....	8
1.3. Malaria control strategy .....	10
1.3.1. Case management.....	12
1.3.2. Indoor residual house spraying (IRS) .....	14
1.3.3. Insecticide treated bed nets (ITNs) .....	16
1.3.4. Environmental management .....	17
1.3.5. Biological control .....	18
1.3.6. Significance of the study .....	19
2. Objective .....	20
2.1. General objective .....	20
2.2. Specific objectives .....	20

3. Material and methods .....	21
3.1. Study area .....	21
3.2. Sample size determination .....	23
3.3. Parasitological survey .....	24
3.4. Knowledge, attitude and practice (KAP) survey.....	25
3.5. Data analysis .....	25
4. Results.....	26
4.1. Clinically treated malaria in Kemisie.....	26
4.2. Malaria prevalence in the study localities of Kemisie .....	29
4.3. Malaria control measures in the study localities of Kemisie .....	33
4.4. KAP survey in mode of malaria transmission.....	34
5. Discussion .....	38
6. Conclusion and recommendation .....	43
7. References .....	45
- Appendices .....	54

## List of Tables

Table.1. Annual malaria prevalence and total morbidity data obtained from clinical records of Kemisie and Dawa Chefa Health centers, from 2005/06_2007/08.....	26
Table.2. Yearly record of malaria control activities in the study area of Kemisie Town and Dawa Chefa Woreda, 2006_2008 .....	28
Table.3. Demographic characteristics of the survey population by age /sex in Kemisie town and rural Kebeles, November/December 2008.....	30
Table.4. Prevalence of <i>Plasmodium</i> species among the study localities in Kemisie town and rural Kbebeles, November/December 2008.....	31
Table.5. Demographic characteristics of the KAP study participants (n=90) in the study localities of Kemisie town and rural Kebeles, November/December 2008.....	35
Table.6. Malaria control measures reported by the study participants in Kemisie town and rural Kebeles, November/December 2008.....	36
Table.7. ITNs use pattern within the family in the study localities in Kemisie town and rural Kebeles, November/December 2008.....	37

## List of Figures

Fig.1.The lie cycle of <i>Plasmodium</i> species. ....	8
Fig.2. Map of Oromiya zone, Amhara regional state .....	22
Fig.3. Prevalence of malaria infection by age group in Kemisie town and rural Kebeles, November/December 2008.....	32

## List of Appendices

Appendix.1. Malaria parasite distribution among the study subjects by sex, age, and stage of the parasite detected in Kemisie, November/ December, 2008.....	54
Appendix.2. KAP Questionnaire.....	55
Appendix.3. Annual malaria prevalence and total examined data obtained from Clinical records of Oromia Zone, Amhara Regional State from 1999 _2008.....	57
Appendix.4. Consent form.....	58

## Abbreviations

AAUSF	Addis Ababa University Science Faculty
ACT	Artemisinin-based Combination Therapy
AL	Arthemeter Lumefantrine
CQ	Chloroquine
CSA	Central Statistics Agency
DALYs	Disability Adjusted Life Years
DDT	Dichlorodiphenyltrichloroethane
FMOH	Federal Ministry of Health
IRS	Indoor Residual Spraying
ITNs	Insecticide Treated Nets
LLIN	Long Lasting Insecticide Net
MARA	Mapping Malaria Risk in Africa
P.f.	<i>Plasmodium falciparum</i>
P.v.	<i>Plasmodium vivax</i>
RBM	Roll Back Malaria
SP	Sulphadoxine-Pyrimethamine
SPSS	Statistical Package for Social Science
SSA	Sub-Saharan- Africa
UNICEF	United Nations Children’s Fund
WDP	Water Dispersible Powder
WHO	World Health Organization

## **Abstract**

Assessment of malaria control efficacy on malaria prevalence was conducted from November/December, 2008 in Kemisie town and in three surrounding rural Kebeles in Dawa Chefa District. Retrospective data on malaria and malaria control activities were obtained from Kemisie and Woledi Health Centers and the District malaria control office for the years 2005/2006 up to 2007/2008. Parasitological survey was conducted during peak malaria transmission season of the area (November/ December 2008). The retrospective clinical reports of Kemisie and Woledi Health Centers showed malaria to be over 31% average annual prevalence, making it a major infectious disease, constituting significant public health problem. On the other hand, examination of blood films from a random sample of 300 individuals, from six Kebeles of Kemisie town and nearby rural Kebeles in 2008 malaria season, detected 5.3% malaria prevalence only. This finding revealed a significant reduction in malaria prevalence, which suggests improvement in malaria control and intervention in the study area. The difference in malaria prevalence between Kemisie town (2.7%) and the rural Kebeles (8.0 %) in the 2008 survey was significant ( $P < 0.05$ ), suggesting a less effective malaria control in the rural Kebeles. Malaria prevalence among different age groups showed more than half of malaria positive individuals to be 15 years and above, indicating lack of anti malaria immunity with increasing residence in the area. The main malaria control measures in the study area were combined use of IRS and ITN supplemented with source reduction activities and treatment of positive cases. There was significant improvement in ITN coverage per household in 2008 compared to 2006(both in urban and rural settings) ( $P < 0.05$ ). The proportion of households with at least one ITN was above 83% whereas IRS coverage per household did not show much change from year to year both in Kemisie town and rural Kebeles. A higher proportion of population was involved in source reduction activities in 2008, with significantly ( $P < 0.01$ ) higher involvement of urban Kebeles (84.0%) compared to the rural Kebeles (49.2%). Despite relative progress shown in malaria control activities both in the urban and rural Kebeles, the KAP survey revealed higher awareness of the urban population about malaria infection and malaria control measures compared to the rural residents. Therefore, based on the present findings, extra attention should be given to the Kemisie rural communities to provide appropriate malaria control and intervention measures and the malaria control activities in Kemisie town must be continued in a sustainable manner.

**Key words:** Malaria prevalence, Malaria control, ITNs, IRS, Kemisie.

## 1. Introduction

Malaria poses one of the greatest threats to human life in the developing world. Of the estimated 1 million malaria deaths worldwide, 90% occur in Africa, killing mostly young children at a rate of 3,000 every day. Malaria costs Africa US\$12 billion every year in lost productivity (RBM, 2006). Currently, in countries with a very heavy malaria burden, the disease can account for as much as 40% of public health expenditure, 50% of inpatient admissions and up to 60% of outpatient visits (Lambert, 2005).

The overwhelming bulk of the world's malaria burden rests upon the population of sub-Saharan Africa because of the unique coincidence of expanding human populations, weak health systems, the world's most efficient vector mosquito species and environmental conditions ideal for transmission (Killeen *et al.*, 2002). In sub-Saharan Africa, *An. gambiae* s.s., *An. arabiensis*, and *An. funestus* are the primary vectors of malaria parasites and show highly anthropophilic tendencies (Keating *et al.*, 2004). The two most important members of the *An. gambiae* complex are *An. Arabiensis*, with plentifully indoors or outdoors, and *An. gambiae* s.s. with females more likely to bite humans indoors. Evidently these anophelines have co adapted to human ecosystem in the Afro-tropical savannah where their combined contributions to malaria transmission have apparently facilitated evolution of *falciparum* malaria (Mukabana *et al.*, 2006).

Africa experiences a complete spectrum of malaria epidemiology ranging from intense perennial transmission to unstable epidemic prone areas (MARA, 1998). According to RBM (2003), malaria accounts for up to 60% of all health facility visits in the eastern African region. However, due to poor health care coverage and other factors, much of the malaria-related illness and death actually occurs in the home, therefore, going unreported. The disease epidemics affect non-immune populations in many highland and semi-arid areas of the continent. It frequently affects highlands and semiarid areas where populations lack immunity (Abeku, 2007). The control of malaria and its anopheline vectors in Africa is less successful because of the occurrence of drug resistance parasites and insecticide resistant vectors, change in the resting behavior of mosquitoes (from indoor to outdoor) as a result of frequent indoor insecticide sprays, lack of efficient infrastructure, shortage of trained manpower, lack of equipment, financial constraints, lack of appropriate management and inability to integrate several methods of control (Toure',2001; Howard *et al.*, 2007).

The malaria situation is worsening with the evolution of resistance to cheap and easily available drugs and insecticides, changes in environmental conditions leading to increasing epidemics, civil unrest coupled with population movements and economic development programmes in risk areas such as wetlands, desert fringes, and highlands. This way malaria has spread into areas, which previously had low or no transmission (FMOH, 2004a).

Malaria control is an increasingly important focus for the international body concerned with public health and disease control. Fighting malaria has become a priority in reaching six of the eight Millennium Development Goals (WHO, 2008). One of the important part of the global malaria control strategy is vector control (Toure', 2001). According to World Malaria Report (2008), the combination of tools and methods to combat malaria now includes long-lasting insecticidal nets (LLIN) and artemisinin based combination therapy (ACT) supported by indoor residual spraying of insecticide (IRS), and intermittent preventive treatment in pregnancy, presents a new opportunity for large scale Malaria control. The idea behind vector control is to reduce the level of mortality and morbidity by reducing transmission of the disease. It was reported that The Global Malaria Action Plan aims to cut deaths and illness by 2010 to half their 2000 levels by scaling up access to ITNs, IRS and treatment ,and achieve the near-zero goal through sustained universal coverage(WHO,2008).

Initial evidence indicated that the combination of mass distribution of LLIN to all children < 5 years or all households and nationwide distribution of ACT in the public sector was associated with substantial declines of in-patient malaria cases and deaths in Rwanda and Ethiopia (Otten *et al.*, 2009). Clinic-based data was a useful tool for local monitoring of the impact of malaria programmes.

## 1.1. Malaria in Ethiopia

Malaria is one of the country's foremost health problem top ranking in the list of common communicable diseases (FMOH, 2005). In 2002/03 the disease has been reported as the first cause of morbidity and mortality accounting for 15.5% outpatient consultations, 20.4% admissions and 27% in-patient deaths (FMOH, 2004a). Even in 2004/05, it was reported to be the leading infectious disease followed by helminthiasis and tuberculosis (FMOH, 2005; Shargie *et al.*, 2008).

According to FMOH (2004a), in non-epidemic year, 5 to 6 million clinical malaria cases and over 600,000 confirmed cases were reported from health facilities. An estimated of more than 65% of the 70 million people has been reported to be exposed to the disease. Nevertheless, as the potential health service coverage is accessible to about 61% of the population and due to low service utilization rate (27%), the number of malaria cases reported by the health facilities is only a portion of the actual magnitude. FMOH (2008) reported, about 52 million people in Ethiopia faced the risk of malaria, primarily in areas below 2,000 meters in altitude.

