THE INFLUENCE OF SOCIO-CULTURAL AND ENVIRONMENTAL FACTORS ON MALARIA RISK AND MANAGEMENT IN MWEA DIVISION OF CENTRAL KENYA

By

DAWIT OKUBATSION WOLDU

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To my late mother, Leterufael Beraki, my late father Okubatsion Woldu, and my late sister Semai-nesh Okubatsion Woldu

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THE INFLUENCE OF SOCIO-CULTURAL AND ENVIROMENTAL FACTORS ON MALARIA RISK AND MANAGEMENT IN MWEA DIVISION OF CENTRAL KENYA

By

Dawit Okubatsion Woldu

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Abstract: This dissertation examines the influence of socio-cultural and environmental factors to malaria risk and management in Mwea central Kenya. Malaria is a major health problem in Mwea because the illness has several risk factors that include socio-cultural and environmental variables. However, research on socio-cultural and economic factors to malaria transmission has been very limited. Malaria in Mwea has been viewed as an ecological problem and current research in the region has been mainly focused on ecological risk factors. The main goal of this dissertation is to examine the cultural understanding of malaria, causes, symptoms, and treatment that might be useful in guiding malaria management policies in the region. Furthermore, the study relies on a mixed research strategy that combines ethnographic and epidemiological methods to examine the ecological and socio-cultural dimension of malaria and presented the contribution of each factor to malaria risk and treatment-seeking behavior.

The selected research questions addressed in this study include, how do people in Mwea discriminate malaria from other common illnesses? Who is mostly affected by

malaria in Mwea and why? What is the relationship between socio-cultural and ecological factors to malaria risk and malaria treatment-seeking behavior? The research strategy to address these questions involved both ethnographic and epidemiological survey methods. The first phase of the project focused on the ethnographic understanding of malaria in Mwea using participant observation, focus group (N=2), unstructured interviews (N=20), and extended successive free-listing (N=53) methods. The second phase of the project was an epidemiological survey about malaria using structured questionnaire (see appendix). The survey included a non-random sample of 250 people. The questionnaire collected data on socio-cultural, ecological and health outcome variables.

Results from this study showed cultural understanding of malaria symptoms overlap with other common illnesses in the division. Men and women have different perception of malaria risk. Regression analysis indicated gender, age, socio-economic status, and access to health care best explain malaria health outcome. Similarly, socio-economic status and ecological residence best explain malaria treatment-seeking behavior.

CHAPTER 1
INTRODUCTION

Malaria is a deadly disease that affects most of world's populations who live in tropical and sub-tropical regions, in Africa and much of Southeast Asia, South and central America. According to the 2008 and 2010 WHO report, while significant progress has been made to limit the prevalence of malaria, the disease mortality rate is still estimated at one million people per year with 247 million new cases of malaria infection appearing every year (WHO 2010). Most of the morbidity and mortality from malaria occurs among children in sub-Saharan Africa. A recent WHO Africa regional office report (2010) shows that between 86% and 90% of the 781,000 annual deaths associated with malaria in Africa are children.

Despite some major efforts to eliminate malaria around the globe, starting from the colonial times until today, the disease continues to be a major threat in a number of societies in developing countries. For example, in Kenya the British colonial administration made an effort to eliminate malaria. However, most of those efforts were related to settlement of colonial officers and major British economic and political interests (Snow et al. 1999). Malaria control Efforts since the colonial period in Kenya and other African countries have had limited success because of funding challenges, as well as a lack of coordinated preventative effort, and integrated research agenda, and colonial history.

During the colonial period medical service was exclusionist, leaving out Africans and other non-white settlers from receiving malaria treatment. The medical system was narrowly technical and defined health as the presence or absence of disease (Packard 2000). This approach ignored the improvement of the health of the colonized population

through social and economic development. There was a total lack of effort by the colonial administration in Kenya and other African countries in East Africa to improve the health of Africans (Nangulu 2000). In the eyes of the colonial administrators dealing with the underlying social and economic determinants of illness and the provision of comprehensive heath care system to every citizen in the colony was not a priority.

In the 1950's and 1960's, the major international health and governance organizations (such as UN, WHO, World Bank) made malaria eradication a priority and delegated WHO to carry out a global malaria eradication program. However, Africa was dropped from this program because it was believed that the continent did not have the necessary infrastructure to be included (Malowany 2006, World Health Report 2007, and Meeks and Webster 2001). Despite the major achievement of this campaign in eliminating malaria in the other parts of the world, the disease continued to kill and spread in Africa.

Malaria eradication has a complicated history in post-independence Africa. In the 1970's several countries embarked on ambitious agricultural expansion as part of the Green Revolution. Green revolution was an agricultural initiative taken by several post independence governments to alleviate the food and water problems that the African continent faced. Unfortunately many of these plans proceeded without the necessary foresight or structural and infrastructural capabilities for dealing with the potential health consequences. For example, the building of dams in arid and semi-arid regions of the continent expanded irrigated farming of rice and other cash crops expanded the epidemiological zone of malaria and waterborne infectious diseases. In addition the lack of good governance and funding, a major problem until today, in

several African countries resulted in poor health care provision and the migration of skilled labor force (Mills et. al 2008, Johnson 2005, Hagopian et al. 2004). For example, more than 23% of the United States physicians received their training outside of the United States. Of those trained outside of the United States and working in the United States 64% of them got their degree from in low income or lower-middle income countries (Hagopian et al. 2004). More than 6% of American physicians came from sub-Saharan Africa.

Political instability and the large-scale displacement of people have also been one of the major challenges to reduce or eradicate malaria (Ryan 2004, Banatvala and Zwi 2000, Bodea and Elbadawi 2008). Wars and social upheavals produce a large refugee population who come or go to malaria risk environment worsening the malaria condition in a country or region (Baomar and Mohamed 2000)

One of the major factors for the lack of progress in eliminating malaria is the lack of cooperation between biomedical and, social and behavioral research approaches (Béhague et al. 2009, Agyepong 1992). Despite some progress to fight malaria with biomedical treatment and prevention approach, malaria remains one of the most deadly diseases in the continent. In collaboration with biomedical approaches social science research could greatly contribute to understand cultural explanatory models of malaria, treatment-seeking behavior, and the socio-economic determinants of malaria. It is essential to have an in-depth cultural and local understanding of diseases and disease management in combination with epidemiological approaches to combat illnesses and make appropriate public health intervention (Behague et al. 2009). It is also critical to understand how local communities' hybridize traditional understandings of illness and

treatment with western medicine. The understanding of gender roles, cultural explanatory models of illness, and treatment seeking behaviors are very important factors in the epidemiology of malaria. For example, in most cases people engaged in agricultural occupation are at higher risk than people who work on non-agricultural occupations. Most occupations in developing countries are gendered and disproportionately affect the health of one gender over another. For example, research in Mwea has shown that women are at greater risk of malaria because of their involvement in irrigated agriculture with several malaria risks occupational activities and higher workload compared to men (Mutero et al. 2004). Studies on economic determinants of malaria in Mwea show that people with low socio-economic status are more likely not to use bed nets because of cost (Ng'ang'a et al. 2009,Musyoka 2011).

With regard to treatment seeking behavior, the use of drugs from shops and pharmacies without doctors' prescription is a common practice in Africa because going to hospital for treatment is expensive for many people. Furthermore, hospitals and treatment centers are located in few places in several developing world. The use of drugs from shops and pharmacies is considered the leading cause for the emergence of drug resistant strains to the malaria parasite (Jones and Williams 2004, and Nayyar et al. 2012) and understanding this behavior and its association with certain socio-cultural variables is very important.

Therefore, as shown above, malaria has very complex causes and treatment practices that need an interdisciplinary and integrated approach to understand both *etic* (an observers perspective) and *emic* (Local and cultural) perspectives, or the intermarriage of the two, on causes, signs, and treatments. Integrated and

interdisciplinary research on malaria will help practitioners develop appropriate treatment and prevention mechanisms. By using data from Mwea, using both qualitative and quantitative research methods, the details of each risk factor are explained in the succeeding chapters of this dissertation.

In the next section of this chapter, I present the biocultural anthropological theoretical framework, particularly critical biocultural anthropology and its difference from other forms of biocultural anthropology in relation to malaria risk and management. In this dissertation it is used as a framework for understanding the role of agriculture and agricultural related occupations in malaria risk and treatment seeking behavior in Kenya. It explores directly the role of agriculture and its associated economic, and socio-cultural factors to malaria risk from data collected in Mwea Division. Mwea Division, as former colonial agricultural area, is an ideal place to understand the role that historical context has on the relationship between agriculture and malaria risk. In addition, this dissertation explores cultural belief systems, behavioral, and socio-demographic characteristics, and how they affect malaria risk as well as treatment seeking behavior. This dissertation explores the implication of treatment-seeking behavior for the emergence of drug-resistant strains of malaria in Mwea Division.

1.1 Towards Critical Biocultural Anthropological Study of Malaria

A considerable amount of research has been conducted on the biological, environmental, and sociocultural forces that influence both individual and community health (Singer et al. 2001, Singer and Baer 2007, Farmer 1999, Leatherman 2005, Leatherman and Goodman 2011, Erickson 2008, Nichter 2008, Packer 2007, Humphrey 2001, McElroy and Townsend 1989, Kleinman et al. 1978 Kleinman 1980, Scheper-Hughes and Lock 1987, Wiley 1992, and Dressler et al. 2005). There are a number of

determinants that affect health and the treatment seeking behavior of patients. Medical anthropologists have taken a central role in devising an alternative explanation to biomedicine for health and wellbeing. Biomedical work on diseases has focused on the immediate cause of disease and how to fix it; ignoring the social, political, and historical forces that caused the disease condition (Packer 2000, Leatherman and Goodman 2011:29-37, Singer and Baer 2007:86). Furthermore, anthropologists question the biomedical perspectives of health on its limitations in understanding the cultural knowledge and meaning as well as the local circumstances of illness (Kleinman 1980,Kamat 2008,Nichter 2008).

However, this does not mean that medical anthropologists have one unified theoretical approach to understanding determinants of health. In fact, medical anthropologists are split on this issue. Early on, medical anthropologists who had an ecological leanings took the lead in advancing the role of ecological and environmental factors, such as weather patterns, the natural landscape and agriculture in influencing disease patterns and individual or community responses to disease (Wiley 1992, Alland 1990, Thomas et al. 1989, May 1958; Brown 1997, Livingstone 1954, Brown 1986, Brown 1998:2, Inhorn 1995; McElroy 1990, McElroy 1996 and Tomasello 1999). Taking adaptation as a core conceptual framework, this model was derived from epidemiology and ecology focused primarily on the interaction between humans, parasites, and the environment (Leatherman and Goodman 2011:29).

However, this model of biocultural approach was criticized by critical and interpretative medical anthropologists who identified it as, “ a closed system, overly functionalist, and homeostatic with explicit reliance on biomedical models of diseases”

(Leatherman and Goodman 2011:29). In many cases, an ecologically focused approach tends to regard environmental stressors and the physical environment as important drivers of health outcomes, while paying less attention to sociocultural factors (Khongsdier 2007). The concept of adaptation, as a central piece of medical ecological anthropology, does not go beyond the immediate causal factor and does not ask why these conditions occur (Leatherman et al.1993, Singer 1993, Smith 2002:5). Critical and interpretative medical anthropologists argued that sickness is not just a physiological malfunction but it is related to socio-economic inequalities and experienced differently across cultures (Erickson 2008:26). Furthermore, they questioned biomedicine because it is confined based on culturally limited assumptions about fundamental categories like "disease causation", "signs and symptoms", and "treatments" (Kleinman 1976, Singer and Baer 2007). Diseases are only proximate causes of human suffering because the underlying causes involve political and economic inequalities (Farmer 1999, Leatherman and Goodman 2011,Singer 1993). Some critical medical anthropologists also see biomedicine as an institution that promotes social inequalities and the discouragement of other ethnomedical systems (Erickson 2008:7).

Anthropologists have been urged to come up with a new perspective that addresses the limitations of the medical ecology oriented approach. As a result, anthropologists have proposed a critical biocultural anthropology, which bridges the gap between biology and culture and encompasses the socio-cultural and the political-economic role in health (Singer et al. 2001, Goodman and Leatherman 1998, Leatherman 2005, Leatherman and Goodman 2011, and Retson 2002). Critical bioculutural anthropology is defined as a research approach that combines the political

economy of health risk, the ethnographic examination of *emic* understanding, meaning systems, behaviors, and the biological analysis of health related issues (Retson 2002).

Critical biocultural anthropology addresses not only the gap between biology and culture that influences individual and societies health but expands the geographic and historical scope of analysis to examine the role of social, political, and economic forces, at the local, global, and national level (Leatherman and Goodman 2011:34, Retson 2002). In brief terms, critical biocultural anthropological theory involves an examination of how political-economic forces and socio-cultural perspectives of illnesses can shape biological phenomena among and within populations. Therefore, critical biocultural anthropological theory encompasses, critical medical anthropology, interpretative or meaning centered anthropology and biocultural anthropology.

1.2 Critical Biocultural Perspectives of Malaria in Mwea

In this dissertation I apply critical biocultural anthropology as a framework to examine how historical, socio-cultural and environmental factors influence malaria risk and malaria treatment-seeking behavior. Critical biocultural anthropology also helps me explain my Mwea data in the context of historical and structural determinants that people in Mwea have been facing from the colonial period until today.

Previous research emphasized on agricultural activity and the amount of water in the rice field in Mwea Division as an idea ecological factor to the reproduction of mosquito and the transmission of malaria (Muturi et al.2008, Mutero et al. 2004,Kamau and John Vulule 2006,Ijumba et al. 1990 and Mwangangi 2010). However, agricultural production, particularly large-scale agricultural production have been historically linked to injustice and exploitation (Packard 2000 and Humphrey 2001). In fact, the issue of

land ownership, water distribution, and fair product marketing are still the main concern of Mwea Division community. This is directly related to this research because these important economic resources benefit communities to alleviate poverty and improve their health. Socio-economic status could affect individual vulnerability to malaria.