The malaria species which cause human malaria are *Plasmodium falciparum*, *P.vivax*, *P.ovale* and *P. malariae*, all of which are transmitted by female anopheles mosquito. All four species of *Plasmodium* are known to occur in Ethiopia (Krafsur and Armstrong, 1982). However, *P. falciparum* and *P.vivax* are the most dominant malaria parasite in the

country, accounting for 60% and 40% of malaria cases respectively. *P. malariae* accounts for less than 1% and *P. ovale* is rarely reported (Tulu, 1993).

The epidemiological pattern of malaria is generally unstable and seasonal, the level of transmission varying from place to place because of altitude and rainfall patterns (GebreMariam, 1984; Nega and Hilemeskel, 1991). The major transmission of malaria follows the June to September rains and occurs between Septembers to December while the minor transmission season occurs between April to May follow the February to March rain (FMOH, 2005).

The main components of malaria control in Ethiopia include diagnosis and treatment of cases, the application of selective vector control measures and the strengthening of the information system to facilitate prevention, early detection and control of epidemics. Vector control is carried out mainly by means of environmental and chemical measures; either applied singly or in an integrated manner, and is based on local epidemiological conditions. In some areas, the community is actively participating in source reduction with malaria control and other health workers providing technical guidance. Results have been satisfactory, particularly in urban centers, settlement villages, and army camps and agro-industrial centers (Abose *et al.*, 1998, Ghebreyesus *et al.*, 2006, Lautze *et al.*, 2007).

More recently, community education regarding the use of ITNs and its supply progressed as one major strategy of malaria control in the country. According to FMOH (2008), with the past 3 years, FMOH and its partners implemented swift Malaria prevention and control programs in country. It was reported that more than 20 million ITNs had been distributed, access to medicines and IRS of households had been considerably increased

and more than 24,000 health extension workers were trained and deployed to improve malaria case management at community level.

Malaria control is a big challenge due to many factors: There is the complexity of disease control process; the complexity of the vectors; expensiveness of the control program. There is a variation of disease patterns and transmission dynamics from place to place, by season and according to climate and environmental circumstances. Since malaria varies from season to season and from place to place within a country, approaches will also differ in the planning and implementation of vector control. Each region's circumstances will influence the organization of practical programmes to identify local problems and priorities, and the design and implementation of appropriate interventions. Therefore, selection of suitable, sustainable and cost-effective interventions must be based on local analysis (Lambert, 2005).

Generally malaria control strategy in Ethiopia should need careful consideration and appropriate decisions on what control measures to be applied, for a maximum cost-effectiveness (FMOH, 2006). It was suggested that a number of control measures are available which differ in their levels of effectiveness. Thus selection of a method should consider the magnitude of the malaria problem, the major vectors involved, levels of transmission and risks groups, available resources, technical and operational realities. Sustainability of selected interventions must be assured. In most cases these measures should be used in an integrated manner to maximize effectiveness.

According to yearly malaria situation reports of Kemisie Health Centers, malaria prevalence was highest from 2004 to 2006 and decreased in the following years.

In contrast, in near by rural Kebeles, no sizable reduction was seen in malaria prevalence (Table.1). Similarly, the data of malaria control activities of Kemisie, IRS distribution of ITNs and community based source reduction activities have been the main control measures undertaken in recent years. Therefore, by gathering relevant documented data and epidemiological survey, this study was designed to compare the efficacy of malaria control measures between Kemisie towns and near by rural Kebeles, and to relate the prevalence survey finding to routine surveillance data for further application of malaria control measures.

## 1.2. The life cycle of malaria parasite and the malaria vector

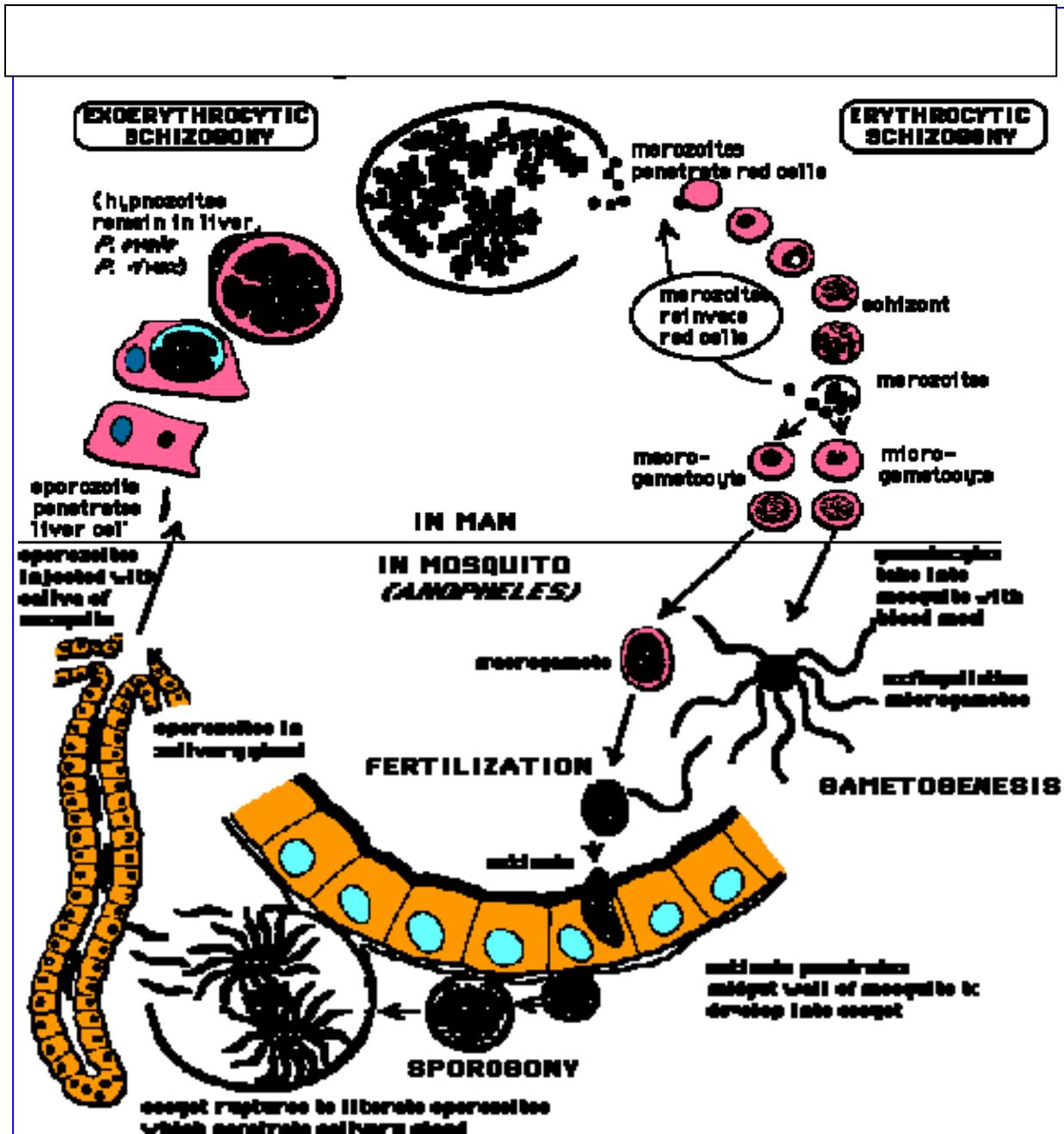


Figure 1. The life cycle of malaria parasite. (Source: [http://www.microbiologybytes.com\(2009\)](http://www.microbiologybytes.com(2009)))

The malaria parasite life cycle involves two hosts. During a blood meal, a malaria infected female *Anopheles* mosquito inoculates sporozoites into the human host. After entering the circulatory system, the sporozoites make quick work of invading liver cells (hepatocytes) using the apical organelles (characteristic of all apicomplexans). After being introduced into the human intermediate host, it enters the bloodstream and is carried to the liver. There, it penetrates hepatocyte and undergoes growth and multiplication. In the case of *P. vivax* and *P. ovale*, some sporozoites transform to the dormant hypnozoite, remaining viable for up to 50 years (Krotoski *et al.*, 1982). This stage is responsible for relapses when it re-enters its developmental cycle. Inside the host's liver cell the *Plasmodium* cell undergoes asexual replication. After 9-16 days they return to the blood and penetrate the red cells, where they multiply again, progressively breaking down the red cells. This induces bouts of fever and anemia in the infected individual. In cerebral malaria, the infected red cells obstruct the blood vessels in the brain. Other vital organs can also be damaged often leading to the death of the patient.

There are about 400 different species of *Anopheles* mosquitoes transmitting malaria, of which only about 70 species have been definitely incriminated as vectors of human malaria (Service, 2000). In Africa, members of *Anopheles gambiae* complex and *Anopheles funestus* are widely distributed and are responsible for the transmission of malaria in the region (Coetzee *et al.*, 2000). *An.gambiae* s.s is the most anthropophilic species in the complex and the most important, probably the world's most efficient malaria vector with characteristic indoor and outdoor resting. *Anopheles arabiensis* and *An. quadriannulatus* sp. B are among the species of the *An. gambiae* complex that are found in Ethiopia (GebreMariam, 1984). *An. arabiensis* occurs in most areas of tropical

Africa and could be considered as a major target for control, as a major vector where malaria transmission is stable (Fortenille and Lochouran, 1999). It is the principal vector of epidemic malaria in all administrative regions of Ethiopia (Ameneshewa, 1995). Apart from the members of *An. gambiae* complex, *An. pharoensis* and *An. nili* are regarded as secondary vectors of malaria in Ethiopia (Nigatu *et al.*, 1994; Abose *et al.*, 1997). Even though entomological findings conducted so far indicated the presence of 42 anophelines in Ethiopia, only *An. arabiensis* is known to play a crucial role in malaria transmission in the country. Others, such as *An. funestus* and *An. pharoensis* playing secondary role, while *An. nili* involves transmission in localized areas (Abose *et al.*, 1997).

### **1.3. Malaria control strategy**

Despite a control program lasting over 40 years, the majority of Ethiopia's population is still at risk from malaria (Fontaine *et al.*, 1961; Negash *et al.*, 2005). The control of malaria in the country has a history of more than four decades, which initially began as pilot control projects in the 1950's and then launched a national eradication campaign in the 1960's followed by a control strategy in the 1970's. The long time economic interest in fertile lowland areas and the devastating malaria epidemic of 1958 were some of the ground reasons to launch eradication service (GebreMariam, 1984).