British colonial encounter with the Kikuyus left a painful social, political and economic experience. The British took most of the fertile Kikuyu land and pushed the Kikuyu communities into reserves and remote villages creating tension and at times assimilation with neighboring ethnic groups (Parsons 2012). Land being the cultural, economic, and social life of the Kikuyus the denial of this right left most of these communities in poverty and become agricultural laborers in the colonial irrigation projects (Kenyatta 1938:22-27). British colonial administration also responded with excessive force to local resistance (such as the Mau Mau movement) against land confiscation and the destruction of Kikuyus cultural and social life (Elkin 2009:31) Thousands of Kikuyus were killed and many more thousands imprisoned and subjected to years of forced labor in the irrigation field. Elkin (2009) argued that even though the main reason for the conflict was land and freedom, the British colonial administration misrepresented the movement as barbaric, anti-European, anti-Christian and a terrorist act meant to derail the British civilizing mission in Kenya. Colonial structure created social and economic inequality in Mwea, the heartland of the Kikuyu and the center of Mau Mau movement that affected the health and social life its people. According to Kenyatta, the first president of Kenya and the Pioneering Kenyan anthropologists asserts that the colonists took away African farms on the ground that land does not belong to individuals rather to communities and anyone can claim it (Kenyatta 1938:23).

Kenyatta further argued British colonial rule brought the Kikuyu social order to ruins and its people to peasants in colonial feudalistic structure leaving them to disease and poverty. According to Kikuyus legend when Nagi (God) was dividing the world's territory to different races, he gave Kikuyus the best land full of good things (Kenyatta 1938:24).

The social and economic inequality during the British colonial system did not much change after independence; most of the British land and political structure was maintained after independence. Communities land taken by the British remained the government of Kenya and few individuals' mostly British white settlers. Independent Kenya adopted the colonial constitution that reflects colonial land policy until 2011.

CHAPTER TWO
SOCIO-CULTURAL AND ECOLOGICAL CHARACTERIZATION OF MALARIA IN KENYA AND THE EAST AFRICAN REGION

In our dynamic world, in which social, cultural, and environmental change is occurring at a fast rate, understanding the consequences of these changes to human health and wellbeing is very important. This is particularly critical for infectious diseases that affect the developing world such as sub-Saharan Africa, where these changes are occurring at a much more rapid pace than the developed world (Packard 2000). These circumstances pose new challenge in the study of malaria that require a more broad and robust understanding of the current infectious disease research agendas that incorporate all forms of health determinants.

Historically, malaria study in Kenya and other African countries focuses on the mosquito as a vector, the malaria parasite, and the physical environment. However, malaria epidemiology depends on the intricate relationship between, humans, mosquitoes, the parasite, the physical environment, and more. Current sociocultural components of malaria epidemiological study in Kenya are limited and the few studies so far conducted focused on household demographics, vulnerable populations, and risk behaviors (Mwensi et al. 2005). At the same time anthropological malaria studies in Kenya and in the region has traditionally been on ethnographic description of malaria.

A lot of research and funding has been allocated to understanding the interplay between climate, physical environment and the mosquito parasite (Buluma et al. 2010, Tatem et al. 2005, and Smith et al. 2005). Several communities in sub-Saharan Africa including Kenya depend on agriculture. Large and small-scale agriculture, rain, and humid climatic conditions are blamed for the persistent existence of malaria in Kenya and other parts of Africa.

In the following sections of this chapter I present the current socio-cultural and ecological characterization of malaria in Kenya and the east Africa region.

2.1 Cultural Explanatory Models of Malaria

Various cultures explain the etiology and experience disease in different ways. Several research projects have been conducted around the world, including Kenya on how people understand and experience malaria (Pool 1994, Kamat 2008,Nichter 2008, Mewnesi et al. 1995, and Hossain et al. 2010). Anthropologists have also studied folk models of illness (ethnomedical approaches) to address the role of cultural factors in understanding malaria. These ethnographic studies highlight cultural diversity in understanding the diagnosis, treatment of diseases, and their implications for health outcomes and interventions (Kamat 2008; Langwick 2007; Okeke A. et al. 2006; Mewnesi et al. 1995; Yoder 1981; Pool 1987). For example, Pool (1987), identified Gujarat communities in eastern India, where disease causation is classified in terms of hot/cold states, and malaria is considered an illness caused by an encounter with a cold object (e.g., cold foods). In Bangladesh, Hossain et al (2010), study on the Upazila region, where several ethnic groups live, found that these different ethnic groups have distinct explanation of malaria causation, diagnosis and treatment that includes both natural and spiritual. In some cases even if people believe the biomedical causal model of malaria, the mechanisms of malaria transmission in most cases is understood differently (Nichter 2008:49).

2.1.1 Malaria Causation

Ethnomedical systems do not usually follow a fixed or single causal model of illness. Rather, they focus on multiple causes that can include the individual, the social, the natural environment, and supernatural forces (Erickson 2008:55-56). Studies on the

cultural understanding of malaria in Kenya and the East African region show multiple causality models (Nichter 2008, Mewnesi et al. 1995, Nuwaha 2002, and Nyamongo 1998). Causes of malaria could be both natural and supernatural. However, the attribution of causation is influenced by several factors including (but not limited to), education, age, diet, and seasonality. For example, lay people in Tanzania associate the causes of malaria with mosquitoes during the rainy season, but when the rainy season is over, malaria is attributed to supernatural causes (Nichter 2008:49). The Mewnesi et al. (1995) study among mothers on the Kenyan coast, found that 56% of mothers believe the mosquito is the primary cause of malaria for their children while 44% of the respondents did not know what exactly causes malaria. Of the 56% only 10% of them knew the biomedical mechanism of the mosquito and malaria link. The anthropological study by Nyamongo on the lay understanding of malaria among the Abagussi ethnic group of Kenya showed that 85.7 % considered mosquitoes as the main cause of malaria, 57.0 % of them believed sugary substances as a cause, and 34.3% blamed witchcraft (1998:40). Similarly, studies in Tanzania and parts of Kenya, explored *Degedege,* which is clinically severe malaria. It is understood locally, as a life-threatening illness caused by a local sprit that takes the form of a bird and casts its shadows on children on moonlit nights (Kamat 2006; Langwick 2007). This form of malaria starts as an ordinary fever that slowly becomes stronger and finally develops into *Degedege*. Most people in malaria-endemic regions of Africa understand that the mosquito causes malaria, but how it transmits the disease is, in many cases, understood differently from the biomedical transmission model (Nichter 2008:48, Mewnesi et al. 1995). Nichter (2008:48) argues that the link between the mosquito and

malaria is associated with water in most cultures in Africa. According to Nichter (2008) the lay epidemiological relationship between mosquitoes, water and malaria is based on the perception that mosquitoes drink and live in dirty, contaminated water.

2.1.2 Recognition and Diagnosing of Malaria

Signs and symptoms are important in the study of malaria because they are critical for determining treatment, as well as control. Understanding how people diagnose and respond to malaria can have significant clinical and public health implications, such as antimalarial drug resistance and the increase of the incidences of the illness.

The understanding of how people diagnose malaria becomes even more important in communities where self-treatment of illness is common. Recognition of the illness, definition, and management are situated in a socio-cultural context and reflect social class, age, and level of education (Mwenesi et al. 1995, Esse et al. 2008, Nuwaha 2001). Furthermore, anthropologists have identified many challenges for clinicians and epidemiologists because of the overlap of malaria symptoms with other infectious illnesses (Nichter 2008:75, Font et al. 2001, Olaleye et al. 1998, English 1996). For example, the study done by Font et al. (2001) in the Kilombero district of Tanzania showed that based on clinical diagnosis, 34% of the patients who visited the clinic for treatment were misdiagnosed with malaria and were given anti-malaria drugs. Approximately 30.1% of the patients were misdiagnosed as not having malaria and were not given anti-malaria treatment.

Not correctly diagnosing of malaria illness does not only occur when patients are self-treating the illness but it could also happen in governmental and private clinics which lack resources for parasitological testing. In the absence of adequate resources

for malaria screening in clinics and hospitals in the developing world, health professionals can also potentially misdiagnose malaria and prescribe the wrong drug for a disease if there is miscommunication during the clinical encounter. In some cultures, malaria is encompassed into a larger illness category (Nichter 2008:56).

Patients may classify clinical malaria symptoms into several distinct illnesses. Most often lay people in Africa confuse malaria symptoms with pneumonia, typhoid, and some diarrheal diseases (O'Dempsey et al. 1993, Ammah et al. 1999). Patients might also think that the malaria has transformed into another category of illness (such as typhoid) based on the severity of the symptoms. Furthermore, the categorization of illness can be based on how symptoms vary by age or gender. Different communities in Kenya and in the region assign different symptoms of malaria to different age groups. For example, Mwenesi et al. (1995) found that mothers in the coastal regions of Kenya assign three stages of malaria (locally known as *Huma*) symptoms in children into mundane, mild, and severe. However, this malaria recognition process does not apply to adults. In Tanzania, *Degedege*, is more common among children than adults (Kamat 2008).

Therefore, the confusion of malaria symptoms with other illnesses could have fatal consequences (Hume et al. 2008). This research takes a step toward examining how people in Mwea division understand malaria symptoms and how they discriminate malaria symptoms from other common illnesses in the district. Understanding how people diagnose an illness is important because people do not self-prescribe treatments based on causes of the illness but on perceived symptoms. In addition the mother's perception of the seriousness of the illness and the decision of others could delay

seeking medical help for a child or for an adult patient. Understanding whom actually diagnoses malaria and who makes the decision to seek medical treatment is an important factor to recognize in order to design and implement policy and educational intervention for malaria.

The current malaria diagnostic policy by the National Malaria Strategy of Kenya (NMS) and the Ministry of Health and Sanitation is that fever is the main clinical diagnosis for malaria, and if a patient visits a clinic with the necessary laboratory facilities, it is recommended that the laboratory do a parasitological test (Kenya Malaria Indicator Survey 2010). However, most government dispensaries do not have lab facilities and provide malaria medication for any person who experiences fever. After all, it is most likely that patients will not go to a clinic or see a doctor for treatment unless all self-treatment options have failed, and the patients' condition is getting worse (Mwensi et al. 1995, Nyamongo 2002 and Okeke et al. 2006).

2.1.3 Strategies for Treatment and Prevention of Malaria

Self-treatment for malaria is likely practiced in all areas where the disease is present. The reasons for self-treatment include distance, cost, and cultural belief systems (Foster 1995). In most African countries, self-treatment occurs at home, using drugs from pharmacies or herbs (Williams and Jones 2004, Mwenesi et al. 1995, Okeke et al. 2006). Furthermore, local communities and health workers may have different priorities and perceptions of illness severity and individual vulnerability to an illness. For example, malaria treatment studies among children in the Kifili district of Kenya showed that people do not believe malaria is preventable, but it is treatable (Mwenesi et al. 1995).

The Ministry of Public Health and Sanitation recommends that all hospitals and governmental health facilities test every patient that experiences fever for malaria. The ministry also requires all governmental hospitals to provide Arteminsinin based combination therapy (ACT), Artemether-lumefantrine (AL) as a first line malaria treatment and sulfadoxine-pyrimethamine as a second line treatment at an affordable rate (Kenya Malaria Indicator Survey 2010) because of the parasite resistance to other malaria drugs.

Herbal self-treatment is very common in Kenya, particularly in rural and remote areas where access to health care is difficult. The Kenyan government does not discourage traditional healers but usually warns the public to be cautious in the use of herbal treatment. The Kenyan government recently indicated that it would put legislation in place to monitor and regulate herbal treatment across the country (Majtenyi, 2012).

The National Malaria Strategy and the National Health Sector Strategic Plan (NHSSP), under the umbrella of the Ministry of Public Health and Sanitation, with donor organizations usually set malaria prevention and control policies in Kenya (Kenya Demographic and Health Survey 2009). The National Malaria Strategy program lists, the main core principles of malaria prevention and control strategy, which includes:

1) Vector control using Insecticide Treated bed-nets (ITNS) and Indoor Residual Spraying (IRS)
2) Case management using both first and second line of treatments with improved lab diagnosis.
3) Management of malaria in pregnancy
4) Epidemic preparedness and response
5) Educational campaigns, providing information and targeting behavioral change.

These goals were set prior to 2005, and were expected to reduce malaria prevalence by 30% in 2006. While the goal has succeeded in changing the prevalence of malaria and reducing malaria in several districts in Kenya, malaria still remains a major challenge and a leading cause of morbidity and mortality in the country (Kenyan Demographic and Health Survey 2010).

2.2 Ecological and Climatic Components of Malaria

Historically, in Kenya and in the wider region of sub-Saharan Africa, malaria research focuses on ecological and climatic factors (Packard 2007: 118, Snow et al. 1999). Starting from the colonial times and until today malaria research emphasized the role of climate on mosquito's habitat, reproductive rate, and behavior. Since the discovery of the malaria parasite, the development of anti-malaria drugs, the behavior, and nature of the parasite in different ecological and demographics took a central role in malaria research. Both donor and sub-Saharan African governments have continuously funded an ecological and biomedical oriented research projects on malaria treatment and prevention. However, while ecological and climatic factors are very important risk factors that need to be tacked, the socio-cultural dimension of malaria etiology should be considered an integral part of the larger malaria treatment and prevention strategy. The limited malaria behavioral study in Kenya and sub-Saharan African in general focused on high-risk groups such as pregnant women and children.

Settlement and population movement have tremendously affected the epidemiology of malaria in East Africa. Because of water and other resource needs most communities are established along major water bodies and man-made dams or irrigation sites. These settlements provide a suitable environmental and human condition for mosquitoes and enhance the cycle of malaria in communities.

Furthermore, pastoral communities, that are always on the move for search of water and other necessary resources are always at risk of malaria when they come in contact with malaria holoendemic or hyper-endemic regions (Prothero 1961). The following sections of this chapter provide the ecological, climatic, and human factors that shaped the pattern of malaria in Kenya and sub-Saharan Africa since colonial times.

2.2.1 Climate, Mosquitoes, and Humans

Climate, subsistence activity, and disease ecology (such as the density and variation in populations of mosquitos and malaria parasites) are key factors to the spread and transmission of malaria. Since the early 1900s, malaria research in Kenya has focused on specific malaria risk factors such as migration and livelihoods, the characterization of mosquitoes and malaria parasites, and drug resistance (Garnham 1929,Anderson 1929, Hoffman et al. 2002,Hartl 2004, Mouchet et al. 1998, White 2004,Inhorn 1995, McElroy 1990,McElroy 1996, and Tomasello 1999). For example, colonial administrators mandated the tropical medical community to study the species of mosquito, their distribution, and their behavior in both Nairobi and Kisumu and other urban centers in Kenya (Garnham 1929; Anderson 1929). This mandate was instituted in 1929 by the official declaration of the colonial government with a policy to eradicate and create malaria free colonial towns around Kenya and the whole East Africa protectorate (Anderson 1929).

Much of the research on mosquito vectors throughout the colonial era focused on the following characteristics: a) mosquito species inventory b), mosquito distribution, c) mosquito habitats and breeding grounds, d) adult mosquito and *larvae* morphological and anatomical description, and e) annual and monthly mosquito growth rate and rain fall distribution. In Kisumu alone, around ten new species of mosquito were discovered

between 1900 and1929 (Garnham 1929). Understanding the life history of mosquitoes and their breeding ground was an important malaria eradication strategy (Anderson 1929; Watson 1937). Anderson (1929) explained the importance of this by quoting James and Shute, the two individuals responsible for malaria policy in the colonial empire:

> The secret of successful control of malaria lies not in the general knowledge of that the diseases is spread by mosquito of a certain kind, but in the particular and exact knowledge of the life history of the few individual mosquitoes which succeed in becoming transmitters of the disease (Watson 1937).

During the Royal African Society monthly address in 1937, Watson asserted that despite some critics of the declaration of the eradication of malaria through the eradication of mosquitoes, it was the only way the civilized world could win the fight against malaria. Similar to what Gorgas did it in the Panama, Balfour in Khartoum, Sudan, and Ross in Ismailia, Kenya. Watson (1937), warned that even quinine, know during those days as “one of God’s greatest gift to man”, would not eliminate malaria without controlling or eradicating the most harmful species of mosquito from the face of the earth.

Therefore, ecological and biomedical research focusing on the mosquito and the malaria parasite dominated most of the malaria studies from the early days of the malaria investigation until today in Kenya and the wider region. For example, in the early days of colonial administration, malaria research in Kenya was focused entirely on the mosquito vector and its ecology (Garnham 1926, Nangulu-Ayukun 2000). Still current research is dominated by biomedical and ecological malaria research in Kenya (Mutero et al.2004, Muturi et al. 2007). For example, Muturi et al (2007) studied the habitat and the diversity of the mosquito vector in the Mwea Division. Their results show

that different species of the mosquito vector are associated with different habitat and climatic conditions. For example, *Cx. Culex poicilipes* mosquito is associated with floating vegetation while; *Cx. Annulioris* is associated with clear water. This means malaria research in Kenya has continued to focus on ecological and biological factors to malaria transmission and malaria response.

A large part of malaria funding goes to biomedical studies or the distribution of bed nets. For example, since the late 1990s, the Japanese International Cooperation Agency (JICA) has provided millions of dollars for malaria and environmental studies, with a special focus on technical support to study mosquito and malaria parasites in several third world countries (JICA 2001). The 2010 JICA annual report shows that Kenya is the second leading recipient (8.4%) of this grant in Africa behind Tanzania. The Bill and Malinda Gates Foundation is also one of the largest donors to malaria research and, as the Bill and Malinda Gates Foundation website clearly states, most of the funding goes to vaccine development, with a relatively small amount directed to bed net distribution (Bill and Melinda Gates foundation 2012).

With some of the funding coming from the aforementioned sources, in the last few years, scientists have been studying spatial modeling of the expansion and transmission rate of malaria using satellite and entomological data in Kenya (Omumbo et al. 2005,Hays et al. 2002, Hays and Tatem 2005,Smith 2007,Tatem et al. 2008, Snow et al. 2005, Snow and Marsh 2002). These spatial and ecological studies primarily focused on rainfall and humidity pattern and the habitat of mosquito vectors. For example, Omumbo et al (2005) identified 330 parasite survey data points (sites with higher malaria prevalence rates) using spatial modeling of malaria transmission in the

East Africa region (without the Horn of Africa) that fulfill the inclusion criteria for malaria risk. Out these 330 data points, 217 were from Kenya, 86 from Tanzania, and 27 from Uganda. The main goal of these studies is to understand the change in number and behavior of mosquitoes both in time and space.

As mentioned before (section 2.1.3), the Kenyan Ministry of Public Health and Sanitation adopted most of the works from ecological and biomedical research to malaria management and prevention. In the Kenyan Demographic and Health Survey 2010 report, the ministry clearly states that it aims to provide affordable health care, target the parasite, and work on environmental threats such as mosquitoes and favorable mosquito environments to support its primary goal of reducing the mortality and morbidity of children under 5 years and pregnant women (Kenya malaria survey Report, 2010). In addition, the ministry and its local and international partners set the following two broad priority goals with regards to malaria reduction: 1) malaria management, in which Arteminsinin based combination therapy (ACT), Artemether-lumefantrine (AL), and parasitological test are provided at affordable rates and 2) malaria prevention, in which the ministry also adopted prevention measures the include Insecticide Treated Bed-nets (ITN), Indoor Residual Spraying (IRS), and campaigns and advocacy for both communities health workers, as well as training for health workers to better detect and diagnose malaria (Kenya Demographic and Health Survey, 2010).

While the Kenyan ministry of health malaria intervention and prevention strategies is important, however, these strategies success could be limited because of cultural and social reasons that influence treatment-seeking behavior. One of the problems is that the adopted anti-malaria measures are built on certain assumptions

that might be affected by people's cultural belief system and treatment-seeking behavior. For example, by adopting the current malaria treatment and prevention strategies, we are assuming all patients seek treatment in government or private hospitals. However, research from Kenya and the region (Williams and Jones 2004, Mwensi et al. 1995, Nyamongo 2002 and White 2002) showed that a large proportion of people do not use the government facility. In addition, several studies and medical report indicated that most people use bed-nets for other purposes than preventing against malaria such as fishing, carrying items, and so on. For example, Ng'ang'a et al. (2008) research in Mwea on malaria vector control practices showed that 39% of people have no knowledge of the most common malaria vector control methods and reported they do not practice them. The same research also show that 93% of respondents use bed net to protect them from mosquito bite and 54% of the respondents said the use it to protect them against malaria. Recent study in Mwea on treatment-seeking behavior showed that people use multiple forms of treatment that includes, home treatment, pharmacies, chemists, hospitals, and herbalists (Musyoka 2011). Musyoka (2011) reports that among 416 households surveyed reported malaria 3.8% did not seek treatment and 96.2% seek treatment. Among those who seek treatment 66% of them sought single treatment while 30.1% sought multiple treatment.

The second assumption is that people have the same understanding of malaria as the formal health care system. Again, detailed anthropological research (Nyamongo 1998, 2002; Kamat 2008) in Kenya and general in the region have already proven that every community or ethnic group has its own unique understanding, perception, and treatment of malaria. In Mwea while most people believe mosquito causes malaria but

people also believe malaria can be caused by cold weather conditions, eating raw foods and dirty water (Ng'ang'a et al. 2008). Finally, assuming that targeting a high-risk population would eventually reduce malaria might not be possible because any age group or gender in the community can harbor the parasite and extend the infection cycle of the parasite in the community. While children and pregnant women are at higher risk of malaria, the elimination of malaria should target the entire demography because any of the people could harbor the parasite for long periods without showing malaria symptoms.

However, people who work on malaria prevention and treatment on malaria are well aware of these limitations but are constrained by funding and resources (Personal communication with Dr.Bernard Okech). Public health officials and researchers have to prioritize their research agenda to meet the health demands with limited resources.

2.2.2 Settlement Patterns and Population Movement

In several sub-Saharan and other third world countries, villages are established very close to rivers, lakes, and swamps because communities heavily depend on this water source to produce crops and raise livestock. Water is a precious material for the survival and is difficult to transport for long distances. Most of the water bodies are open and infested with mosquitoes and other disease vectors such as snails. In some cases, high labor demand means there is a lot of migration of people from one place to another, particularly during rainy season when the malaria incidence is at its peak. Furthermore, anthropogenic changes to the environment such as the establishment of irrigation schemes, dams, and water reservoirs increase malaria transmission and negatively affect the health of population by creating permanent mosquito breeding sites. The man-made environmental changes could further intensify the labor demand

and increase seasonal migration of people, which could extend the transmission of malaria beyond the epidemic zones. Generally, nomadism and seasonal labor migration play a major role in the transmission of malaria in East Africa (Martens and Hall 2000). Pastoral communities in Kenya and the East African regions are always on the move in search of water and grass, and the people can be exposed to malaria and water-born diseases. Pastoral communities and other migrants are at higher risk than population who live in stable malaria endemic zones because of their low acquired immunity (Martens and Hall 2000, Ijumba and Lindsay 2008). In Kenya and several eastern African countries pastoral groups, and labor migrants have less access to health facilities are constrained by their residential status (even at times their citizenship status) and a lack of information on where these facilities are.

The sanitation programs in most eastern African villages are non-existent (WHO/UNICEF 2011). Governments do not have the resources or sometimes the willingness to provide resources to build contained water cannels and pipe based water services to communities to minimize malaria and other water born diseases. Self-reported malaria survey of 314 women in Accra Ghana showed that household characteristics and proximity of residence to site of urban agriculture are positively correlated to malaria incidence (Stoler et al. 2009; Statedke et al. 2003). The study showed that malaria, which is self-reported, is associated with age, education, overall health, socio-economic status, and solid waste disposal. Women who live within one-kilometer distance from the urban irrigation site reported higher malaria incidence. The incidence of malaria disappears as the residence of the women gets far away from the one-kilometer distance range.

Urban communities might enjoy relatively better health care services than their rural counterparts in most non-Western countries, but urban environment in itself could be a malaria risk**.** The number of urban population has been rapidly increasing in Africa and is expected to grow from 39% at the moment to 54% in 2030 (Tatem and Hay 2004). This will pose a major health challenge to the continent and other third world countries (Stoler et al. 2009, Robert et al.2003,Keiser et al. 2004, and Tatem and Hay 2004).

Urban populations in sub-Saharan Africa, Southeast Asia, and other developing countries are at risk of malaria, depending on the climatic and ecological factors, agriculture, level of poverty, population density, availability of good infrastructure, level of pollution and other factors (Robert et al. 2003, Donnely et al. 2005; Paul 1984). Most towns and cities in sub-Saharan Africa are not well prepared or equipped to accommodate the growing migration of people from rural areas; housing conditions and the social and infrastructural facilities are poor or non-existent (Keiser et al.2004). Growing urban agriculture, growing level of poverty and high-density population in the urban tropics showed a strong likelihood of transmission of malaria (Robert et al. 2003, Keiser et al. 2004, and Stoler et al. 2009). Despite the lack of data on population surveys in urban areas in East African towns, the migration of people from rural to urban has been on the rise creating major slums and crowded neighborhoods in Nairobi, Kisumu, Addis Ababa, Kampala and Dar es Salaam and other major urban centers in the region. Most of these urban centers suffer from poor drainage and sewage systems.

Using the latest remote sensing techniques and using United Nations urban population figures in Africa, Keiser et al (2004) estimated that there are 200 million people (26.4% of the African population) who are at risk of malaria. However, Tatem et al. (2008) argued that while these sources of information are useful to predict the pattern of urban malaria, the contemporary urban population survey data, in Kenya and for that matter in several sub-Saharan Africa, is very poor. Better data is needed before we can understand the potential of the disease in urban areas (Tatem and Hay 2004, Tatem et al.2008). Omombu et al (2004) argued despite a big gap in the prevalence of malaria between urban and rural in East Africa, the extent and definition of urban must be established in order to capture the non-climatic determinants of malaria in urban areas. The causes and pattern of malaria transmission in rural areas might not be the same in urban areas and a new methodological and theoretical framework must be introduced to understand the determinants of the disease in urban setting (Robert et al. 2003 and Tatem et al. 2008).

According to the Kenya Demographic and Health Survey (2009) rural communities experience a much higher incidence of malaria than urban populations. However, the incidence of malaria in urban communities in Sub-Saharan Africa is on the rise (Stoler et al. 2009). For example, the deteriorating life standard and increasing political instability in rural areas forced many people to migrate to urban areas in Southeast Asia and Africa in the 1970s and 1980s. As a result, the transmission of malaria in urban areas has intensified (Paul 1984, and Decastro et al. 2004). The deteriorating environmental conditions of major urban areas because of over population (through the creation of slams and lack of sanitation) have created suitable conditions

for the reproduction of mosquito vectors. These socio-political and ecological problems continue in several developing countries and are pushing people to migrate to urban centers. The growing migration of people from rural areas to urban areas not only increases the transmission of infectious diseases, but it could create over- population-related problems such as crime and the shortage of social services. This is discussed in the next section of this chapter.

2.3 Biological and Economic Impacts of Malaria

Malaria and its effect on the biology and socio-economic status of individuals and communities has been a major debate in anthropology, development studies, and evolutionary biology. Regardless of the directionality of the cause and effect of malaria, it is clear that the interaction of malaria with an individual biology, the social and economic life of communities, and individuals is undeniable. Populations in malaria endemic regions have a higher frequency of malaria protective molecular markers but experience other health problems such as anemia and lower immunity levels to withstand other infections. Similarly most people who live in malaria endemic regions experience a low productivity level because of malaria infection. A large portion of their income is spent on treatment. Furthermore, a great portion of their time is spent taking care of malaria sick family members or getting sick themselves.

2.3.1 Malaria and Poverty

The relationship between poverty and malaria in non-Western countries has been a major debate among researchers. The main issue being whether poverty is the cause of malaria or malaria is the cause of poverty (Acemolgu et. al. 2003,Mustafa 1999,Packard 2000,Humphrey 2001,Gallup and Sachs 2001, and Malaney et al. 2004).

Structural inequalities, both locally and globally have an influence on the status of individual health and the persistence of malaria in certain regions of the world and in certain communities within highly malaria affected countries (Acemolgu et al. 2003, Malaney et al. 2004 and Humphrey 2001). Some of these inequalities are unfair global trade arrangements, weak local public heath infrastructure, high health costs, extreme poverty, poor sanitary condition, and lack of public education. Domestic factors such as ethnic rivalry, and unsustainable use of the environment could also indirectly affect malaria epidemiology (Collier and Gunning 1999).