The effort to achieve malaria eradication in the country was not successful partly due to technical and financial constraints in countries and institutions that were supporting the eradication effort (FMOH, 2000). However, since the development of the Global Malaria Control Strategy by the World Health Organization in 1992, emphasis in malaria control

has shifted from vector eradication to increased case detection and treatment of malaria (Roberts *et al.*, 1997).

Since June 1993, under the general policy of decentralization and federalism in Ethiopia, malaria control became the responsibility of the regional health offices. At the central level, cores of professionals are now responsible for formulation of policies, provision of technical guidelines to regions, assistance in training, conducting operational research and support in anti-malaria drugs, insecticides and equipment (FMOH, 1995; CSA, 2000).

The Roll Back Malaria and the Abuja Declaration are the recent attempts to coordinate efforts and provide more resources to reduce the malaria burden in the world. Mostly, the strategies used aimed at primary prevention through vector control or use of personal preventive methods such as bed nets, mosquito repellants, chemoprophylaxis and finally, through effective case management and medication (Nyarango *et al.*, 2006).

Currently, the main components of malaria control strategies in Ethiopia included the early diagnosis and effective treatment of cases, the application of selective vector control measures like indoor residual insecticide spray (IRS) and environmental management, strengthening the information system to facilitate the prevention and early detection and control of epidemics (Tulu, 1993; Abose *et al.*, 1997). More recently, community education regarding the use of ITNs and its supply progressed as one major control strategy of malaria in the country (UNICEF, 2004).

Generally in many developing countries there is variable success in vector control using ITNs, IRS with DDT and other agents. The factors which influence the effectiveness of malaria prevention and control include national policies, community and personal prevention, community awareness, quality of health care, facility and health personnel competence as well as effective monitoring of anti-malarial drugs (WHO, 2005).

### **1.3.1. Case management**

Malaria can be effectively treated with drugs. The success of disease management relies on a prompt and accurate diagnosis, which is based on confirmation of parasite in the blood. Optimal diagnosis is made by microscopic examination requiring trained laboratory technicians, well maintained equipment and reagents, all of which is time consuming and expensive. Because many health facilities in developing countries cannot meet these requirements, diagnosis is based on clinical signs and symptoms, which include chills, fever, diarrhea, general body aches or headaches. This clinical picture mimics that of many other common diseases and in absence of a microscopic diagnosis treatment is initiated on “presumptive” basis. Such practices result in over-treatment and increases costs significantly in addition to the potential health hazards associated to excessive drug exposure and increased propensity for drug resistance (WHO/UNICEF, 2003). This wastage could be reduced if clinical diagnosis was done according to criteria based on epidemiology (transmission season), age and gender of the patient.

However, the biological diversity of *P. falciparum* and its ability to develop resistance to a number of anti-malarial drugs has been a major challenge in malaria chemotherapy. FMOH (2004a) stated the high treatment failure rates of chloroquine for the treatment of uncomplicated *falciparum* malaria as documented through a nationwide study conducted in 1997/98, which led to a treatment policy change that recommends the use of Sulfadoxine-Pyrimethamine as first line drug for the treatment of uncomplicated *falciparum* malaria and chloroquine for the treatment of *vivax* malaria.

Currently, a number of anti-malarias are available, however, two of the most widely used drugs, chloroquine and SP (Sulfadoxin Pyrimethamine) have become less effective in many parts of the world due to drug resistance. The most favored anti malarial on the market for uncomplicated *P.falciparum* malaria is Artemether-Lumefantrine, a fixed-dose artemisinin-based combination therapy (ACT) as recommended by the WHO for first line treatment (WHO, 2006).

### **1.3.2. Indoor residual house spraying (IRS)**

Indoor residual house spraying is one of the most valuable tools in malaria vector control. It was the strategy used in the most successful eradication programs of the 50's and 60's (FMOH, 2004b). It involves coating the walls and other surfaces of a house with a residual insecticide. For several months, the insecticide will kill mosquitoes and other insects that come in contact with these surfaces. IRS does not directly prevent people from being bitten by mosquitoes. Rather, it usually kills mosquitoes after they have fed, if

they come to rest on the sprayed surface. Thus it prevents transmission of infection from one person to other persons (WHO, 2006).

IRS, mainly with DDT, was the principal method of malaria control in many countries between the 1940's and 1960's (Mabaso *et al.*, 2004). In Ethiopia, DDT has been in use for more than 40 years to control indoor resting Anophelines (Abose *et al.*, 1998). Its long-lasting residual property and relatively low cost made DDT preferable to use for such a long time in the country. In addition to this other groups of insecticides such as organophosphates, Carbamates and Pyrethroids are available for indoor spraying (FMOH, 2004a).

The national five year strategic plan (2001-2005) for IRS in Ethiopia was to cover annually 7-15% of the epidemic prone areas on a selective and systematic basis so that it would be reached a level of 50% by the end of 2005 (FMOH, 2001). The insecticides which are in use for residual house spraying in Ethiopia are DDT 75% water dispersible powder (WDP), DDT 100% technical and Malathion 50% WDP. Mekuria and Ginna (1970) reported DDT spraying at a dosage of 2g/m<sup>2</sup> was carried out twice yearly first as a pilot control program and then as an active control operation.

Since the development of resistance to DDT and concern over the environment, the use of DDT for indoor spraying is very much restricted in many countries now a day. In Ethiopia, higher levels of DDT resistance of epidemiological significance were revealed in many areas such as Arbaminch (60%) and Gambella (76%) (Abose *et al.*, 1998). According to Nigatu *et al.*, (1994), after 1986 DDT-spraying was widely used in vast areas of the region due to the increasing activities of resettlement and agricultural

development schemes which may have resulted in the occurrence of resistant strains within a short period.

Presence of higher levels of insecticide resistance in many parts of the countries necessitated a change from DDT to Malathion in the past few years (Abose *et al.*, 1998). Malathion is considerably more expensive than DDT but may provide effective control of mosquitoes in areas where there are problems of resistance. More over several studies revealed that some of important endophily malaria mosquito species are increasingly exhibiting exophily, as a result, it is becoming more difficult to eliminate it by chemical applied indoors(Ameneshewa and Service ,1996; Krafur ,1977).

### **1.3.3. Insecticide treated bed net (ITNs)**

proper use of ITNs combined with prompt treatment for malaria at community level can reduce malaria transmission by as much as 60% and the overall young child death rate by at least one fifth (WHO-UNICEF, 2003). The one trial that demonstrated a substantial impact on severe malaria disease provided evidence that ITNs can have an impact on preventing severe illness and the associated high costs to both patients and healthcare providers (Lengeler, 2004). An approximate extrapolation to the current population of children less than five years of age at risk for malaria in sub-Saharan Africa (14% of approximately 480 million population at risk, or 67 million children) indicates that approximately 370,000 child deaths could be avoided if every child could be protected by ITNs (Shargie *et al.*, 2008).

According to World Malaria Report (2009), an increased percentages of African households (31%) are estimated to own at least one insecticide-treated net (ITN) in 2008 compared to 2006 (17%), and more children under 5 years of age used ITN in 2008 (24%) compared to previous years. It stated that household ITN ownership reached more than 50% in 13 high burden countries.

In Ethiopia, the recent UNICEF report showed that between 2000 and 2005 Ethiopia reduced deaths from malaria in young children by 20 % (RBM, 2006). The proportion of households with at least one ITN in the country rose to 53.3% percent, compared to 3% in 2005. Also, over 33% of young children (under age 5) slept under ITNs compared to only 1.5% in 2005 and 67% pregnant women utilized these net (FMOH, 2008). Since 2005, approximately 20 million LLINs have been distributed to 10 million households nationwide with support from the Global Fund, including 6.5 million LLINs in Oromia.

A 2007 Malaria Indicator Survey showed a rapid increase in the household ITN coverage from 6% to 65% in the targeted, malarious areas since 2005 (FMOH, 2008). More over, according to a National 5-Year Strategic Plan for Malaria Prevention and Control for 2006-2010, the over all goal of the National Strategic Plan is a 50% reduction in malaria morbidity and mortality, by achieving 100% coverage with at least two ITNs per household, by the end of 2010.

### **1.3.4. Environmental management**

Environmental management refers to planning, organizing, carrying out and monitoring of activities for the modification and manipulation of environmental factors with an inspection to preventing or minimizing vector propagation and reducing man-vector contact (WHO, 1982). Since mosquitoes need water to breed, environmental management involves the modification of the environment to make it unfavorable for the vectors to breed. Measures include draining or filling up of ponds and borrow pits, intermittent draining of irrigated areas and construction of drainage channels (WHO, 2003).

It is one component of the integrated vector control, which is in the long run cost-effective, environmentally safe and community-oriented control strategy. Its target objective is the reduction of aquatic stages of vector mosquitoes (FMOH, 2004a). Furthermore, the method can be used as a supplementary or even as alternatives measure of control in areas where there is a serious vector resistance problem. It can be applied anywhere, where breeding sites are well defined, limited in number and accessible. Moreover it is easy to apply and can be done by the communities themselves.

### **1.3.5. Biological control**

Biological control of mosquito vectors involves the introduction of natural enemies into mosquito breeding sites. These could be in form of parasites or predatory animals e.g. fish, insects, fungi, nematodes or plants. Use of biological control agents require a good understanding of the agents and the mosquitoes to be controlled as well as their local environment. The most widely employed biological control agent is the larvivorous fish and to some extent the bacteria *Bacillus thuringiensis* (FMOH, 2004a). It has now regained interest because of the resistance of mosquitoes to pesticides and to anti-malarial drugs (Matias, 2009).

Generally, the main components of malaria control in Ethiopia included the diagnosis and treatment of cases, the application of selective vector control measures and strengthening of the information system to facilitate the prevention and early detection, and control of epidemics

Therefore, it is hypothesized that the current malaria control measures in Kemisie town and its rural surroundings have reduced malaria prevalence.

### **1.3.6. Significance of the study**

This study will help to provide significant information on the level of current malaria prevalence, and evaluate the existing malaria control measures and their impact on malaria transmission in the study area. Moreover, the result of this study may help to provide valuable information for further improvement on the malaria control program in practice.

## **2. Objectives of the study**

### **2.1. General Objective**

- To assess the impact of malaria control measures in urban and rural communities of Kemisie, Oromiya Zone, and Amhara Regional State.