On the other hand, malaria could affect economic development and lead to poverty in several different pathways (Gallup et al. 1995: 5, Gallup and Sachs 2001). Malaria hinders the flow of direct foreign investment in malaria endemic regions and limits internal movement of people and goods because of weak infrastructure. Furthermore, malaria could also lead to poverty by debilitating the work force through high medical costs and days lost to illness. Gallup and Sachs (2001) argued that the burden of malaria, the major cause of poverty in several third worlds, is best explained by climate and ecology. Nevertheless, this argument has been rejected. Acemoglu et al. (2003), Parker (2002), (Parckard 2007:157) and others assert that the impact of disease environment on the economy of nations is not because of the direct impact of health conditions on income but because of an indirect effect through institutions. Furthermore, the current geographic distribution of malaria better fits more to the global poverty index than to world climate zones.

Current empirical studies on the link between malaria and poverty in several African countries show mixed results (Worrall et al. 2005). For example, a study by

Sylvester and Ivan (2006) in, Dar es Salaam, Tanzania among 50 randomly selected households showed a positive association between income poverty and malaria experience. A study by Ng'anga et al. (2009) work on bed net use in Mwea division found that social and economic factors affect use in that low-income individuals are less likely to use bed netting. Reasons for regular non-use of malaria protection methods in Mwea include unaffordability (67.7%), side effects (26.6), lack of effectiveness (21.5%), and lack of time (3.5%) (Ng'ang'a et al.2008). A similar study by Chuma et al. (2006) conducted a two-stage cross-sectional study (dry and wet season) in Ganze, Kilifi district of Kenya on the association between household economy and malaria risk. This study indicates that 50.7% of the households in the wet season and 55.4% households in the dry season did not have money to cover their malaria treatment cost and were at high risk of malaria. However, a study by Clark et al. 2006 showed a negative relationship between income and malaria experience. The few inconsistency in the results of the studies is probably related to methodological and conceptual challenges, particularly the measure of socio-economic status and the definition and recognition of the malaria. Furthermore, the link between malaria and poverty has been studied based on national and global data with very limited studies done at household and local levels. The uses of western standardized socio-economic measures do not reflect local economic and social gradation in several non-western contexts.

Despite the noted inconsistency it is has been generally reported the close relationship between malaria and poverty. For example, a map depicting the global distribution of malaria from 1900 to 2004 shows that while populations at high risk of malaria have significantly decreased outside of Africa, they increased from 0.06 billion

to 0.65 billion in Africa (Hay et al. 2004). Hay et al (2004) argued that while humans are capable of controlling malaria today, a minimum effort against it in poor regions of the world led to its current distribution. Malaria was also concentrated in the poorest segments of the population within the United States. The history of malaria in the United States in the 19th and 20th century is directly related to race and poverty (Humphrey 2001:3). Humphrey argued that African-Americans, particularly in the south, who experienced racism, poverty, and structural inequalities, lived under conditions that favored the transmission of malaria. Brentlinger (2006) said:

> Although malaria could, in theory, become endemic wherever local climatic conditions are hospitable both to humans and Anopheles mosquito, persistent malaria is more common where a third condition is met: the presence of poverty.

Therefore, regardless of the directionality, conceptual, and methodological problem, still malaria and poverty have been closely associated to contribute in several populations in third world countries. Despite very well established micro or household level understanding of malaria and poverty, the current distribution of malaria is concentrated in the most impoverished countries in the world. Kenya and the larger East Africa region are not exceptions to the persistent suffering caused by the intertwined relationship between malaria and poverty.

A recently released World Bank poverty report ranked Kenya among the top 20 impoverished countries in the World with 50% of its population below the poverty line and close to 40% unemployment rate (World Bank Poverty Index 2010). Furthermore, Kenya is one of the top five countries of the entire continent in terms of income inequality. The income and infrastructure gap between rural and urban areas is extremely high in Kenya. Malaria burden inequalities across gender, urban-rural, and

age groups in the country are very high as shown in the following table from the Kenyan Demographic and Health Survey Report. Close to 94% of the rural communities, where malaria incidence is high, fall into the lowest wealth quintiles and close to 79% people in the urban fall into the highest wealth quintile (see table 2-1 the income distribution in Kenya).

In addition, to the conceptual and methodological scrutiny to the current malaria research approaches in Kenya and the region, it is important to examine malaria impact among different demographic groups and gender.

Table 2-1. Wealth distribution of the Kenyan population in five wealth levels (Quintiles) based on wealth index by residence calculated by possession of various household items, means of transportation, possession of agricultural land and livestock/farm by residence in Kenya from 2008-2009. (Source: Kenyan Demographic and Health Survey 2010: 25)

	Quintiles						
	Lowest	Second	Middle	Fourth	Highest	Total	Number of population
Residence							
Urban	0.5	1.5	2.7	16.8	78.5	100.0	7,365
Rural	24.7	24.4	24.2	20.7	6.0	100.0	30,704
Province							
Nairobi	0.0	0.0	0.2	4.2	95.5	100.0	2,352
Central	2.2	11.1	29.2	36.0	21.4	100.0	3,870
Coast	26.3	12.4	9.4	16.2	35.7	100.0	2,953
Eastern	16.7	22.3	27.6	26.3	7.1	100.0	6,629
Nyanza	17.6	28.4	23.9	17.7	12.3	100.0	6324
Rift valley	28.2	19.2	16.1	17.8	18.7	100.0	10375
Western	17.9	33.0	25.1	18.8	5.2	100.0	4506
Northern Eastern	75.9	5.6	5.5	4.9	8.0	100.0	1059
Total	20.0	20.0	20.0	19.9	20.1	100.	38,069

2.3.2 Biological Impact of Malaria

Malaria has been with humans for the last 10,000 years constantly affecting human biology and health. It has both molecular and physiological impact on the human body (Kiwiatski 2005, Tiskoff et al. 2001, and Fernado et al. 2003). Research on the biological impact of malaria has shown neurological and physical effects including low birth weight, stunting, iron deficiency, and learning and developmental retardation

(Fernando et al. 2003, Guyatt and Snow 2004, Shell-Duncan and McDade 2005, Wander et al. 2009). Malaria heavily affects children's' brain and immune system. According to Guyatt and Snow (2004) of the 3,020,00 low birth weight children born in Africa every year, the 573,800 (19%) are due malaria in pregnancy. The number infant mortality caused by malaria during pregnancy are estimated between 75,000 and 200,000 every year. Low birth weight of children is caused by biological and socio-cultural, and political and economic factors (Guyatt and Snow 2004). The biological factors are genetics, placental abnormality during pregnancy, and maternal age. The socio-cultural and political economy factors include lack of proper nutrition, exposure to infection (malaria and other bacterial infection), and excessive work during pregnancy, smoking, and stress. The biological factors such as genetics and placental abnormality are rare and only affect a very small portion of women. However, the socio-cultural, political and economic factors are abundantly common in several third world countries. Pregnant women worries about what to feed their incoming child or the already born children, and work in a more labor-intensive jobs in addition to exposure to infectious diseases that impact their health more negatively than men. All these social, political, and economic problems affect the biological and health of a pregnant woman. The biological mechanisms by which malaria impact the biology of pregnant women is through the reduction of the level of red blood cells and the supply of necessary nutrients and oxygen to major vital organs and the fetus in her womb (Fernando et al. 2003).

Children could still be affected by malaria once they are born or could be born with malaria. Most children in most malaria endemic regions suffer malaria several

times before they reach adulthood (Fernando et al. 2003). The exposure to repeated malaria infection at such a young age leads to major neurological and psychological malfunction. For example, Fernando et al (2003) investigated the impact of repeated malaria infection on school performance among 571 children between the ages of 6-14 in Southern Sri Lanka. The result of this research shows that of the 571 children 385 of them experienced 1091 episodes of malaria between January of 1992 and November of 1997. The remaining 186 children experienced no episodes of malaria. At the end of the study the children school performance of was evaluated and it showed a significant correlation between malaria experience and school performance. The children are drawn from socio-economically poor rural agricultural community in Southern Sri-lanka. About 61% of the mothers of these children are housewives.

At molecular level malaria has been a major evolutionary force in human history leading to the development of genetic polymorphisms that confer malaria protection in several malaria endemic parts of the world (Kiwiatski 2005, Brown 1989). However, most of these genetic polymorphisms have a side effect such as anemia and limited immune function. This particularly, affects immune compromised groups such as pregnant women, children and elders. For example, sickle cell, G6PD deficiency, and other hematological disorders are considered health problems in the United States and many western countries but originally they were selected in malaria endemic regions of the world because of their protective advantage against malaria. Populations in endemic regions or previously endemic regions live with those biological consequences even once malaria is eradicated.

CHAPTER THREE
IRRIGATION AND MALARIA IN KENYA AND PARTS OF SUB-SAHARAN AFRICA

Irrigation and in general agriculture are the largest employing sector in Kenya and several other countries in the tropical regions of Africa. According to the World Bank 2012 report more than 65% of sub-Saharan African populations are employed by the agricultural sector. Irrigation in this case refers, to agricultural activity that involves (large-scale) production of agricultural products through channeling water to a vast agricultural field all year round.

Irrigation and not well-planned development projects, such as the construction of roads, building of dams, and clearance of forests, could negatively affect the epidemiology of malaria both in endemic and non-endemic regions. The continuous presence of water in irrigated areas, and dams, forest clearance creates a suitable condition to the reproduction of mosquitoes. Similarly, development projects such as construction of roads facilitate the movement of people that indirectly impact the transmission of malaria from one region to another. The emergence or re-emergence of drug resistant malaria parasites and insecticide resistant mosquitoes in irrigated regions of Sub-Saharan African and South East Asia has been a major challenge in malaria treatment and prevention efforts (WHO, 2012, White, 2004, Nayyar et al. 2012). The use of poor quality of anti-malaria drugs and insecticide chemicals to control the mosquito vector in several Sub-Saharan Africa and Southeast Asia continued to increase the emergence or re-emergence of anti-malaria drugs and insecticide resistant mosquitoes.

However, large-scale irrigation in several developing countries has shown mixed results depending on local and global structural conditions. Historically, irrigation in

several parts of developing countries is owned either by colonial or current governments or large-scale capital investors (RRI 2012, Packard 2007,Whitehead 2000). In this situation, malaria is considered a major problem in communities, because most of the income from the irrigation goes to the investors not to the local communities, which does not alleviate the poverty and health problem. However, in situations where communities have a lot of control over large-scale irrigation, community health outcome is highly improved, and malaria incidence is very low (Ijumba and Lindsay 2001). As discussed in chapter 3, the link between poverty and malaria is very clear, with more impoverished communities suffering a greater burden from malaria than better of communities.

The nature and location of large-scale irrigation is also important. The nature of the malaria environment (such as hyper-endemic, holoendemic or non-endemic) as well as social and economic change could have major impact upon malaria. Malaria endemic zones and non-endemic zones have different reactions to these large-scale irrigational developments (Ijumba and Lindsay 2008). Ljuma and Lindsay (2008) argue that the establishment of new irrigation sites attracts labor migrants who could potentially extend the epidemiological zone of malaria. The clearance of forestland, multi-purpose water reservoirs, and roads are developmental projects usually accompany such a large-irrigational projects that could influence the pattern of malaria incidence and prevalence. For example, the building of dams in northern Ethiopia and the clearance of and establishment large-scale irrigation in southern Africa has increased the rate of malaria in these regions (Ghebreysus et al. 2000 and Packard

1984). In the following sections of this chapter I present the complex relationship between irrigation and malaria.

In sub-Saharan Africa and for that matter in several developing countries, gender roles in irrigational and agricultural activities are generally delineated. Gender roles in this dissertation refer to the cultural and social expectation to the kinds of agricultural and non-agricultural activities men and women perform. Men and women have different roles in agricultural production and which is more visible in rice irrigation communities (Lampietti, et al. 1999). For example, in Mwea men and women have different roles in the rice irrigation. Women are engaged in the wet aspect of the irrigation focusing on planting and weeding. On the other hand men are solely engaged in the dry aspect of the irrigation focusing on ploughing, threshing, loading and transportation of the rice to the market. These differential occupational roles within the agricultural sector put men and women at different levels of malaria risk. Furthermore, the allocation, management, and decision-making regarding resources for treatment within the household in these communities could also potentially put one gender at more health risk than the other. In addition, there is a gendered pattern of socio-cultural and behavioral characteristics that influence the exposure and incidence of malaria between men and women (WHO 2007). Women are also at greater risk of malaria because of their reproductive role in society (Uneke and Ogbonna 2009). Uneke and Ogbonna (2009) argue that pregnant women are more vulnerable to the consequences of malaria infection than other groups because of their compromised immunity. In section 4.2, I present the intricate relationship between gender roles and malaria risk as it refers to agricultural

communities particularly, macro-scale rice irrigation societies in Kenya and other third world countries.

The establishment of rice irrigation scheme in Mwea by the British colonial administration created disease ecology that negatively affected the life of many poor Kikuyu peasants and prisoners of war. The unfair land policy combined with the ecological change created a favorable environmental condition to the reproduction of mosquito. The land inequality and occupational roles of the poor and women in Mwea resulted in uneven burden of malaria between men and women and between the poor and the rich.

3.1. Irrigation and Malaria

Malaria in irrigated and agricultural environment in general in the developing world has been major health challenge. Irrigation refers to small and large-scale agricultural projects that involve artificial control of water for agricultural purposes into small or large dry and wet areas from rainfall, river diversion, and the construction of dams (Sweet 1937, Ijumba and Lindsay 2008). Agriculture on the other hand refers to both irrigation and seasonal based rain-feed agricultural practices. Mwea, the research site of this dissertation, is as major rice irrigation that has been affected by malaria and other infectious diseases since the British colonial administration (Kubatha and Mutero 2002: 192)

Generally, the improvement of the agricultural sector and its impact on malaria depends largely on local and global economic and political structures (Packard 2007:14; Klinkenberg 2004). Packard (2007) argues that agriculture production stagnates in instances where market forces are not sufficient enough to stimulate improvements in production. At the same time, agriculture becomes weaker where the structure of

commodity markets, particularly the prices paid to producers for their crops, restrict the ability to build up capital (Packard 2007:14; Ropetto 1987). These have been common phenomena among wide areas of tropical Africa, Asia, and Latin America since the 19th century. According to Packard (2007:14) the transformation of agriculture did not always lead to the decline of malaria; indeed, the opposite could happen, which is exactly what happened throughout human history from the Roman Empire to the 16th century in England.