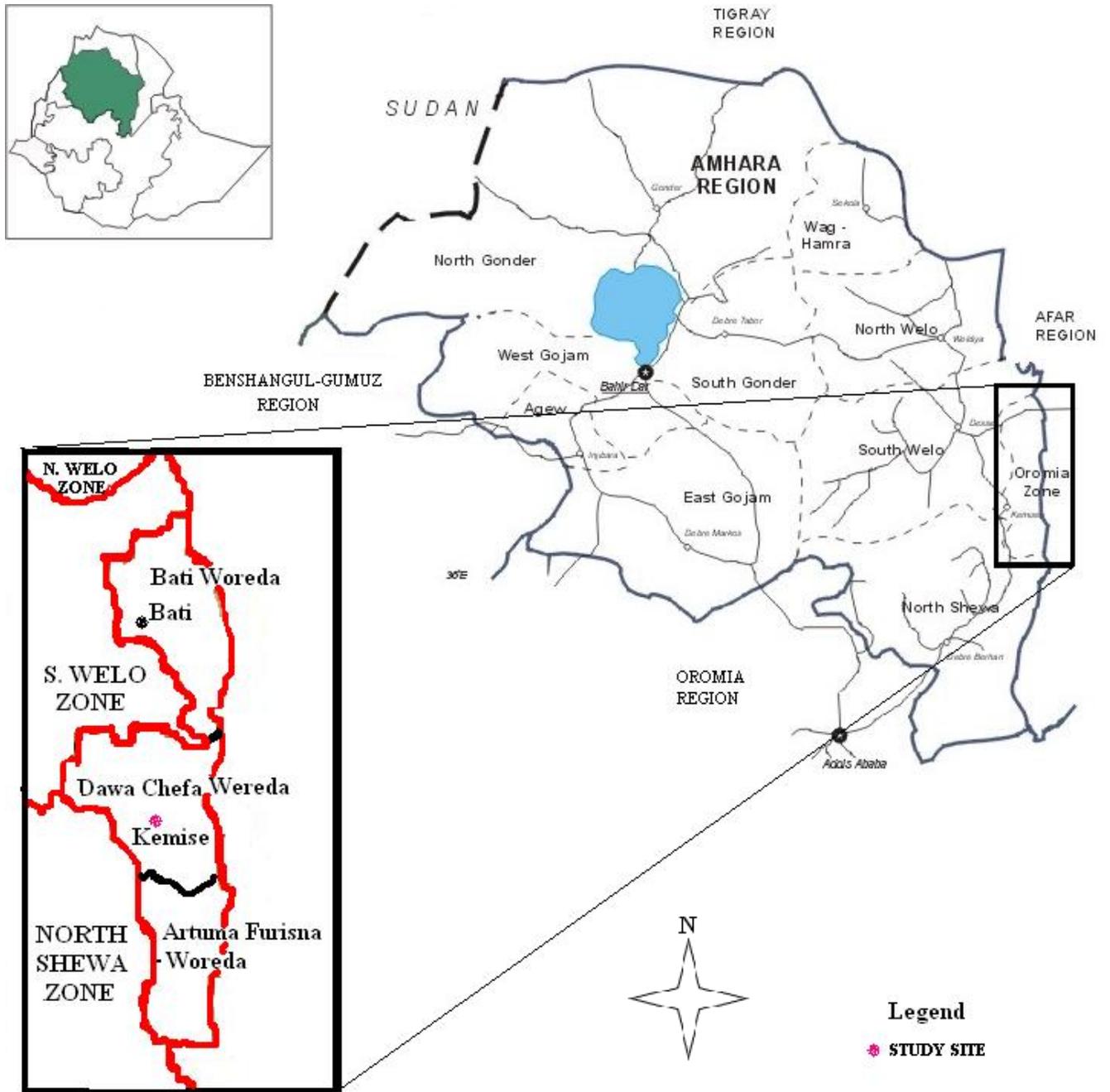
### **2.2. Specific Objectives**

- To assess the level of malaria prevalence in the study area
- To compare the impact of malaria control measures between Kemisie town and the surrounding rural Kebeles.
- To assess the knowledge, attitude and practice of the population towards malaria prevention and control.
- To recommend improvement on the current malaria control measures.

### **3. Material and methods.**

#### **3.1 Study area**

The study was conducted in Kemisie town and surrounding rural Kebeles, Oromiya Zone, Amhara region, in November/December, 2008. Kemisie is located in northeastern Ethiopia and has been the administrative center of Oromiya Zone, Amhara Regional state since 1994. The surrounding rural Kebeles are namely Shekila, Woledi, and Koladi Kebeles, and recently, they have been included in Dawa Chefa Woreda. Kemisie has a longitude and latitude of 10°43'N 39°30'E/ 10.717°N 39.5°E with an elevation of 1424 meters above sea level. It is located at 325 km from Addis Ababa and 75km from Dessie. The total population of the study area: Kmisie town (22181) and the population of the three rural Kebeles in Dawa Chefa Woreda (36752). Weather condition of the area is 84% arid, 15% semi arid, and 1% cool environment. The temperature of the area lies between 24°C to 29°C. One of the main features of the area is the presence of Borkena River which flows close to Kemisie town and the surrounding rural Kebeles. The area is with relatively flat terrain and surrounded with a number of scattered small hills. The total area of the zone is exposed to malaria ([http://en.wikipedia.org/wiki/Oromia\\_Zone](http://en.wikipedia.org/wiki/Oromia_Zone)). The main occupation of the population is subsistence agriculture, livestock herding and trade.



**Figure 2:** Map of the study site, Oromiya zone, Amhara regional state.  
 (Source: Oromiya Zone Administrative Office, Kemisie.)

### 3.2 Study design and sample size determination

To assess the effect of malaria control measures by epidemiological and parasitological survey, three Kebeles were randomly selected from Kemisie town and three Kebeles from the surrounding rural areas. The study period was in November/December 2008. This survey was done by a house to house visit with a view to collecting blood samples, gathering information from recorded document and concerned body about malaria control measures in the area and demographic information from the member of the households selected with the help of a questionnaire.

Calculation of sample size (n) was determined using the formula:

$$n = z^2 P (1-P)/d^2$$

Where, n= Sample size

$$Z = 1.96 \text{ (A confidence level of 95\% was used)}$$

P= average prevalence (Since there were no previous malaria studies conducted in the area, P was used from recent year, 2008, malaria prevalence report of zone malaria control sector, 23.3 %(Appendix.3).)

$$d = \text{worst accepted value/marginal error}$$

A minimum 275 of samples (n) was generated using 5% marginal error (d) as follows

$$n = Z^2 P (1-p) d^2$$

$$n = (1.96)^2(23.3\%) (76.7\%) / (0.05)^2$$

n= 275 Assuming an additional 2 % as contingency and compensation for response.

Therefore, n= 275 + 25 = 300

### **3.3. Parasitological Survey**

For Parasitological survey, the list of the households of the six selected Kebeles was used as the sampling frame. A total of 300 individuals were selected systematically from Kemisie town: Kebele 01, Kebele 02, and Kebele 03; from Dawa Chefa Woreda: Shekila, Woledi, and Koladi Kebele, by taking every 5<sup>th</sup> house from random start based on their Kebele registration list. In addition to this, ninety household heads (n=90) were randomly selected systematically for Knowledge Attitude and Practice (KAP) Surveys for Malaria.

Blood film collection was carried out by laboratory technician by pricking the finger with disposable blood lancet. Peripheral blood smear examination of well prepared and well stained blood film is the gold standard in confirming the presence of malaria parasite (Payne, 1988).

Thick and thin blood smears was taken on the same slide and identification numbers marked on the thin films. The thin films were fixed using 100% methanol and then all slides were stained with 3% Giemsa solution for 20 minutes. The staining technique and blood film examination was conducted according to a standard of World Health Organization Protocols (CheesBrough, 1987; Garcia, 2001). Then, parasite positivity was determined from thick smear and species identification was carried out from thin smear slide preparations. Examination for parasites by using light microscope was made in the Kemisie Health Center by laboratory technicians and confirmatory examination was carried out in the Biomedical Laboratory of Biology Department, Addis Ababa University.

### **3.4. Knowledge Attitude and Practice (KAP) Surveys for Malaria**

In order to understand the knowledge, attitude and practices of the local population about the nature and mode of malaria transmission and its prevention and control, a structured KAP questionnaire was developed. The questions consist of issues like means of malaria transmission, exposure factors, and treatment practices. It also dealt with issues of current malaria preventive techniques including use of chemo prophylaxis for preventive purpose, awareness towards insecticide spray to their house and the use of ITNs. The questionnaire was originally developed in English and then translated into affanOromo. A total of ninety house hold heads (n=90) were randomly selected systematically from registration list of the Kebele by taking every 5<sup>th</sup> house from random start. Then by interviewing the questionnaire (Appendix 2) was filled by the interviewer.

### **3.5. Data Analysis**

Data collected on parasitological and KAP surveys were managed and analyzed using computer program SPSS v 15.0. Descriptive statistics were used to examine the characteristics of the sample. Differences in proportions between Kemisie town and rural Kebeles were compared using Pearson's chi-square test. Results were considered to be statistically significant when the 2-sided P-value was  $< 0.05$ .

## 4. Results

### 4.1. Clinically treated malaria in the study area

According to yearly malaria situation reports of Kemisie and Dawa Chefa Health Centers (Table 1) in 2007/08, the prevalence of malaria reported by Kemisie Health Center was three fold lower than 2005/06, while it was twofold higher in Dawa Chefa Health Center.

**Table.1.** Annual malaria prevalence data obtained from clinical records of Kemisie town and Dawa Chefa Health Centers from 2005/06 - 2007/08.

---

	<b>Kemisie Health Center</b>			<b>Dawa Chefa Health Center</b>		
	<b>2005/06</b>	<b>2006/07</b>	<b>2007/08</b>	<b>2005/06</b>	<b>2006/207</b>	<b>2007/08</b>
<b>Total examined</b>	27992	14840	10155	50289	32322	30354
<b>Malaria cases (n)</b>	9085	4305	1073	20674	12563	7164
<b>Prevalence (%)</b>	32.5	29.0	10.6	41.1	38.9	23.6
<b><i>P. falciparum</i>(%)</b>	69.1	60.8	42.5	76.3	65.0	48.8
<b><i>P. vivax</i> (%)</b>	30.9	39.2	57.5	23.7	35.0	51.2

---

The dominant malaria species reported in 2005/06 and 2006/07 was *P.falciparum*. Where as, in 2007/08, the prevalence of *P.vivax* was higher both in Kemisie and Dawa Chefa Health Centers. On the other hand, even though prevalence of *P.falciparum* showed relative decrease in both health centers, it was relatively higher in Dawa Chefa Health Center than Kemisie Health Center in all years. In contrast, prevalence of *P.vivax* was increasing in higher rate in Kemisie Health Center as compared to Dawa Chefa Health Center. The result may indicate the reduction of new cases in the study area. Since relapse is possible in *P.vivax*, majority of malaria positive individuals found in the present survey might not be infected recently.