The health benefits of expanding irrigation and agricultural production have been frequently limited, particularly in situations where the ownership of land and capital is overwhelmingly in the hands of large landowners and corporations. (Packard 2007:14-15). For example, in Mwea the British government owned the land until independence and then by the Kenyan government until 1998 and most of the people in Mwea worked as laborers. During this period the government managed the land through lease to individuals. After 1998 the government gave the land to farmers but the distribution of land was not fairly distributed. Those who leased bigger land became richer but those who had leased small land became poorer. In addition to this unfair allocation of land, still the management of water remained under the governments control and farmers has to pay to get water to farm their land.

In many cases, malaria thrives among poor farmers who were displaced from their land or have small plot of land but could not improve it because of lack of resources and capital. In many cases, these poor farmers live in inadequate shelters, eat nutritionally poor diet, and spend a lot of time or live close to their farm area (Matthys et al. 2006). The inequality in land ownership, and exploitation in the

agricultural sector and the health consequence associated with it is similar in all developing world in Asia, Africa and Latin America (Ijumba and Lindsay 2008, Packard 2007:15)

Packard (2007) states that even in places where major irrigational and agricultural improvements are made to eradicate malaria; the illness could easily return.

> Malaria has always been an opportunistic disease that can quickly take advantage of conditions created by the breakdown of mature agricultural communities following social, economic or political disruption like what happened in Russia and Bengal India in the 1950's (Packard 2007:15).

The resurgence of malaria during the late 1980s and early 1990s in several African countries including Kenya, was related to the so-called "Green Revolution" of the previous decades. During the 1970s and early 1980s, several African governments invested in the development of large-scale agricultural dams and the extensive use of fertilizers and pesticides to boost up agricultural production (Packard 1986; Sissoko et al. 2004; Mutero et al. 2004). The use of pesticides resulted in the emergence of DDT resistant strains of the *Anopheles* mosquito, and the dams constructed to feed this large-scale irrigation schemes became mosquito reproductive sites (Ghebreyesus et al. 1999, Ghebreysus et al. 1998, Kloos 1985). The main goal of the Green Revolution was to increase agricultural production to alleviate the food problems the continent faced, however, the revolution failed to address the health and environmental consequences. According to Ijumba and Lindsay (2008) this ambitious agricultural projects has extended malaria to arid and semi-arid areas of sub-Saharan Africa where people have low immunity. The use of pesticide and other agricultural chemicals in most regions are not monitored and their environmental hazard is not properly assessed.

However, recent studies show different impact of irrigation on malaria. For example, studies from Asia and Africa show how irrigation, particularly rice irrigation, is associated with malaria (Ghebreyesus et al. 2005; Dolo et al. 2004; Lacey and Lacey 1990; Gartz 1999; Surtees 1970; Mutero et al. 2004). For example, in Ethiopia's Tigray region, communities near dams or irrigated areas are seven times more likely to exhibit malaria than communities outside the dam or irrigated region (Ghebreysus et al. 2005). On the other hand, irrigation-related malaria will be less of a risk for communities where malaria transmission is stable (constant rate of malaria incidence and prevalence) rather than communities where malaria transmission is not stable. The existence of Irrigation has no impact on malaria for communities living in stable transmission zones if people have access to bed nets, quality healthcare, economic benefits from irrigation, and safe environmental practices (Ijumba and Lindsay 2001, Muturi et al. 2007, Muturi et al. 2008, Sissoko et al. 2004). For example, in Kenya, Senegal, and the Gambia, families with income above the poverty threshold in irrigated regions show the adoption of malaria control measures such as the use bed nets, going to hospitals immediately when they get sick, and clearance of bushes (Mweba 1991, Ijumba and Lindsay 2001, Lindsay et al. 1991). A 1997 study done among the Moshi rice irrigation farming community in Tanzania showed that the prevalence of malaria among children living near the irrigation site was four times lower than that of children living outside of the irrigation zone (Ijumba et al. 2002). Ijumba et al. (2002) argued that the improved health in the irrigated area of Moshi was related to better economic development and better general health services in these communities, generated from the irrigation revenue, compared to their adjacent non-irrigated communities. A Similar study in Sri-

Lanka indicates that areas of high malaria risk are characterized by higher rain precipitation levels more than slash and burn cultivation or the presence of irrigation reservoirs (Klinkenberg et al. 2004). Iljumba et al (2002) and Klinkenberg et al (2004) argued that irrigation was not a risk factor to malaria; in fact irrigation areas have lower malaria prevalence than non-irrigated areas. The reason is that well off communities who greatly benefit from the irrigation are better prepared for malaria through the greater use of bed nets, cash resources, better knowledge of malaria, and the adoption of better malaria treatment seeking behaviors. Communities that benefit from irrigation will have better social services such as schools, hospitals, and economic prosperity that help the community to have enough resources and knowledge to fight malaria and other health problems.

However, according to the Rights and Resource Initiative Institute (RRI) February 2012 report, most communities in irrigation areas in sub-Saharan African are poor in revenues from the irrigation benefit governments or large investors. Communities who live in irrigation areas mostly work, as laborers and can not compete with foreign governments and investors to buy land (Zoomer 2010). Those who have land lack enough money to exploit their land properly. At times people in these communities are displaced by force from their land by their governments in order for land to be distributed to local and foreign investors for large-scale irrigation. For example, the current development with regards to land ownership and the government's allocation of land for foreign investors in Africa is happening at alarming high rate; the RRI called it a " modern scramble for Africa" or others called it "the foreignisation of space" (Zoomers 2010). The RRI report indicates majority of 1.4 billion hectares (approx. 5.4 million

square miles) of uncultivated land in Africa is claimed by regional or national governments but are assumed to be managed by communities, and local and federal governments (Provost 2012). However, local communities have little power, or are not protected, by modern national or international laws, and governments are now leasing these lands to foreign investors, particularly those from Middle Eastern and Asian countries, for irrigation and other agricultural purposes. The RRI study further states that only 2% of sub-Saharan African fertile land is owned by communities and 98% of that land is owned by government and they are free to sell it or lease it to foreign governments and investors in the name of development (RRI 2012). Most oil rich Middle Eastern countries are desperately looking for alternative agricultural land and markets to support their growing population. This could have a negative effect on the transmission of malaria in the land leasing African countries if Africa governments do not take the necessary measures that involve local population as the main stakeholders. African governments need to learn from the Green revolution of the 1970s and 1980s, and they need to make the necessary arrangements to thwart malaria expansion using the revenues and corporate taxes that comes from leased land. At the same time, local communities should directly benefit from these agricultural or irrigational projects through employment and the establishment of social service providing institutions such as hospitals and schools. However, if communities are left out of the process, it could result in social and political conflicts could potentially lead to large-scale population displacement that would further leave people vulnerable to malaria and other infectious illnesses (Harris and Zwar 2005, Provost 2012).

Therefore, it is important to understand the holistic nature of malaria in communities in irrigation and agricultural areas where malaria is prevalent by examining the historical and political forces that shaped the vulnerability of people to malaria. Anthropology as a holistic field is well positioned to understand the totality and multi-dimensional facets of malaria. Critical biocultural anthropology provides the theoretical framework to accomplish this holistic understanding of malaria in Mwea Division of Kenya in the context of local, regional, and historical processes.

Malaria continues to exist where irrigation and other forms of agricultural systems expose human populations to a constant risk of infection and reduce people's ability to resist it. In most cases, in Kenya women and children are disproportionately affected because of women's role in the agricultural labor force and children's weak immunity to malaria (Muter et al. 2004, Snow et al. 2001). According to Snow et al. (2001) the mortality percentage of children from malaria compared to other diseases (malaria as a percentage of all-cause mortality) increased from 14% in 1935 to 35% in 1995 in coastal Kenya, from 23% to 46% in Bagamayo, Tanzania, and from 10% to 23% in Niakar Senegal. As in Mwea, studies on women in other east African countries show that women spend more time in the agricultural field (weeding, planting and harvesting) than men and making them more vulnerable to malaria and other infectious disease than their male counter parts (Ghebreyesus et al. 2000, Lampietti, et al.1999).

3.2 Irrigation and the Emergence of Drug Resistant Malaria Parasite and Insecticide Resistant Mosquitoes

The emergence of drug resistant malaria parasites is one of the major challenges to reducing or eliminating malaria in several developing countries (WHO 2012). Drug resistance refers to a situation where a standard drug and dose failed to kill a microbial

parasite or vector (WHO 2012). According to the world health organization (WHO) Multi-Drug Resistant (MDR) parasite are the leading causes of death in the world. The World Health Organization is alarmed by the recent emergence of drug resistant malaria parasites along the Thailand and Cambodia border (Nayyar et al. 2012). While the region has been known for the emergence of drug resistant malaria parasites, the emergence of drug resistance to the current first line malaria treatment (Artemisinin compounds) really jeopardizes the progress that has been made over the last decade.

Most drug resistance in malarial parasites is caused by low quality drugs, intensity of malaria transmission, misuse of drugs, and absence of lab facilities in most health clinics in poor countries and communities (Nayyar et al. 2012,WHO 2001,Nichter 2008:64; Petryan 2005). With globalization and the intercontinental movement of people, drug resistant malaria parasites can easily be transmitted and spread in short periods of time around the globe.

Most of the drugs in Kenya and other sub-Saharan Africa countries are low quality drugs imported from India and China. These drugs are not effective, and over their long term use leads to the emergence of resistant strains of malaria parasite. The public health infrastructure to control and monitor the drugs on the market in sub-Saharan Africa is very weak and in some cases absent. Expired drugs and drugs that no longer treat malaria can be found in private pharmacies. For example, Nayyar ‘s (2012) study from 21 surveys of six classes of drugs from 21 countries in sub-Saharan Africa found that 796 (35%) of 2,297 drugs failed chemical analysis, 28 (36%) of 77 failed packaging analysis, and 79 (20%) of 389 were classified as falsified. Several studies from Kenya between 2005 and 2008 showed that between 38-69 % of the drugs

imported to the country failed chemical and packaging testing (Amin et al.2005, Thoithi et al. 2008, and Atemnkeng et al. 2007, and Kibwage 2005). Therefore, the quality of drugs is one key factor to the emergence or re-emergence of drug resistant malaria parasites in developing countries.

The intensity of malaria transmission is one other factor that could increase the chance of the emergence or re-emergence of drug resistant malaria parasites. In most malaria stable regions, particularly irrigation zones, the chance of the emergence of drug resistant strains is much higher than other epidemiological zones. Irrigation zones have high malaria transmission by virtue of constant water presence (assuming most of the people in the region are poor and benefit very little from the irrigation sector). This also means high consumption of anti-malaria drugs. The combination of high transmission intensity and high consumption of low quality drugs increases the emergence of drug resistant malaria parasites. Irrigation areas also attract people from different geographic and social groups facilitating the movement of drug resistant malaria parasites between individuals and regions.

In most developing countries self-treatment using both drugs from pharmacies and local herbs is very common (WHO 2001). Anyone can buy any available drug he/she wants without doctor's prescriptions in most sub-Saharan Africa countries. In Kenya drugs are available in pharmacies and stores and can be bought without doctors prescription. The same is true in most of the neighboring countries such as Ethiopia, Eritrea, and Uganda. The absolute lack of regulation and the availability of low quality drugs in the market is posing a major public health challenge in Kenya and across the African continent where malaria is prevalent. These practices especially affect

communities around irrigation areas where malaria transmission is high, and the impact of the illness has major economic and health consequences. Generally, communities' misuse of drugs and the continuous use one type of drugs is related to the socio-economic status of communities and the inabilities of national governments to afford subside healthcare costs in their countries (Alessandro 2001). The problem is further complicated because malaria mostly affects the global poor, there are no incentives for pharmaceutical and research companies to do research and produce effective and updated anti-malaria drugs (Ridley 2002). Medical drug companies invest on drugs that potentially have large market demand from large population who could afford to buy their product. Malaria and other related infectious illnesses largely are concentrated on the world's poor population and medical drug companies are less likely to be interested in these markets. Therefore, the larger global inequalities in drug supply for disease that affect the poor such as malaria leave them vulnerable to malaria. The use of cheap and low quality drugs from pharmacies and shops (self-treatment) contribute to a growing anti-malaria drug resistance that will expand the transmission rate and geography of malaria. Self-treatment is the most common malaria treatment-seeking behavior in Mwea (Muysoka 2011) and the consequence of anti-malaria drugs resistance because of the current self-treatment behavior will continue to maintain the cycle of malaria in the division.

In addition, the prescription of drugs based on clinical diagnosis and the lack of lab testing for malaria could also contribute to this problem. As explained in chapter two, misdiagnosing is common in the absence of lab testing, and patients could be given a wrong medication or dosage. This resource related challenges in malaria treatment

could contribute to the emergence of drug resistant malaria strains. In addition, the lack of testing technologies and resources to detect drug resistant malaria parasites in local hospitals and clinics poses a major challenge to identifying the drug resistant strains on time before they spread to other regions.

Future research also need to address, how local populations understand drug resistant pathogens and their impact. There is also a lack of public health initiative to translate drug resistance into locally meaningful concepts to ameliorate the problem in developing societies and prevent the circulation of drug resistant strains around the globe (Nichter 2008: 92,174).

In addition to MDR parasites, insecticide resistant mosquitoes have posed some challenges in the fight against malaria. According to a recent WHO report, since 2009 insecticide resistance of mosquitoes in Africa have been increasing rapidly for all four classes of insecticide chemical compounds namely DDT, pyrethroids, organophosphates, and carbamates (WHO 2012). Several countries in western Africa, all eastern Africa countries and a few southern African countries are heavily affected by insecticide resistant mosquitoes.

However, insecticide resistant mosquitoes have been evolving since the start of mechanized agriculture and irrigation systems because of extensive use of pesticides in post independence Africa. Therefore, the expansion of commercial agriculture and irrigation systems on the continent has been a primary cause for the emergence and re-emergence of insecticide resistant mosquitoes in the continent.

CHAPTER FOUR
GENDER ROLES AND MALARIA RISK IN AGRICULTURAL COMMUNITIES

It is imperative for malaria and other infectious illnesses studies and interventions to take gender into account to examine the inequalities in health outcomes between men and women. The high incidence and prevalence of malaria in women is not accidental but it is socially, historically, culturally, and behaviorally patterned (WHO 2007,Whitehead 2000). The socio-cultural and behavioral patterns of gender role in society could greatly influence malaria epidemiology and malaria intervention efforts. In many societies in Africa, including Kenya, both traditional and large-scale agricultural communities, have different expectations of men and women in daily or seasonal agricultural activities. These gender-based labor arrangements could result in an uneven exposure to malaria. Even though agriculture accounts for the largest portion of family income and is the largest employing industry in Africa (Lampietti, et al. 1999), the link between gender-specific roles in the agricultural sector and malaria risk has not been empirically examined. Cultural norms and values dictate the kind of work done in the agricultural field. In addition to occupational risk, culture dictates sleeping patterns, resource allocations, decision making about treatments and so on (Rhaman et al. 1995, Vlassoff and Manderson 1998, Whitehead 2000). These kinds of social expectation could also lead to the differences in the understanding and experience of malaria between men and women.