**Table.2.** Yearly record of malaria control activities in the study area of Kemisie town and rural Kebeles, 2006-2008.

(Population: Kemisie town, 22181; Dawa Chefa Woreda, 36752)

No	Activities	2006		2007		2008	
		Kemisie Town	Rural Kebeles	Kemisie Rural Town Kebeles		Kemisie Town	Rural Kebeles
1	No. of ITNs distributed	310	3850	14291	7118	5576	1500
2	DDT spraying( kg)	1988.8	2689	1908.9	2975	2000.7	2524
3	No. of houses sprayed DDT	6493	11917	6419	12750	7586	10805
4	Environmental management						
	Filling /hec.	470	41	1011	123	4304	1003
	Draining /hec.	641	68	514	127	12939	800
	Clearing / hec.	557	61	2332	875	10986	1479
5	No. people enrolled In source reduction activities	8013	995	13020	1073	16317	9883

#### **4.2. Malaria prevalence in the study localities of Kemisie**

A total of 300 individuals were enrolled in the study, 154 (51.3%) were male and 146 (48.7%) female. In this study group 10.3% of the population were under 5 years, 29.0% in between 5-14 years and 60.7% were 15 and above years (Table 3).

Malaria positive individuals were identified from three Kebeles of Kemisie Town and three nearby rural Kebeles, namely Shekila, Woledi and Koladi Kebeles, in November/December 2008. Of the 300 blood films examined the overall malaria positivity was 16 (5.3%), out of this 62.5% and 37.5 % of the infections occurred in males and females, respectively. The malaria parasite prevalence differed markedly between Kemise town 4(2.7%) and rural Kebeles 12(8.0%) ( $P < 0.05$ ) (Table 4). The only malaria species seen in the study group was *P.vivax* (100.0%). No *P.falciparum* and mixed infection of *P.falciparum* and *P.vivax* were observed.

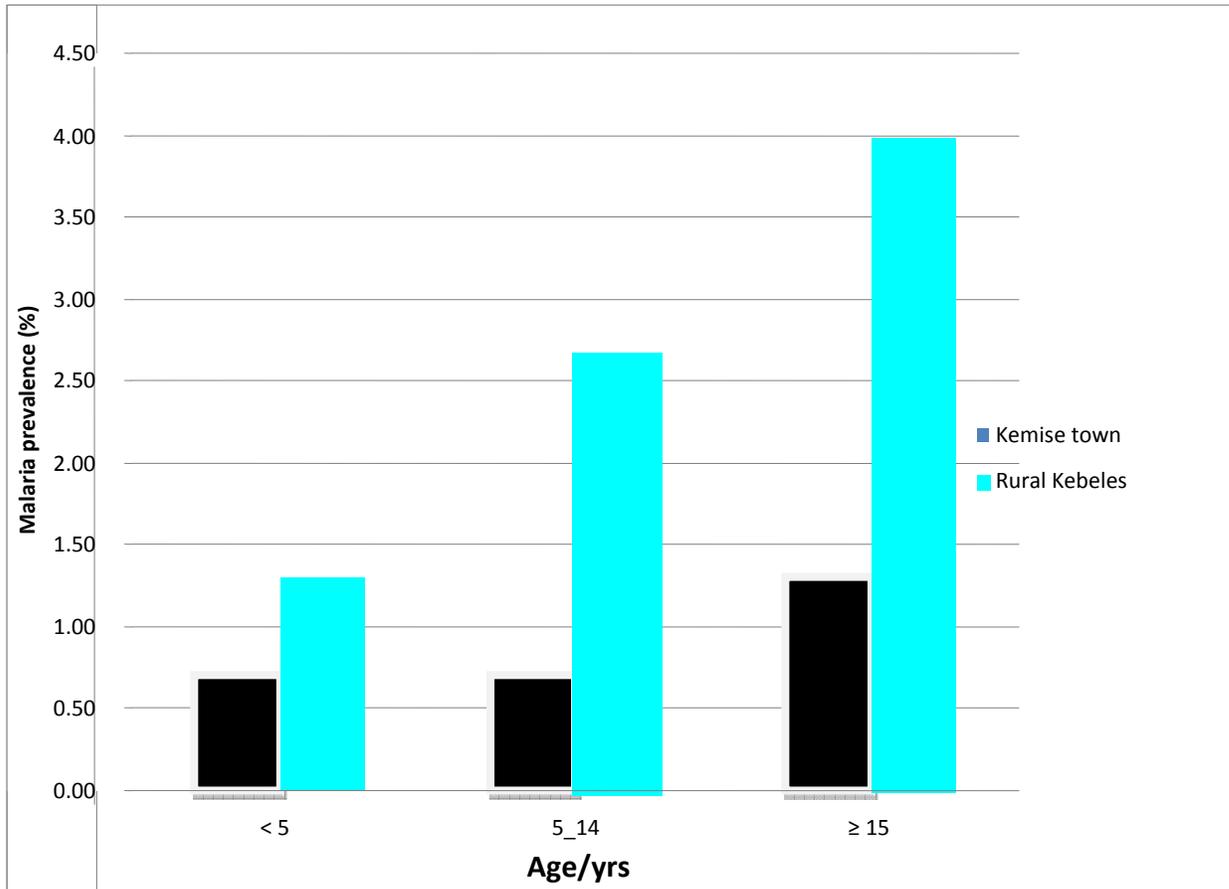
**Table 3.** Demographic characteristics of the survey population by age /sex in Kemisie Town and rural Kebeles, November/December, 2008.

Age group (in years)	sex	Locality	
		Kemisie town	Rural Kebeles
		n (%)	n (%)
<5	M	10 (52.6)	6 (50.0)
	F	9 (47.4)	6 (50.0)
5-14	M	23 (45.1)	19 (46.3)
	F	28 (54.1)	22 (53.7)
≥15	F	43 (53.8)	56 (57.7)
	M	37 (46.2)	41 (42.3)
<b>Total</b>		150 (100.0%)	150 (100.0%)

**Table 4.** Prevalence of *Plasmodium vivax* among the study localities in  
Kemisie town and rural Kebeles, November/December, 2008.

<b>Locality</b>	<b>No. examined</b>	<b>Malaria positive n (%)</b>
<b>Kemise Town</b>	<b>150</b>	<b>4 (2.7)</b>
<b>Rural Kebeles</b>	<b>150</b>	<b>12 (8.0)</b>
<b>Total</b>	<b>300</b>	<b>16 (5.3)</b>
<b>P &lt; 0.05</b>		

The under 5 years old malaria prevalence was 0.7 % in Kemisie town and 1.3 % in rural Kebeles (Figure 3). The difference in the under 5 in malaria prevalence between the two localities was statistically significant ( $P < 0.05$ ). On the other hand, although no significant difference was observed ( $P > 0.05$ ), malaria prevalence in the age group above 15 years was higher in rural Kebeles (4.0%) than in Kemisie town (1.3%).



**Figure 3.** The prevalence of malaria infection by age group in Kemise town and rural Kebeles, November/December, 2008.

### **4.3. Malaria control measures**

#### **Indoor residual spraying (IRS)**

In 2008 the overall IRS per household coverage was 31.2%. Comparing the distribution of DDT spraying per household between Kemisie Town (34.2%) and Dawa Chefa Woreda (29.4%), no significant difference was observed ( $P>0.05$ ). According to yearly report of Kemisie District malaria control office, the coverage of households DDT sprayed from 2006 to 2008 was nearly similar, 29.3%, 28.9% and 34.2%, respectively, and the difference was not statistically significant.

#### **Insecticide treated bed nets (ITNs) coverage**

According to Kemisie malaria control office the proportion of at least one mosquito net was reported to be 83.6 % of households, with a range of 0 to 3 nets observed. On the other hand, as shown Table 2 the recent three years (2006-2008) the highest number of ITNs distribution both in Kemisie town and rural Kebeles was reported in 2007 as compared to 2006 and 2008. The difference is statistically significant ( $P<0.05$ ). Comparing town and rural Kebeles, in 2006, higher numbers of ITNs distribution per households was reported in rural Kebeles (9.9%) than town (0.01%), ( $P<0.05$ ). However in 2007 and 2008 the proportion of ITNs distribution per households in Kemisie town was much higher than rural Kebeles. The difference was statistically significant ( $P<0.05$ ).

### **Source reduction by using environmental management**

As shown in table 2 in 2008, 44.4% of people in the study localities participated in source reduction activities such as draining and filling stagnant water bodies and swampy areas, and cutting and clearing bushes and weeds to remove breeding site of malaria vector. Comparing the proportion of people participating in vector reduction activities, there was great difference between Kemisie town (73.6%) and (26.9%) in the study localities of rural Kebeles, which was statistically significant ( $P < 0.01$ ). However, in 2008 the highest proportion of people were participating both in Kemisie Town and Dawa Chefa Woreda compared to 2007 and 2006. Similarly in Dawa Chefa Woreda, the number of people participating in 2008 (26.9%) was much higher than 2007 (2.9%) and 2006 (2.7%). In Kemisie town also the highest number of people were reported in 2008 (73.7%) followed by 2007 (58.7%) and the lowest in 2006 (36.1%).

### **4.4. Knowledge, attitude and practice (KAP) survey on mode of malaria transmission and its control measures.**

The study population included 90 individuals: 41 (45.6%) males and 49 (54.4%) females (Table 5). The mean age was 39 years with a range of 16-70 years. Their occupation consisted of farmer; the most commonly reported occupation, (45.6%), merchant (33.3%), government employee (13.3%) and daily laborer (7.8%), respectively,

The educational status of the interviewees was 67.8% illiterate and the rest 32.2% were literate. Of the total literate, 14% could read and write only, 49% completed elementary school and 17.5% high school.

**Table 5.** Demographic characteristics of the KAP study participants (n=90) in the study localities of Kemisie town and rural Kebeles, November/December, 2008.

<b>Characteristics</b>		<b>Freq.(%)</b>
<b>Sex</b>	Male	41 (45.6%)
	Female	49 (54.4%)
<b>Mean Age of participants in years(Range)</b>		39 (16-70)
<b>Education</b>	No schooling	61 (67.8%)
	>Primary school	29 (32.2%)
<b>Occupation</b>	Farmer	41 (45.6%)
	Merchant	30 (33.3%)
	Gov. employee	12 (13.3%)
	Daily laborer	7 (7.8%)

Of the total 90 household heads interviewed from the localities, 89.7% replied that they had experienced malaria and had used anti-malaria drugs. When asked what brand of anti-malaria drugs they used, 60% replied Chloroquine (CQ) and Sulphadoxine-Pyrimethamine (Fansidar), 31.4% Quartem, whereas 8.6% indicated that they did not know.

**Table 6.** Malaria control measures reported by the households in Kemisie Town and Rural Kebeles in November/December, 2008.

<b>Malaria control measure</b>	<b>Kemisie Town n(%)</b>	<b>Rural Kebeles n(%)</b>
IRS	9 (20.0%)	10 (22.2%)
ITNs	30 (66.7%)	30 (66.7%)
Treatment of cases	1 (2.2%)	3 (6.7%)
Source reduction	5(11.1%)	2 (4.4%)
<b>Total</b>	<b>45 (100)</b>	<b>45 (100)</b>

Furthermore, few respondents reported to have used combination of two or more of the anti-malaria drugs. In general, the community exhibited low awareness regarding knowledge towards anti-malaria drug types as well as use of anti-malarial drugs for preventive purpose.

With regard to the frequency of application of anti-mosquito residual spraying, all the respondents replied that it was applied once a year in May/June. And relatively the same proportion of households in both localities, (20%) in town and (22.2%) in the rural Kebeles replied that DDT spraying reduce malaria transmission (Table.6). However the majority of respondents did not believe IRS protection against malaria transmission. In this regard no significant difference between the town and rural localities.

**Table 7.** Reported ITN use pattern within the family in the study localities in Kemisie town and rural Kebeles, November/December, 2008.

Sleeping under ITN	Kemisie Town	Rural Kebeles
	n(%)	n(%)
Husband and wife	2 (4.44%)	6 (13.3%)
Children alone	5 (11.11%)	11 (24.4%)
Mother and child	10 (22.22%)	16 (35.6%)
All family members	28 (62.22%)	12 (26.7%)
<b>Total</b>	45 (100)	45 (100)

Concerning the use of ITNs in the study localities, the majority of respondent replied all year (67.8%), while some indicated using it only during peak prevalence season, September to December, when mosquitoes are abundant. Most of them (83.3%) thought that sleeping under the net would reduce the risk of getting malaria and few (16.7%) responded that it would reduce the risk only minimally. Regarding ITN usage, the majority of interviewees, in both study sites, replied that they slept under ITN during the night; however, as shown in (Table. 7) the proportion of children alone and mother and child were higher in rural Kebeles than Kemisie town but not statistically significant ( $p > 0.05$ ). The survey showed the majority of rural people left their nets to children and pregnant women. Generally the result indicates that awareness of people toward malaria control measures is higher in town than rural Kebeles.

## 5. Discussion

Malaria remains to be one of the leading causes of illness and death in Kemisie town and the surrounding rural localities. According to Kemisie malaria control office report, malaria was put in the second place from the top 20 leading diseases reported in 2008. Some of the contributing factors are the presence of Borkena river that flows year-round close to Kemisie town and the rural Kebeles, the presence of temporary streams and swampy areas which are created by rise of Borkena river during the rainy season. These, together with suitability of weather condition of the area, favor malaria transmission throughout the year. However, the present study revealed significant reduction of malaria prevalence both in Kemisie town and the nearby rural areas in 2008. This finding was in agreement with Kemisie and Dawa Chefa Woreda malaria control office report. The record shows that malaria prevalence in the whole Zone was lower in 2008 (23.3%) as compared to 2005/2006(32.6%), which suggests improvement in malaria control and intervention in the study area. On the other hand, this study and clinical record showed that malaria prevalence in rural Kebeles was more than twice higher than in Kemisie town ( $P < 0.05$ ) indicating that a less effective malaria control measures were applied in the rural Kebeles.

The discrepancy observed between the average annual malaria prevalence (10.6%) and that determined by the cross-sectional survey (5.3%) for Kemisie town during the year 2007/2008 can be explained by the fact that the clinical records are based on treatment seeking patients reporting to Kemisie Health Center, thus selectively focusing on malaria cases only. The fact that disease prevalence based on clinical records is much higher than those obtained from cross-sectional survey is a frequently encountered phenomena

(Seboca and Snow, 1997). Furthermore, false negative reports during microscopic examination of blood films have been reported to be more in cross-sectional studies and this could result in the underestimation of malaria prevalence (Roper *et al.* 1998, Babiker *et al.*, 1998).

The average annual clinical report of Kemisie in 2007/2008 showed 45.7% *P. falciparum* and 54.3% *P. vivax* as compared to 100% *P. vivax* in the present survey. This may represent seasonal variation since the survey was done at one point in time rather than over a full year as in surveillance data. Apart from seasonal variation, this difference may also be related to differences between *falciparum* and *vivax* infected persons in their treatment seeking behavior (e.g. a large proportion of *falciparum* cases may report to health facilities than *P. vivax* cases because of more severe symptoms), or in the relatively longer duration of infection which will affect parasite prevalence in the survey but not the incidence.

FMOH (2000) reported *P. falciparum* to be the dominant species during peak malaria transmission season while *P. vivax* tended to dominate during the dry season in Ethiopia. However, in the present study, *P. vivax* was the only parasite detected during the survey period (November /December 2008), which is known to be within the peak transmission season. The *P. vivax* case detected may have been both new and also the result of relapse of due to activated hypnozoites in the liver. The absence of new cases cannot be assumed because the improvement in the malaria control activities over the past three years cannot be considered as adequate because the proportion of households with at least one ITN in

Kemisie town and rural Kebeles increased only by 29%. The efficacy of ITN alone as a malaria control method had been demonstrated through randomized study whereby up to 30% reduction in the number of deaths was achieved (William *et. al.*, 2003). In view of this, there is a positive development in malaria control in Ethiopia as FMOH (2008) report shows that the proportion of households with at least one ITN in the country rose to more than 53% compared to 3% in 2000 and was as high as 88% in some high malaria risk regions of the country. Furthermore, the government has set the national goal of full coverage of population at risk with a mean of 2 long-lasting insecticidal nets (LLINs) per household through distribution of about 20 million LLINs by the end of 2007. However since preliminary studies show that there is a serious gap between effective use of the ITN by the population and its distribution, a close follow up by the health extension workers will be needed for an effective malaria control.

In contrast to the established convention that infection among children less than 5 year olds in stable communities implies autochthonous malaria transmission (Giha *et. al.*, 2000), the finding in Kemisie town and rural Kebeles, where the highest prevalence was in the age group 5 years and above, does not fit into the conventional characterization of malaria epidemiology based on age stratification. The higher prevalence in the age group 15 years and above may be explained by the inadequate coverage of household members with ITNs as each household received only 2 nets and most often only children slept inside the nets in majority of the cases, which leave the adults exposed to high risk of infection.

Conventionally, in areas of high endemicity, prevalence of malaria infection is known to peak at early age with an increase up to the age of 5 years; followed by a sharp fall in age group 10-15 years and continuing on slow decline with increasing age (WHO, 2000). This pattern of prevalence is a reflection of the age-related state of antimalaria immunity that is developed as a result of repeated malaria infections; with individuals living in areas of unstable and low intensity malaria transmission acquiring very poor antimalaria immunity (Giha *et. al.*, 2000; Oesterholt *et. al.*, 2006). Thus, information on malaria prevalence obtained through the present study has indicated the malaria epidemiological condition in Kemisie town and its surroundings to be unstable with low level of endemicity.

The proportion of ITN distribution per household was higher in Kemisie town (73.6%) than in rural Kebeles (35.4%) ( $P < 0.05$ ) and it is interesting to note that malaria prevalence determined in this study was inversely related to the intensity of ITN coverage. On the other hand, the reported IRS coverage both in Kemisie town and the rural Kebeles in 2008 did not show significant difference as compared to 2005/2006 ( $P > 0.05$ ). This suggested that the effect of IRS on malaria transmission in the area was minimal and hence the reduction in malaria prevalence is due to increase in ITN usage.

The opinion of the population obtained through the KAP survey (63%) also points to possible lack of effectiveness of DDT spraying for mosquito control. On the other hand, the proportion of people participating in vector control by source reduction activities has shown some progress in 2008 both in the town and rural Kebeles as compared to

2005/2006 (  $P < 0.01$ ). This is suggestive of the improvement of people's awareness about malaria infection and its control measures especially in Kemisie town.

## **6. Conclusions and recommendations**

The present study was an initial step for the understanding of the epidemiology of malaria in Kemisie town and the surrounding rural areas. Based on the finding of the study, the following conclusions are drawn about the malaria situation in Kemisie town and the surrounding rural areas:

- 1.** Malaria in Kemisie town and its surrounding rural areas is unstable with low level of endemicity.
- 2.** Malaria prevalence significantly decreased in localities where appropriate malaria control measures were applied.
- 3.** The current use of ITN was acceptable to the population and has served as an effective malaria control measure especially in Kemisie town.
- 4.** Reduction of malaria transmission in Kemisie town was related to health education and awareness of the population about malaria control and its modes of transmission.

On the basis of the results obtained from the study, the following recommendations may be made:

- 1.** Since poor awareness about the modes of malaria transmission and control measures characterized the rural community in Kemisie area, improvement in health education and appropriate malaria control measures will be necessary.

2. Effort must be made to expand and sustain the combined application of ITNs with source reduction measures both in Kemisie town and the rural localities.