There are several factors that play into an unequal risk and exposure to malaria between men and women in several agricultural and irrigation dependent societies in developing countries (Whitehead 2000). Whitehead (2000) argued that there is a historical link between men and agriculture in Africa that emerged during the colonial

period in which African men underperformed or refused to work in colonial farm work as a means of protest. Men viewed agriculture, especially irrigation agriculture, as a tool of social oppression by colonial governments and many men start to leave agricultural work to women after independence and the sector started to be dominated by women ever since. Men began to look for a more profitable labor jobs such as mining, forest clearance, and construction work that require long days and hours of work away from home. For example, in the mining and forest clearance sectors in several parts of sub-Saharan African countries and other developing countries, men are at greater risk of contracting malaria than women because migrant men perform most of these jobs (Eisler 2002). However, many studies have indicted (Vlassoff and Manderson 1998, Ghebreyesus et al. 2000, WHO 2007, Rhaman et al. 1995,Mutero et al. 2004) the agricultural sector is the most risky jobs when it comes to malaria. In several agricultural communities in sub-Saharan Africa, including Kenya, women work in the high malaria risk aspects of the agricultural or irrigational sectors such as planting, weeding, and harvesting. Most of these gender-specific roles in the agricultural or irrigational sector are labor intensive and require long hours of work in mosquito-infested environment. During planting and wedding, mosquitoes are active and women are exposed to constant mosquito biting. For example, personal experience and observation in Mwea, Kenya, show that women perform most these aspects of the agricultural work. This is also true in my own country of Eritrea and the neighboring countries of Ethiopia and Sudan where weeding and women do planting predominantly.

The impact of malaria on women is even greater in the rice irrigation community because of the yearlong workload and the labor-intensive nature of the work. Rice is

grown in swampy and flooded lands, which provide a natural habitat to the breeding of mosquitoes. Besides rice irrigation African irrigation systems also include sugar cane, wheat, cotton, and fruits, which could increase the rate of both mosquito and malaria if proper malaria prevention strategies are not put in place (Ijumba and Lindsay 2001). Therefore, not only rice irrigation but also any kind of irrigation has the potential to increase malaria transmission in different ecological zones that grow different kinds of agricultural products. As I mentioned in section 4.1, irrigation systems have a negative malaria effect, if generated revenues from the irrigation are not directed to benefit the community economically (Packard, 2000). Most rice irrigation systems in sub-Saharan Africa and Southeast Asia use open water canals, extending the transmission season of malaria by becoming a breeding ground for mosquitoes (Shah T et al. 2000). For example, Shah et al. (2000) study in Eastern India and Bangladesh found that the introduction of treadle pump irrigation that employs bamboo to pump water from aquifers increased the annual income of a household by $100, but more importantly, it reduced the malaria incidence and prevalence by three fold. However, in Sudan's Gezira-Managil irrigation scheme, water is channeled through open canals and used to grow wheat during the dry season thus creating a favorable condition to the reproduction of mosquitoes that also extends the malaria transmission season from the rainy season to the dry season (Keiser et al. 2000). In Mwea, Kenya, the largest rice irrigation in the country uses open water cannels to support the rice irrigation paddy fields with substantial amount of water is accumulated in the rice paddy fields for an extended period of time.

Women's work schedules are also another factor that put them at a greater malaria risk than their male counter parts. Women are often at work before dawn and continue late into the night when the mosquitoes are active (Vlassoff and Manderson 1998, Ghebreyesus et al. 2000). They wake up during early mornings to prepare food and stay up late to clean and to take care of other household chores in the evening. In addition, women fetch water from rivers, dams, and water reservoirs, in most cases early in the morning. Women also wash family clothes and household items by going to these rivers and water reservoirs. These water sources harbor a large population of mosquitoes increasing women's chances of getting malaria. In most cases men don't involve in household chores. These are common cultural expectation in Kenya and other sub-Saharan African countries. Therefore, the disproportionate household workload and the timing of these tasks put women at increased risk of getting malaria.

However, men have better access and knowledge about malaria risk than women because of their educational opportunity, experience, and unrestricted mobility. Women, in many rural agricultural societies, are usually isolated from urban and modern sector products, including health care, because of their limited mobility. The illiteracy level among women is higher in several third world countries than that of men, and this affects both their knowledge of the illness and its treatment (WHO 2007). For example, a research study by Lampietti, et al (1999) among the Tigrinya ethnic group of Ethiopia, found that literate women have significantly higher demand for the utilization of, malaria treatment and preventative methods than their illiterate counter-parts. One research on the knowledge, perception, and practice of malaria in southern Nigeria by Dike et al (2006) found a direct relationship between levels of education and better knowledge

and practices with regards to malaria treatment and prevention approaches. Higher levels of education are associated with both long and short-term knowledge of malaria treatment and prevention strategies.Tables 4-1 and 4-2show the educational difference between the two genders and regions in Kenya.

Furthermore, men's access to school and their increased mobility helps them to communicate better with health workers about their illness experience than women. This particularly, important in several sub-Saharan Africa where different languages are spoken in one region (WHO 2005-2). For example, a study by Krause et al (1997) in Burkina Faso, West Africa, showed that 24% of women could not communicate with healthcare workers in the same language compared to only 10% of men.

These problems are further confounded with other cultural and socio-economic inequality that exists between men and women in those countries. The household ecology in communities in rural and agricultural community is an important social organizational structure (Wilk 1997). According to Wilk (1997) household ecology refers to the creation of new forms of family organization to response to ecological, social and historical processes. Different communities in Africa and other developing world has responded to the introduction of irrigation and other forms of large scale agriculture (RRI 2012, Whitehead 2000,Mutero et al. 2004,Adekayne 1984). For example, Adekayne (1984) study three ethnic groups in Nigeria (Ibo, Hausa, and Yoruba) show that the socio-economic activities of women in these agricultural communities depend on the season and household priorities. During the non-farming season women activity is confined to childcare, household keeping, and trade. However, during the farming season women's priority is working on the farm spending less time with their children.

Table 4-1. Educational attainment of the female household population in Kenya. (Source: Kenyan Health and Demographic Survey 2010)

Background Characteristic	No Education	Some Primary	Completed Primary[1]	Some Secondary	Completed Secondary[2]	More than Secondary	Don't know/ Missing	Total	Number	Median years Completed
Age										
6-9	39.7	60.1	0.1	0.0	0.0	0.0	0.0	100.0	2,242	0.3
10-14	4.5	90.0	4.3	1.0	0.0	0.0	0.2	100.0	2,680	3.7
15-19	4.5	43.6	22.0	21.7	7.3	0.8	0.1	100.0	1,862	7.1
20-24	7.5	25.2	29.4	11.0	18.1	8.7	0.0	100.0	1,806	7.6
25-29	8.3	24.0	33.0	9.6	15.2	10.0	0.0	100.0	1,529	7.5
30-34	7.9	32.2	24.8	9.6	16.2	9.2	0.1	100.0	1,232	7.4
35-39	11.0	32.0	22.9	7.6	17.0	9.1	0.4	100.0	933	7.3
40-44	14.5	20.7	29.1	8.3	19.4	7.8	0.2	100.0	791	6.6
45-49	22.0	25.9	24.2	9.4	13.6	4.9	0.0	100.0	697	6.1
50-54	34.5	27.5	18.1	4.7	8.3	6.6	0.4	100.0	625	3.9
55-59	43.9	24.7	16.6	3.6	4.5	6.2	0.6	100.0	439	2.2
60-64	55.6	23.7	10.8	1.4	2.8	4.9	0.8	100.0	380	0.0
65+	76.8	16.7	3.2	0.4	0.5	1.3	1.1	100.0	828	0.0
Residence										
Urban	11.3	27.2	18.1	9.6	20.2	13.4	0.1	100.0	3,257	7.6
Rural	21.3	47.3	16.7	6.5	5.7	2.2	0.2	100.0	12,805	4.5
Province										
Nairobi	6.1	20.4	17.8	9.6	20.5	25.3	0.3	100.0	1,014	9.6
Central	10.9	38.2	25.3	10.0	11.2	4.2	0.1	100.0	1,726	6.5
Coast	33.1	36.8	13.1	5.3	8.5	3.2	0.0	100.0	1,265	3.4
Eastern	20.8	45.9	17.3	6.5	6.6	2.7	0.3	100.0	2,847	4.5
Nyanza	13.4	49.3	17.4	9.3	6.4	4.0	0.2	100.0	2,594	5.7
Rift Valley	21.5	43.7	16.9	5.7	9.0	3.1	0.2	100.0	4,369	4.9
Western	14.2	55.4	14.2	7.3	6.9	1.6	0.4	100.0	1,833	5.0
North Eastern	69.6	23.9	2.4	1.4	1.6	1.0	0.1	100.0	413	0.0

Table 4-1. Continued

Background Characteristic	No Education	Some Primary	Completed Primary[1]	Some Secondary	Completed Secondary[2]	More than Secondary	Don't know/ Missing	Total	Number	Median years Completed
Wealth quintile										
Lowest	40.2	46.5	9.5	2.4	0.7	0.3	0.3	100.0	3,089	1.5
Second	20.0	55.0	15.8	5.6	3.1	0.3	0.2	100.0	3,154	4.2
Middle	17.1	48.7	19.4	7.3	6.1	1.2	0.2	100.0	3,238	5.1
Fourth	12.9	40.8	20.3	10.7	11.0	4.0	0.3	100.0	3,270	6.3
Highest	7.5	26.0	19.7	9.4	21.4	15.9	0.1	100.0	3,310	7.8
Total	19.3	43.2	17.0	7.2	8.7	4.5	0.2	100.0	16,061	5.2

Note: Total includes 17 women whose age was not stated. [1]Completed Grade 8 at the primary level, for those under age 40; because of the change in the school system in the 1980s, those age 40 and above are considered to have completed primary if they completed Grade 7.

[2] Completed Form 4 at the secondary level

Percent distribution of the de facto female household populations age six and cover by highest level of the schooling attended or completed and median grade completed according to background characteristics, Kenya 2008-2009.

Table 4-2. Educational attainment of the Male household population in Kenya. (Source: Kenyan Health and Demographic Survey 2010)

Background Characteristic	No Education	Some Primary	Completed Primary[1]	Some Secondary	Completed Secondary[2]	More than Secondary	Don't know/ Missing	Total	Number	Median years Completed
Age										
6-9	42.9	56.9	0.0	0.1	0.0	0.0	0.1	100.0	2,453	0.2
10-14	4.9	91.5	2.6	1.0	0.0	0.0	0.0	100.0	2,557	3.6
15-19	1.6	49.4	18.4	23.7	6.5	0.4	0.1	100.0	1,952	6.9
20-24	3.2	22.6	26.3	13.6	23.9	10.2	0.1	100.0	1,472	8.0
25-29	4.1	23.8	26.2	9.4	23.3	13.2	0.1	100.0	1,226	7.8
30-34	4.4	24.2	28.8	7.1	22.1	13.1	0.2	100.0	1,067	7.7
35-39	4.0	22.4	25.2	9.1	27.5	11.7	0.1	100.0	863	8.0
40-44	6.0	14.8	31.1	6.5	26.1	15.3	0.1	100.0	774	7.8
45-49	7.9	18.7	30.9	6.3	24.1	12.0	0.1	100.0	629	6.9
50-54	12.6	18.6	30.5	9.5	18.9	9.5	0.4	100.0	476	6.7
55-59	13.9	22.2	26.5	7.9	17.5	10.6	1.3	100.0	378	6.7
60-64	21.4	18.6	27.0	9.5	11.6	11.4	0.5	100.0	347	6.7
65+	39.6	33.5	12.3	3.4	6.4	4.6	0.2	100.0	678	2.3
Residence										
Urban	6.8	24.3	16.2	9.0	23.9	19.5	0.3	100.0	2,997	8.8
Rural	14.7	48.3	17.1	7.7	9.4	2.7	0.1	100.0	11,884	5.2
Province										
Nairobi	4.6	16.9	12.7	7.4	27.0	31.1	0.4	100.0	1,002	11.1
Central	5.3	41.8	23.7	9.1	14.7	5.3	0.1	100.0	1,568	6.7
Coast	17.6	34.1	19.6	7.5	14.7	6.4	0.1	100.0	1,145	6.4
Eastern	14.2	48.6	17.7	7.2	9.2	2.8	0.3	100.0	2,638	5.2
Nyanza	8.9	48.4	17.6	9.7	9.3	5.9	0.2	100.0	2,461	6.1
Rift Valley	16.5	43.4	15.4	6.6	13.5	4.4	0.1	100.0	3,897	5.4
Western	9.9	53.6	15.3	10.3	8.5	2.3	0.1	100.0	1,754	5.3
North Eastern	49.1	35.7	6.6	3.1	3.2	2.3	0.1	100.0	417	0.0

Table 4-2. Continued

Background Characteristic	No Education	Some Primary	Completed Primary[1]	Some Secondary	Completed Secondary[2]	More than Secondary	Don't know/ Missing	Total	Number	Median years Completed
Wealth quintile										
Lowest	29.6	50.9	11.8	4.5	2.5	0.4	0.2	100.0	2,702	2.8
Second	14.0	53.0	18.2	7.4	6.5	0.9	0.1	100.0	2,986	4.8
Middle	11.0	49.8	19.6	8.6	9.5	1.3	0.1	100.0	3,000	5.6
Fourth	8.3	41.8	18.2	9.9	16.1	5.3	0.4	100.0	3,048	6.6
Highest	4.6	23.6	16.2	8.9	25.1	21.4	0.2	100.0	3,145	9.6
Total	13.1	43.5	16.9	7.9	12.3	6.1	0.2	100.0	14,881	6.0

Note: Total includes 9 men whose age was not stated. [1] Completed Grade 8 at the primary level, for those under age 40; because of the change in the school system in the 1980s, those age 40 and above are considered to have completed primary if they completed Grade 7.
[2] Completed Form 4 at the secondary level
Percent distribution of the de facto male household populations age six and over by highest level of schooling attended or completed and median grade completed, according to background characteristics, Kenya 2008-09

Despite women's vital role in the agricultural sector, the socio-economic inequality in the household is very common in several developing countries (Moss 2002,Ghebreysus et al. 2000). As Moss (2002) argues that the equality of women in the work place but in the inequality of the socio-economic benefit it both in the household and beyond has a negative health influence on women. Resource allocation and decision making powers within the household and outside are entrenched in gender roles (Rashid et al. 1999). Men have the dominant role in decisions about accessing malaria treatment and prevention resources. Treatment decisions particularly outside of the house are mostly in the hands of the household head or other male family members. Economic inequalities in the control and possession of household resources important to malaria prevention and treatment affect women's health negatively (WHO 2007). Accessing prevention methods, such as ITNs, and treatments like paying hospital fee and buying drugs from pharmacies involve both access to capital and decision making powers. In most agricultural communities in sub-Saharan Africa, financial resources are generally limited for all persons, especially for women, and resources are seasonal (Lampietti et.al. 1999). Financial resources are in most cases available after the harvest season but very limited during planting and weeding seasons, when malaria is at its peak. Besides the financial limitation, women have less time to seek treatment because of the excessive workload both in the house and in the agricultural field.

Generally, women are the primary caregivers for sick family members, and this puts them at a very greater risk of contracting malaria than their male counter parts. This is particularly true for several sub-Saharan African countries. Besides the stress related to resources and experiencing the suffering of a family member, women are in

close proximity to the patient. Spending more time and in close contact with the patient increases women's chance of getting malaria and other infectious illnesses.

Even though this research does not directly address the interaction between HIV and malaria but the synergistic effect of the two illnesses is major health concern in Kenya and several other sub-Saharan African countries. Malaria and HIV co-infection is creating a major health challenge in these countries, particularly among women (Uneke & Ogbonna 2009). Pregnant women are at greater risk of malaria and HIV co-infection, which has deadly consequences for both the mother and child. The nature and interaction between HIV and malaria infection is bidirectional and synergistic, and their distribution in tropical regions overlap in much of sub-Saharan Africa particularly Eastern and Southern Africa (Adams et al. 2008, Abu-Raddad et al. 2006, Van geertruyden & D'Alessandro 2007). For example, Van geertruyden and D'Alessandro (2007) research in Kenya using a mathematical model shows that HIV infection can exacerbate the risk and severity of malaria infection and that increased parasite load might increase malaria transmission in pregnant women. Another study by Adams et al (2008) showed that individuals who live in malaria endemic areas, usually considered semi-immune to malaria, could develop clinical malaria if infected with HIV. HIV viral load, a major determinant of disease progression and infectivity, shows an increase of one-log elevation during episodes of malaria (Abdu-Raddad et al. 2006, Adams et al. 2008). Since 1980, the interaction between malaria and HIV might have caused 980,000 excess malaria episodes and 8,500 excess HIV infections (Abu-Raddad et al. 2006). Abu-Raddad and his colleagues argue that co-infection has also facilitated the geographic expansion of malaria in areas where HIV prevalence is high. The

consequences of malaria and HIV co-infection have a more devastating effect on reproductive age women than any other socio-demographic groups.

Most importantly, there are cultural and social norms that potentially could affect women's health negatively such as the acceptability and use of preventative methods, such as bed nets and drugs, sleeping pattern, doctor visits (especially male doctor) without the accompaniment of the husband, and other cultural rules applied to men and women in society. For example, a study by Ghebreyesus et al. (2000) on the use of community health workers in northern Ethiopia found that women were less likely to see a male doctor because they are afraid of being perceived as sexually disloyal to their husband. This could explain one of the reasons in the under reporting of malaria cases in Ethiopia and other cultures in the region with similar cultural belief systems (Rahman et al. 1995). The underreporting of malaria cases disadvantages women because the malaria burden could be underestimated, resulting in a major gap in malaria intervention policy.

In some cultures, sleeping patterns are gendered. For example, in Sudan and the western lowlands of Eritrea men sleep outside while women sleep inside. In this instance men are at higher risk of malaria than women (Rhaman et al. 1995). On the other hand, in several other cultures in Africa, men are expected to get the best available resources in the household, including bed nets, putting women and children at greater risk of contracting malaria.

Therefore, malaria and other infectious illnesses need to take a gendered approach not only to examine the disparity in health among men and women, but also to see how men and women experience and respond to malaria. Considering the

mentioned previous research on malaria and the risk women face in the developing world, this dissertation directly address whether women in Mwea are at higher risk of malaria than men. If people agree that women are at higher risk of malaria than men then how do each gender explain these differences of malaria experience.

CHAPTER FIVE
RESEARCH METHODS AND DESIGN

5.1 Research Setting

Mwea Division is located in Kirinyaga South District, which is about 100 kilometers northeast of Nairobi, the capital of the Republic of Kenya. Mwea is located at an altitude of 1200 meters above sea level at the base of Mount Kenya, the highest mountain in Kenya. The villages in this district are scattered across 581 square kilometers. The overall population of the division is approximately 20,000 people divided into about ten villages. The area has two rainfall seasons with the long rainy season occurring between October and November. The second rainy season is between March and May.

The research site occupies much of the lower altitudes of Mwea, which is characterized by several perennial rivers that flow into the low lying land at the base of the mountain, forming swamps (see Figure 2-1). It is located in the west-central region of Mwea and covers an area of 13,640 hectares and is served with open-water canal networks. The swampy areas were the sites of the development of one of the largest rice irrigation farms in Kenya, which was once known as the Mwea Tebere Rice irrigation farm (Okech et al. 2008, Mutero et al. 2004). The rice irrigation farm produces 90 percent of the rice in the country. More than 50 percent of the farm area is used for rice irrigation and the rest is used for subsistence farming, grazing, and community activity.

The irrigation farm in Mwea was started in 1953 by the British colonial administration, using Mau Mau captive labor taken during the state of emergency declared in 1952 (Kubatha and Mutero 2002: 192). However, the farm was handed to

the Kenyan government in 1963 after independence and was used to settle landless and unemployed former Mau Mau freedom fighters. Most of these individuals were from central Kenya, and had been detained in the Mwea detention camp by the colonial government. The Kenyan government managed the irrigation system through its National Irrigation Board (NIB), Ministry of Agriculture, until 1966. The relationship between the farmers and the NIB was tense until 1998 when the farmers became autonomous from the NIB (Kubatha and Mutero 2002:192).

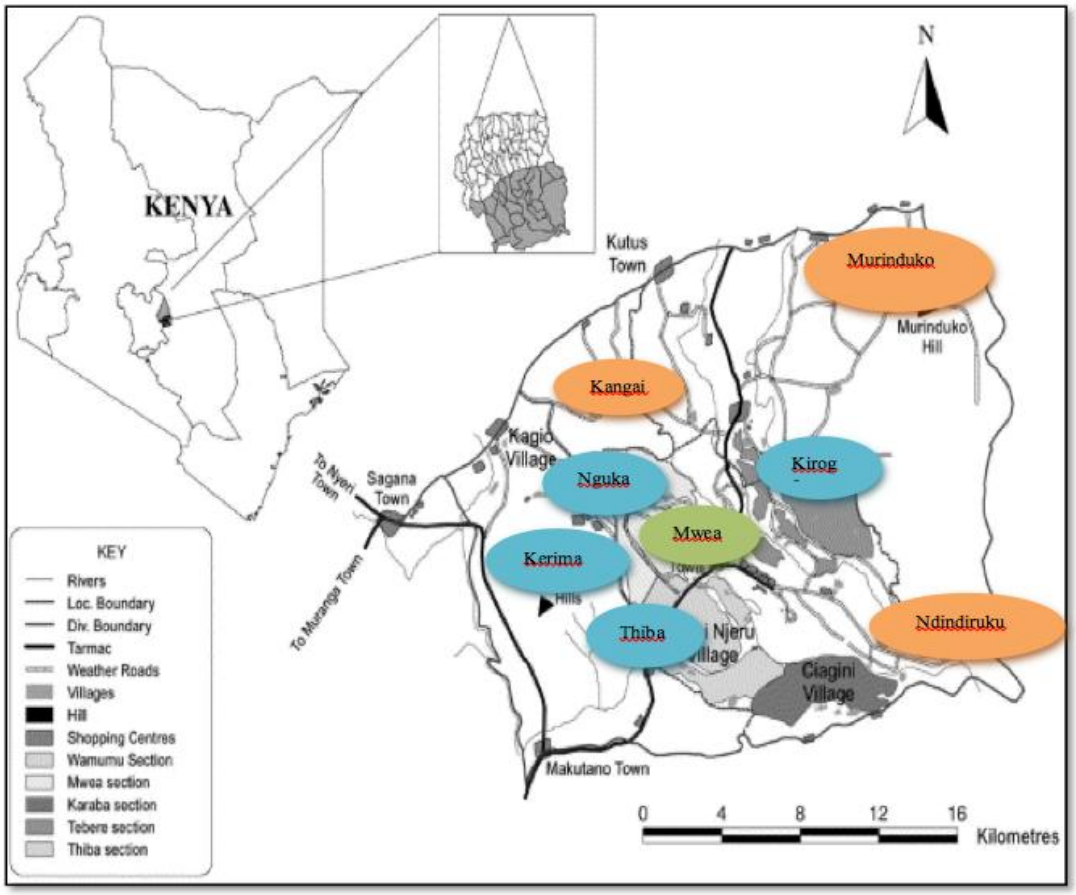


Figure 5- 1. Map of the Research Site (Blue: Irrigated Villages; Red: Non-Irrigated Villages; Green: Mwea Town) (Adapted from Mutero et al. 2004. A transdisciplinary perspective on the links between malaria and agroecosystems in Kenya (Page 173, Figure 1). Acta Tropica 89(2)

The irrigation farm was historically managed as a centralized system in which farmers were very passive in decision-making and management of the irrigation farm. Some of the areas of conflict between farmers and NIB included the high cost of irrigation services, low price of rice, and land ownership (Kuthaba and Mutero 2002:192). The recently formed farmers association is weak and does not have much power to influence decisions that foster farmers' rights and social and economic growth. Villages outside of the irrigation sites are not as engaged in rice farming. Most residents of non-irrigated villages are engaged in small-scale farming and livestock production. The main economic activity of Mwea town, inside the irrigation farm, is directly linked to the rice irrigation farm.

5.2 Study Population

The study population is drawn from three villages that are in the non-irrigated area, four that are in the irrigated area, and from Mwea town, which falls in the irrigation area. An irrigated village refers to any village that is completely encircled by irrigated rice farms. Non-irrigated villages lack a common boundary with the rice irrigation farm. Only men and women above the ages of 18 were included in the study.

In terms of social composition, ex-detainees of the Mau Mau movement of central Kenya and other political prisoners initially inhabited Mwea. However, it has increased considerably over the years from economically impoverished segments of the Kenyan population attracted by the irrigation farm. The ethnic composition of the Mwea communities is predominantly Kikuyu with some seasonal immigrants from Embu, Meru, and other ethnic groups from the neighboring areas as well as the Rift Valley of Kenya. Villages outside of the irrigation sites are not necessarily engaged in rice farming. Most residents of non-irrigated villages are also engaged in small-scale farming and livestock

keeping. However, the main economic activity of Mwea town, inside the farm, is directly linked to the rice irrigation farm. Most of the people in town work in rice marketing, and service industry.

5.2.1 Kikuyu Culture and Language

Kikuyu are patrilineal societies that belong to the Bantu language sub-family. They are one of the largest ethnic groups in Kenya and are mostly concentrated around the Mount Kenya region. Most of the Kikuyus totems and cultural emblems are associated with Mount Kenya and the fertile agricultural areas that occupy the bottom of the mountain (Stocking 1992:268, Kenyatta 1938:23). Kenyatta in his vivid ethnographic account of the Kikuyus asserts that it is impossible to understand the social organization, religious, and economic life of the Kikuyus without understanding the land tenure system. In his strong opposition to the colonial narratives of land ownership in Kenya, Kenyatta said:

> In trying to understand the kikuyu tribal organization it is necessary to take into consideration land tenure as the most important factor in the social, political and religious, and economic life of the tribe. Communion with the ancestral sprit is perpetuated through contact with the soil in which ancestors of the tribe lie buried. The Kikiuys consider the earth as the "mother" of the tribe for the reason that the mother bears her burden for about nine moons while the child is in her womb and then for a short period of suckling. Owning to the importance of attached to the land the system of land tenure was carefully and ceremonially laid down, so as to ensure to an individual or a family group a peaceful settlement on the land they possessed. According to Kikuyus customary law of land tenure every family unit had a land right of one form or another (Kenyatta 1938:22)

Kikuyu are culturally and linguistically related to neighboring ethnic groups, who live around Mount Kenya namely, the Embu, Meru, Mbree, and Kamba. The interaction between Kikuyu and the ethnic groups in the region has been characterized by conflict and assimilation during pre and colonial times (Parsons 2012, Muriuki 1974). Before the

19th century Kikuyu clans were loosely connected and they had a lot of cultural, social, and linguistic assimilation with their immediate neighbors (Muriuki 1974:110). However, after the 19th century the different Kikuyu clans start to come together and solidify their unity to overcome threats from their neighbors, wild animals, and other environmental challenges. During colonialism Kikuyus land was taken by the British and they were pushed to reserves in the Meru, Embu and Kiamba territories (Parsons 2012). Parsons (2012) argued that this colonial arrangement created a unique cultural and linguistic identity among different Kikuyu factions. While most adopted the culture and ethnic identity of the Meru, Embu, and Kiamba, others protested and continued to form their own Kikuyu identity throughout the colonial times.

Kikuyus have a traditional monotheistic religious belief system in a god known as “Ngai” or “Mogai” which refers to God. Ngai, in traditional belief systems, is the ultimate creator of the universe and the provider of all things in Kikuyu land including land, rain, animals, and plants (Kenyatta 1938:223). Ngai created the mountain and its Kikuyu inhabitants, the landscape, and trees that are used as social and spiritual spaces. Nagi has both spiritual and human characteristics making a constant visit to the land and its people to bless to those who follow his order and to punish those who violate his order. According to Kikuyu legend, Mount Kenya is the resting place and home of the great Ngai when he comes to earth. Most Kikuyu today are devout Christians, who worship in different Christian denominations including, Protestants, Catholics, and few Coptic Orthodox. Churches and pastors play an important role in the community particularly, in resolving disputes and in fighting HIV/AIDS (Interview with District commissioner and religious leaders).