## 7. References

- Abeku, T.A. (2007). Response to malaria epidemics in Africa. *J Em Infect Diseases Home*, **13**: 1-6.
- Abose, T., Ye-ebiyo, Y., Olana D., Alamirew, D., Beyene, Y., Regassa, L. and Mengesha, A. (1997). The epidemiology and control of the distribution, behaviour susceptibility to insecticides of anopheline vectors and chloroquine resistance in Zwai, central Ethiopia, and other areas .MOVBD.F MOH, Addis Ababa, Ethiopia.
- Abose, T., Ye-ebiyo, Y., Olana, D., Alamirew, D., Beyene, Y., Regassa., L. and Mengesha, A. (1998). Re-Orientation and definition of the role of malaria vector control in Ethiopia; the epidemiology and control of malaria with special emphasis to the distribution, behavior and susceptibility to insecticides of anopheline vectors and chloroquine resistance in Ziway, central Ethiopia and other areas. MOVBD, MOH, Addis Ababa, Ethiopia.
- Ameneshewa, B. (1995). The behaviour and biology of *Anopheles arabiensis* in relation to the epidemiology and control of malaria in Ethiopia. Ph.D. Thesis. University of Liverpool, UK.
- Ameneshewa, B. and Service, M.W. (1996). Resting habits of *Anopheles arabiensis* in the Awash river valley of Ethiopia. *Ann Trop Med Parasitol*, **90**:515-512.
- Babiker, H. A., Abdel-Muhsin, A., Ranford, C. L., Satti, G. and Walliker, D. (1998). Characteristics of *Plasmodium falciparum* parasites that survive the lengthy dry season in eastern Sudan where malaria transmission is markedly seasonal. *Am J Trop Med Hyg.* **59**: 582-590.

- Binka F.N., Kubaje, A., Adjuik, M., Williams, M., Lengeler, C., Maude, G.H. (1996).  
Impact of permethrin impregnated bednets on child mortality in Kassena-  
Nankana District, Ghana: A randomized controlled trial. *Trop Med Int Health*  
**1**:147-154.
- Central Statistical Authority (2000). Ethiopia Demographic and Health Survey,  
Preliminary Report.
- Cheesbrough, M. (1987). *Medical Laboratory Manual for tropical countries*. 2<sup>ed</sup>.602 pp.
- D'Alessandro, U, Olaleye, B.O., Mc Guire, W., Langerock, P., Bennett, S., Alkins, M.K.,  
Thomson, M.C., Cham, M.k., Cham, B.A. and Green Wood, B.M  
(1995). Mortality and Morbidity from malaria in Gambian Children after  
introduction of an impregnated bed net programme. *Lancet*, **345**:479-483.
- FMOH (1995). Health Sector Development Strategy. Addis Ababa, Ethiopia.
- FMOH (2000). Malaria Profile. Commercial Printing Press. Addis Ababa, Ethiopia.
- FMOH (2002). Guide line for Malaria Vector in Ethiopia. Mega Printing Enterprise,  
AddisAbaba, Ethiopia. 65pp.
- FMOH (2001). *National five years strategic plan for malaria Control in Ethiopia*:
- FMOH (2003). Malaria Prevention and Control Extension Package Addis Ababa  
Ethiopia 59PP
- FMOH (2004a). *Guide lines for malaria epidemic prevention and control in Ethiopia*  
(2<sup>nd</sup> edition. FDRE, Addis Ababa Ethiopia 52pp.
- FMOH (2004b). Insecticide treated nets (ITNs): National strategic plan for going to scale  
with coverage and utilization in Ethiopia; 20004-2007. Addis Ababa, Ethiopia.  
28pp.

- FMOH (2005). Health and Health related indicators. Addis Ababa .74pp.  
2001-2005. Malaria and other vector born diseases prevention and control department. Addis Ababa, Ethiopia 58PP.
- FMOH (2008).Ethiopia Makes Striking Strides in Malaria Control, Addis Ababa, Ethiopia.
- Fortenille, D. and Lochouran, L. (1999). The complex of the malaria vectorial system in Africa. *Parasitol*, **41**: 267-271.
- Fontaine RE, Najar AE, Prince JS (1961). The 1958 malaria epidemic in Ethiopia. *Am J Trop Med Hyg*, **10**:795-803.
- Garcia L.S (2001).*Diagnostic Medical Parasitology*. 4<sup>th</sup> ed. ASM press, Washington, D.C.PP. 850-875
- Gebere-Mariam, N. (1984). Highlights of malaria situation in Ethiopia. **In:** *Proceedings of the workshop on the promotion and strengthening of malaria control through primary health care*. National Health Development Network. 5-18 October, Addis Ababa. pp. 5-17.
- Gebreyesus T.A., Deressa W., Witten W., Witten K.H., Getachew A. and Seboxa,T. (2006). Malaria. In: Brehane Y. *et al.* (eds ).*Epid Ecol Hlth Diseases Eth* , Pp 556-590, Shama Books , Addis Ababa
- Giha, H.A., Rosthoj, S., Dodoo, D., Hviid, L., Satti, G.M., Scheike, T., Arnot, D.E., Theander, T.G. (2000). The epidemiology of febrile malaria episodes in an Area of unstable and seasonal transmission. *Trans R Soc Trop Med Hyg*, **94**: 645-651
- Howard, A.F., Zhou, G. and Omlin, F.X., (2007). Malaria Mosquito control using edible

- fish in Western Kenya: Preliminary findings of a controlled study. *J Bio Med Cent Pub Hlth*, **7**:199
- Keating., J., Macinture, K., Mbogo, C.M., Githure, J.I., and Jhon, C. (2004). Characterization of potential larval habitats for malaria vectors in Africa for the 40 years: Impact of climatic and human factors. *J Americ Mosq Cont Ass*, **14**:120-130.
- Killeen, G.F, Fillinger, U., Kiche I., Gouagna, L., Knols, B. (2002). Eradication of *Anopheles gambiae* from Brazil: Lessons for malaria control in Africa. *Lanc Infe Diseases*, **2**:618-627.
- Krafsur, E.S. and Armstrong .J.C. (1982). Epidemiology of *Plasmodium malaria* infection in Gambella. *Eth Parasitol*. **24**: 105-120.
- Krafsur, E.S. (1977). The bionomics and relative prevalence of *Anopheles* species with respect to the transmission of *Plasmodium* to man in Western Ethiopia. *J Med Ento*, **14**:180-194.
- Krotoski, W.A., Collins, W.E., Bray, R.S., Garnham, P.C., Cogswell, F.B., Gwadz, R.W., Killick-Kendrick, R., Wolf, R., Sinden, R., Koontz, L.C. and Stanfill, P.S. (1982). Demonstration of hypnozoites in sporozoite-transmitted *Plasmodium vivax* infection. *Am J Trop Med Hyg*, **31**(6): 1291-1293.
- Lengeler C. (1998). Insecticide-treated bed nets and curtains for preventing malaria. Cochrane Database of Systematic Reviews, Issue 3. Art. No.: CD000363.
- Lengeler, C. (2004). Insecticide treated bed nets and curtains for preventing malaria. *Cochrance Database Syst Rev*. (2) CD000363.
- Lambert, P.H. (2005). Malaria: Past and Present. [http:// nobleprize .org /medicine/](http://nobleprize.org/medicine/)

- educational malaria. Date accessed November 2005.*
- Lautze, J and Kirshen, P. (2007), Dams, health and livelihoods: Lessons from the Senegal, suggestions for Africa. *Int J Riv Basin Mang*, **5**:199-206.
- Mabaso, M., Sharp, B. and Lengder, C. (2004). Historical review of malaria control in Southern African with emphasis on the use of indoor residual house spraying. *Trop Med Int Hlth*, **9** (8): 846-856.
- MARA (1998). Toward an atlas of malaria risk in Africa: First technical report of the Mapping Malaria Risk in Africa(MARA/ARMA) Collaboration .Pp34.
- Matias , J. R (2009).Malaria Vector Control Method Using Native Larvivorous Fish That Mimic The Life Cycle Of Malarial Mosquitoes. *Trop Diseases New*.
- Mekuria, Y, and Ginna, W. (1970). Malaria survey in North Eastern Ethiopia. *Ethiop Med J*, **8**:201-206.12 pp
- Mukaban, W.R., Kannady, K. and Kiama, G.M. (2006). Ecologists can enable Communities to implement malaria Vector Control in Africa. *J Malari*, **5**:1-9.
- Negash, K., Kebede, A., Medhin, A., Argaw, D., Babaniyi, O., Guintran, J. and Delacollette, C.(2005).Malaria epidemics in the highlands of Ethiopia. *J East Afr Med* , **82**(4):186-192.
- Nega, A. and Haile-Meskel, F. (1991). Population migration and Malaria transmission in Ethiopia. **In: Malaria and Development in Africa: A cross-sectoral approach.** American Association for the Advancement of Science, Washington DC, pp.181-188
- Nevill, C.G, Some, E.S., Mung'ala V.O., Muteme, W., New, L., Marsh K.(1996). Insecticide-treated bednets reduce mortality and severe morbidity among children on the Kenyan coast. *Trop Med Int Health*, **1**:139-146.

- Nigatu, W., Petros B., Lulu, M., Adugna, N., Wirtz, R. and Tilahun, D. (1994). Some aspects of malaria prevalence, vector infectivity and DDT resistance studies in Gambella region, South Western Ethiopia. *Ethiop J Hlth Dev*, **8** (1): 1-10.
- Nyarango, P. M., Gebremeskel, T., Mebrahtu, G., Mufunda, J., Abdulmumini, U., Ogbamariam, A., Kosia, A., Gebremichael, A., Gunawardena, D., Ghebrat, Y and Okbaldet Y. (2006). A steep decline of malaria morbidity and mortality trends in Eritrea between 2000 and 2004: the effect of combination of control methods. *J Bio Med*, **5**:33
- Oesterholt, M.J., Bousema, J.T., Mwerinde, O.K., Harris, C., Lushino, P., Masokoto, A., Mwerinde, H., Mosha, F.W. and Drakeley, C.J. (2006). Spatial and temporal variation in malaria transmission in a low endemicity area in northern Tanzania *Malar J*. **5**(98): 1-7.
- Otten, M., Aregawi, M., Were, W., Karema, K., Medin, A., Bekele, W., Jima, D., Gausi, K., Komatsu, R., Korenromp, E., Low-Beer, D. and Grabowsky, M. (2009). Initial evidence of reduction of malaria cases and deaths in Rwanda and Ethiopia due to rapid scale-up of malaria prevention and treatment. *J Malar* . **8**: 14.
- Pyne, D. (1988). Use and Limitations of light Microscopy for diagnosing Malaria at the Primary health care level. *Bul Wrl Hlth Org*, **66**: 621-626.
- RBM (2000). World Health Organization. The Abuja declaration and plan of action: an extract from the African summit on the Roll Back Malaria. WHO/CDS/17. Geneva. Switzerland, 2000.
- RBM (2003). Scaling-up insecticide treated netting programmes in Africa: A strategic frame work for coordinated national action. Geneva, WHO/CDS/RBM. 26pp.

- RBM (2006). What is Malaria? RBM Info sheet.
- Roberts, D., Manguin, S., Laughlin, L.L., Hsueh, P. and Legters, L.J.(1997). DDT global strategies, and a malaria control crisis in South America. *Emerg Infect Dis*, **3**: 295-302.
- Roper, C., Richardson, W., El-Hassan, I. M., Hviid, L., Giha, H., Satti, G. M. H., Theander, T. G. and Arnot, D. E. (1998). Seasonal changes in the *Plasmodium falciparum* population in individuals and their relationship to clinical malaria: a longitudinal study in a Sudanese village. *Parasitol*, **116**: 501-510.
- Seboxa, T. and Snow, R.W. (1997). Epidemiological features of severe pediatric Malaria in north western Ethiopia. *J East Afric Med*, **74**(12): 780-783.
- Service, M.W. (2000). Medical entomology for students. Cambridge University Press. London, Pp.39.
- Shargie, B.E., Gebre, T., Ngondi, J., Graves, M. P., Mosher, A. W., Emerson, P., Ejigsemahu, Y., Endeshaw, T., Olana, D., WeldeMeske, A., Teferra, A., Tadesse, Z., Tilahun, A., Yohannes, G., and Frank, O., Richards, F. O. Jr. (2008) Malaria prevalence and mosquito net coverage in Oromia and SNNPR regions of Ethiopia. *BMCPublic Hlth*, **8**:321
- Snow, R.W. and Gilles, H.M. (2002). The epidemiology of malaria. **In**: *Essential malarialogy*. David, A., and Gilles, H.M. (eds.). (4<sup>th</sup> edition Arnold. pp. 85-106).
- Toure, Y.(2001). Malaria Vector Control: *Strategies and Challenge*. AAAS Annual Meeting Report, San Francisco.
- Tulu, A.N. (1993). Malaria. **In**: *The Ecology of Health and Disease in Ethiopia*, (Kloos, H. and Zein, Z.A. eds). West View Press. pp-341-352.
- UNICEF (2004). United Nation Country Team. Focus on Ethiopia. Roll back malaria in

- Ethiopia.8pp.
- Walker, K. and Lynch, M. (2007). Contributions of *Anopheles* larval control to malaria suppression in tropical Africa: Review of achievements and potential. *Med Vet Entmol*, **21**:2-21.
- WHO (1982). Manual of environmental management for mosquito control with special emphasis of malaria vectors. Geneva, WHO. Offset publ.No.66 284pp.
- WHO (1993). A global strategy for malaria control. Switzerland, 30pp.
- WHO/UNICEF (2003). African malaria report. (<http://rbm.who.int/amd>).112pp.
- WHO (2000). The epidemiological approach to malaria control. WHO unpublished document. Part II. WHO/CDS/CPE/SMT/ 2000.1. 62 pp.
- WHO (2005). Roll Back Malaria, World Health Organization and UNICEF. World Malaria Report.
- WHO (2006.) Malaria vector control and personal protection. Report of a World Health Organization study group World Health Organization Technica Report Series, No. 936, Pp52.
- WHO (2008). Global Malaria Action Plan, ACTMalaria Forum.pp123.
- WHO (2009). World Malaria Report, WHO Press. pp.66.
- William, A.H., Penlope, A., Feiko, O., Terkuile, F.O. and Dainn, J. (2003). The efficacy of permethrin treated bed nets on child mortality and morbidity in Western Kenya. *Am J Trop Med Hyg*, **68**: 121-127.

World Malaria Report (2008). Roll back Malaria, World Health Organization and

UNICEF. World Malaria Report.

<http://www.microbiologybytes.com>(2009). The life cycle of malaria parasite.

[http://en.wikipedia.org/wiki/Oromia\\_Zone](http://en.wikipedia.org/wiki/Oromia_Zone)( 2009,)"

## Appendices

**Appendix 1.** Malaria parasite distribution among the study subjects by sex, age, place and stage of the parasite detected in Kemisie district, November/December, 2008.

<b>N<sub>o</sub></b>	<b>Slide N<sub>o</sub></b>	<b>Sex</b>	<b>Age</b>	<b>Locality (Kebele)</b>	<b>Malaria parasite</b>	<b>Stages of malaria detected</b>
1	7V	M	4	Kemisie 02	<i>P. vivax</i>	Ring form, Schizont, Trophozoite
2	38V	M	7	Kemisie 02	<i>P. vivax</i>	Early trophozoite
3	A	M	48	Kemisie 03	<i>P. vivax</i>	Gametocyte, Ring form
4	1	F	35	Kemisie 03	<i>P. vivax</i>	Schizont, Trophozoite
5	3V	F	3	Shekila	<i>P. vivax</i>	Ring form
6	16V	M	11	Shekila	<i>P. vivax</i>	Gametocyte, Ring form
7	3	M	9	Shekila	<i>P. vivax</i>	Schizoant, Gametocyte
8	11A	F	20	Shekila	<i>P. vivax</i>	Ring form
9	B3	F	12	Woledi	<i>P. vivax</i>	Trophozoite
10	1N	M	60	Woledi	<i>P. vivax</i>	Gametocyte
11	1S	M	27	Woledi	<i>P. vivax</i>	Ring form
12	11V	M	4	Koladi	<i>P. vivax</i>	Ring form
13	C	M	10	Koladi	<i>P. vivax</i>	Gametocyte
14	PV	M	37	Koladi	<i>P. vivax</i>	Schizont, Ring form
15	VA	M	18	Koladi	<i>P. vivax</i>	Gametocyte
16	11+	F	41	Koladi	<i>P. vivax</i>	Ring form

## Appendix 2. KAP Questionnaire

**Title: Impact of malaria control measures on malaria prevalence and public awareness in urban and rural settings of Kemisie, Oromiya Zone, Amhara Region.**

### I. Area Identification

1. Woreda \_\_\_\_\_
2. Kebele \_\_\_\_\_
3. House No. \_\_\_\_\_

### II. Particulars of the study subjects. (head of the house hold)

1. Name \_\_\_\_\_
2. Sex \_\_\_\_\_
3. Age \_\_\_\_\_
4. Occupation \_\_\_\_\_
5. Religion \_\_\_\_\_
6. Education: (1 literate, read, write only, elementary school, high school, higher institutions) (underline)
7. Have you ever experienced Malaria or fever? Yes/ No (underline)

7.1. if yes, did you use medicine? Yes \_\_\_\_\_ No \_\_\_\_\_ 7.1.1 if Yes. How did you obtain the medicine you used? Free/with payment.

7.1.2. What was the brand of medicine you used? (chloroquine, Fansidar, Quinine, Coartum premaquine, other specify) (under line)

8. Is there chemical spraying to control mosquitoes? Yes \_\_\_\_\_ No \_\_\_\_\_

8.1 If yes how frequent? One /year \_\_\_\_\_ twice/year more in a year \_\_\_\_\_

8.2 Do you think that the spraying helps to decrease malaria? Yes \_\_\_\_\_

,No \_\_\_\_\_

9. Do you use insecticide treated Mosquito net? Ye \_\_\_\_\_ No \_\_\_\_\_

if yes how many \_\_\_\_\_

9.1 Who usually sleeps under the net at night? Mother \_\_\_\_\_, children only \_\_\_\_\_,

Mother & children \_\_\_\_\_ husband & wife \_\_\_\_\_, other \_\_\_\_\_,

9.2 When do you sleep under the net? \_\_\_\_\_

1. All year ----- 2. Only during the rains----- 3. only during the winter-----

9.3 Does sleeping under a treated net reduce the risk of getting malaria?

Yes-----No-----

10. Are there any environmental management activities in controlling

malaria in your Kebele? Yes \_\_\_\_\_ No \_\_\_\_\_ -

10.1 If yes which kind? 1. Draining stagnant water \_\_\_\_\_, 2. filling \_\_\_\_\_,

3. \_\_\_\_\_, leveling burrows and pits \_\_\_\_\_, 4. all \_\_\_\_\_, 5. others. \_\_\_\_\_

10.2 have you ever participated in theses activities? Yes \_\_\_\_\_, No \_\_\_\_\_

**Appendix 3.**Annual malaria prevalence and total morbidity data obtained from

Clinical records of Oromia Zone, Amhara Regional State from 1999 -2008

<b>Year</b>	<b>Total Morbidity</b>	<b>Malaria Cases</b>	<b>Malaria Prevalence (%)</b>
<b>1999</b>	88037	33880	38.5
<b>2000</b>	119028	35015	29.4
<b>2001</b>	115817	32873	28.4
<b>2002</b>	113637	17506	15.4
<b>2003</b>	184845	66879	36
<b>2004</b>	182342	86249	47.3
<b>2005</b>	165823	57791	34.9
<b>2006</b>	198964	107192	53.9
<b>2007</b>	152086	46887	30.8
<b>2008</b>	152516	35601	23.3

**Appedix 4.Consent form**

**Title: Impact of malaria control measures on malaria prevalence and public awareness in urban and rural settings of Kemisie, Oromiya Zone, Amhara Region.**

PIN -----

Name of study participant ----- Age----- Sex-----

Physician Name----- Site /Health center -----

I have been informed about a study that plans to investigate the malaria transmission pattern in kemise District entitled “**Impact of malaria control measures on malaria prevalence and public awareness in urban and rural settings of Kemisie, Oromiya Zone, Amhara Region.**” which will help in investigating the extent to which malaria is a public health problem in the area. This study could contribute to A recommending the use of appropriate control measures that can minimize the transmission of the disease in the area. For the study I have been requested to give a drop of blood from my finger and children under my guardian. They told me that experienced health professionals according to the established aseptic procedure would do the blood collection on to glass slide by finger pricier (lancet). I have been informed that if positive result is observed treatment will be given to children and me by using the standard drug regimen. Based on this, I have agreed to continue the examination with my children and me too. The investigator also informed me that if I want all the laboratory results would be kept confidential. I have been given enough time to think over before I signed this informed consent. It is therefore, with full understanding of the situation that I gave my informed consent and cooperates at my will in the course of the conduct of the study.

Name (participant) -----Signature -----Date -----

Name (investigator) -----Signature -----Date -----

Name (Witness) -----Signature -----Date -----

## DECLARATION

I, the undersigned, hereby declare that this thesis is my original work, has not been presented for a degree in any other University and all source of materials used for the study have been duly acknowledged.

Name: HaileMariam Getaneh

Signature: \_\_\_\_\_

Place: Addis Ababa University

Date of Submission \_\_\_\_\_

This work has been presented with my approval as supervisor.

Name: Prof. Beyene Petros

Signature: \_\_\_\_\_

Date: \_\_\_\_\_