Marriage, kin relationships, and family among the Kikuyu are an important social institution that has a long tradition. According to Kenyatta one of the outstanding Kikuyus marriage system is the desire of every member of Kikuyu society to start his own family and expanding his father mbari (Kenyatta 1938:157). The traditional definition of marriage among the Kikuyu constitute the union of one man and a woman or women based on a mutual love and fulfillment of sexual instinct between the two individuals (Kenyatta 1938:157). Traditionally males around the age of 18 and females around 15 often begin to think about marriage and starting family. In traditional Kikuyu culture men and women are free to choose their own mates. Initially the young male goes with his best friend to the girl's house and asks her if she would marry him. If she agrees then the young male sends his parents to bride's parents and asks them for a marriage. If the bride's parents agree then the male's parents had to raise money to buy livestock for the dowry. Today relationships among Kikuyu are more similar to the western world. In my own personal observation, it is very common for youngsters to have a girlfriend/boyfriend or to date without parental approval.

Kikuyu traditional food includes *Githeri*, made of maize and beans*, Mukimo* (mashed green peas and potatoes), *Irio* (mashed dry beans, corn and potatoes). Kikuyu diet also includes roast beef and chicken with rice or *ugali*. Like most other ethnic groups in Kenya, roasted goat, traditionally know us "*Nyama choma*", is highly favored food and consumed by middle and upper class Kenyans. It is a national dish and is commonly served at festive events. There is an absolute national obsession to Nyama choma with high publicity in the media.

5.2.2 Social Structure

For Kikuyus, wealth, prestige, and power are highly associated with land, the ownership of livestock, and the spiritual connection of an individual to *Ngai (Kenyatta 1938:*22-25). The social organization of Kikiuyus are organized along three social principles (Kenyatta 1938,Muriuki 1974:111). The first one is the family group known as *mbari.* This family unit brings all members that are related by blood. Mbari as a family group could be in the hundreds and more within a generation because of the polygamy marriage system. The second one is a clan system known as "*moherega*" that is formed by several mbari groups. The third one is the different clans that form the Kikuyu social, cultural, economic, and religious ethnic identity. Before the 19th century the social and political organization of the Kikuyus was egalitarian and uncentralized and had a very fluid territorial organization (Muriuki 1974:110). According to Muriuki (1974) before the 19th century there was no single political and social institution that unified the different Kikuyu clans and most of these clans had very close kin ties with their neighboring ethnic groups. Before the 18th century the Kikuyus were small in number and were vulnerable to outside threats. The political and social organization of the Kikuyus get stronger in the 19th century creating a viable social organization to address external threats through inter-mbari cooperation and the formation of a strong young male army (Muriuki 1974:112). According to Kikuyu culture a young male has to endure social and environmental hardship and young males were expected to protect the Kikuyu land and social values.

> As Muriuki puts it " Understandably the picture of the frontiersmen painted by folklore is that of men of courage, resourcefulness, and hard work; in short the type of hero that any good kikuyu was exhorted to emulate." (Muriuki 1974:112)

The traditional political and social organization of the group is also associated with the harvest seasons to help the family and the community to harvest crops and defend the crops, cattle, and other resources from other non-Kikuyu groups. Young boys undergo initiation rite and are then assigned to army regiments that would make up a ruling generation to protect the land and the social order in the Kikuyu land for an average of three decades (Muriuki 1974:119-125).

At the household level in traditional Kikuyu society, the father is the head of the household and clan chiefs are the heads of villages. This social structure continued until the introduction of colonialism in the 19th century. The British instituted a colonial political structure, which included provincial, district, and village level administrations. After independence, the Kikuyus constituted the main political structure of the state holding the president's office until 1978, and then, since 2002, until today, Kikuyu remain an integral part of the coalition government that successfully ratified and implemented a new constitution.

All ethnographic narratives of the Kikuyu emphasize the role of land in their economic and social life. The seizure of their land by the British, and the development of agricultural projects primarily for export purposes, created poverty and social discontent among the Kikuyu that affect their health in disease-infested environment. The British land confiscation also created social inequality in the post-independent Kenya by unfair land policies that favored the few. Mwea embodies much of the colonial land tenure legacies that favored the few within the majority are laborers in the rice irrigation. The British colonial system did not only forcefully seize land, but created a disease ecology that affect the poor that live and work in these agricultural fields.

5.3 Research Design

The research design of this dissertation involves both qualitative and quantitative data collection and analysis using ethnographic methods and a structured survey questionnaire. The first phase was an exploratory phase that focused on the ethnographic aspect of the project.

The primary goals of ethnographic data collection were:

a) Elicit information on cultural models of malaria in the Mwea Division using both qualitative and quantitative approaches.

b) Elicit information on the relationships between malaria and other common illnesses in their causes, symptoms, and treatment as well as the level of intracultural variation in beliefs about these relationships.

c) Describe the social and structural determinants of malaria.

The following data collection methods were used to fulfill these goals:

a) Participant observation
b) Free listing
c) Focus groups
d) Unstructured interviews

In 2011, data collection focused on identifying explanatory variables and built on the exploratory research done in 2010 through the use of a structured questionnaire. The questionnaire was developed from salient items identified from the free-lists, focus groups, and participant observation from the 2010 research. The rest of the data collected in 2011 included demographic information, environmental information, data on episodes of malaria, and treatment-seeking behavior. The main goal of the structured questionnaire was to investigate the sociocultural, demographic, and environmental factors that are associated with individual malaria risk and treatment-seeking behavior.

5.4 Ethnographic Data Collection

The study included five individuals from each of the seven representative villages (i.e., three from non-irrigated, and four from irrigated) and ten individuals from Mwea town. A free-list was also collected from the 8 chiefs or sub-chiefs, which makes it a total of 53 total informants for this activity. People from the focus group or the 20 key informants (except the 8 chiefs or sub-chiefs) were not included in this sample. The sample consisted of roughly equal numbers of men and women. People of all educational levels, socio-economic status, ages, and gender are represented (see Table 5-1). The 53 individuals provided a free-list of causes, signs and symptoms, and treatments for malaria and the three major illnesses (i.e., typhoid, worms, and tuberculosis). The informants then provided detailed ethnographic description of all items mentioned. The main goal of the free-list is to elicit data from individual informants in order to define the cultural domain of malaria and what each malaria category is consist of. The data from the free list data will be used to understand the relationship between malaria and other illnesses and the intercultural variation that exist within each category of malaria illness.

Both unstructured and semi-structured interview processes began with the explanation of the research policy and inclusion criteria to village authorities or village chiefs. The research team included two research assistants, a KEMRI representative and myself. We provided each village leader with our research authorization document from KEMRI that solicited their assistance with the project. If the village chiefs agreed, then they nominated specific informants and provided us with their names and addresses. The chief also assigned a village point person, who knew each informant, to take us to each informant's residence to conduct the interview. Once we read the

consent form and the informant gave consent, then we collected detailed free-list data on illnesses that were common in the community. At the same time, each informant was encouraged to provide causes, signs and symptoms, and treatments for malaria and the three major illnesses, identified by the salience measure, focus groups, and medical reports. For example, if an informant was asked to list causes of malaria and the person mentioned “mangoes,” then we asked that informant to explain how mangoes cause malaria.

Table 5- 1. Demographic characteristic of the 53 informants

	N	Mini	Maxi	Mean	Std. D
Age	53	18	99	49.64	19.282
Valid N	53				
Gender		Freq	%	Valid %	Cumulative %
Valid	F	26	49.1	49.1	49.1
	M	27	50.9	50.9	100.0
	Total	53	100.0	100.0	
Education		Freq	%	Valid %	Cumulative %
Valid	College	7	13.2	13.2	13.2
	High school	14	26.4	26.4	39.6
	No education	9	17.0	17.0	56.6
	Primary school	23	43.4	43.4	100.0
	Total	53	100.0	100.0	
Occupation		Freq	%	Valid %	Cumulative %
	Business	8	15.1	15.1	15.1
	Carpenter	1	1.9	1.9	17.0
	Cleaner	1	1.9	1.9	18.9
	Driver	1	1.9	1.9	20.8
	Farmer	26	49.1%	49.1%	69.8
	Health worker	1	1.9	1.9	71.7
	House wife	2	3.8	3.8	75.5
	Laborer	4	7.5	7.5	83.0
	No job	2	3.8	3.8	86.8
	Pastor	1	1.9	1.9	88.7
	Student	3	5.7	5.7	94.3
	Teacher	3	5.7	5.7	100.0
	Total	53	100.0	100.0	

5.4.1 Participant Observation

Participant observation is an important ethnographic data collection method. It provides a firsthand experience of the cultural and social practices of the society under study. I started my ethnographic fieldwork among the rice producing Kikuyu communities of Mwea in Central Kenya. I stayed in Mwea from June of 2010 to November 2010 to do the ethnographic phase of my research and, then, the summer of 2011 mostly administering my structured questionnaire. Most of my participant observation involves passive participant observation simply observing what people do in their work place, treatment centers, households, markets, and other public places. Resource and time limited my stay in the field to conduct a more active participant observation and to collect more extensive ethnographic data through this method. My participant observation can be characterized more as observation data collection than active participation. Passive participant observation in this context refers to when a researcher simply observes and jots down people's activities and practices of the study population. On the other hand active participant observation refers to when the researcher actively participates in the daily activities and practices (cultural immersion) of the community he/she studies (DeWalt and DeWalt 2011).

Therefore, to have a better understanding of people's perception of and treatment seeking behavior for malaria, I went to hospitals, pharmacies, traditional herbal treatment centers, and individual homes to see how people manage their malaria illness. I also went and observed people working within and outside of the farm to see the division of labor in the rice field and the extent of malaria risk in the agricultural field. I documented all my observations throughout my stay in the district. Being an African

descent made it easier for the participants to accept me to observe them without getting distracted by my presence.

5.4.2 Focus Group And Unstructured Interviews

I conducted two focus groups and 20 unstructured interviews with roughly equal numbers of men and women from both irrigated and non-irrigated villages. Originally, I planned to do a 10 people focus group, however, the number grew to 17 in the non-irrigated area and to 20 in the irrigated area, because people from around the villages would join the discussion as they passed. In addition, we did an unstructured interview with 20 key informants from the entire region. Eight of the informants are sub-chiefs or chiefs and are considered key informants because of their status in the community. I used the two focus groups and the 20 semi-structured interviews to get a sense of the general health, social, and environmental landscape of the study area. Furthermore, it helped me develop a list of semi-structured questions to ask and illnesses on which to focus for the free-list data collection stage.

5.4.3 Text Analysis

In addition to the free-list data I conducted an in-depth interviews with the 53 informants to collect narrative data to examine how men and women understand and experience malaria in Mwea town. Text analysis is an important aspect of social science research that helps researchers identify patterns of cultural description of a topic of interest or reasoning from text and other qualitative data (Ryan and Bernard 2003). Text analysis is also useful for linking items of cultural description or reasoning to theoretical models (Ryan and Bernard 2003, MacQueen 1993). In this study I asked each informant who if men or women are at higher levels of risk for contracting malaria? And

then I ask each informant why the gender they mentioned is at a higher risk of malaria than the opposite gender.

5.4.4 Free-List Data On Cultural Understanding Of Causes, Symptoms And Treatments Of Malaria

In this study, free-listing methods were used to understand local perceptions of the causes, symptoms, and treatments for malaria, typhoid, worms, and tuberculosis by the 53 informants mentioned above. Free listing is a powerful but simple systematic data collection method that can provide anthropologists with an *emic* perspective (through identification of cultural domains of knowledge) and has an empirical edge over other anthropological approaches (Bernard 2006:303; Hruschka and Hadley 2008). A cultural domain refers to an "organized set of words, concepts or sentences, all in the same level of contrast, that jointly refer to a single conceptual sphere" (Weller and Romney 1988:9). Free- listing, as a data-collection method, identifies items that belong to a specific cultural domain (e.g., illnesses, animals, food, etc.), enabling a researcher to delimit the boundaries and understand how items are structured and related in the domain.

Free-list data are traditionally measured both in frequency and salience. Frequency measures the number of informants who mention a specific item (Weller and Romney 1988), while salience measures the order and the frequency of an item in relation to the total number of items in the list (Smith 1993, Thompson and Juan 2006). These two components are important because they give information about the importance and distribution of cultural knowledge in particular domains. Items that are identified by informants more frequently are assumed to be more salient in the domain than items mentioned by only few informants (Ryan et al. 2000, Bernard 2006:304).

Likewise, the lists of items provided by individual informants are expected to relate to the general order and appearance of each item in the general informants list (Smith 1993). According to Thompson and Juan (2006:400), this provides both “the native contents of the domain” and also “the relative salience of terms within the domain.” In most cases these two measures are calculated by ANTHOPAC (Borgatti 1992).

I employed the successive free-listing method used by Ryan et al. (2000) in conjunction with detailed ethnographic observation, in an effort to understand lay beliefs about the relationships between these four infectious illnesses. Ethnographic interviews were used to provide context for the risk factors, symptoms, and treatments identified by respondents. Successive free-listing (see Figure 2-2) links multiple lists and provides an opportunity to analyze how items are related, whereas traditional free-list only provides list data (Gartin et al. 2010, Ryan et al. 2000). In this type of free-list activity, the researcher starts by asking informants to name all the items they know in a particular domain. Once the list is completed, the researcher uses each item mentioned as a probe for an additional set of lists. In this case, successive free-listing data was converted into illness-by-combined items (symptoms + causes + treatments) and then dichotomized into “1” and “0” for correspondence analysis.

I used successive free-listing in a slightly different manner from Ryan et al (2000) with regards to the selection of illnesses. Instead of collecting the causes, signs, and treatments of all illnesses mentioned by informants, I only focused on the four major illnesses that are very common and constitute major health threats in the district. Very common illnesses refer to illnesses that have high prevalence rates in the community based on, focus groups, medical records, and annul health reports. All informants are

asked to list all kinds of illnesses they know in the district; however, I only focused on malaria, typhoid, worms, and TB to probe for causes, signs and treatments. HIV was above TB in the free-list but I didn't include it because it requires additional IRB/KEMRI approval. HIV/AIDS falls into a different ethical review standard and needs additional paperwork and review time than malaria by both UF/IRB and KEMRI.

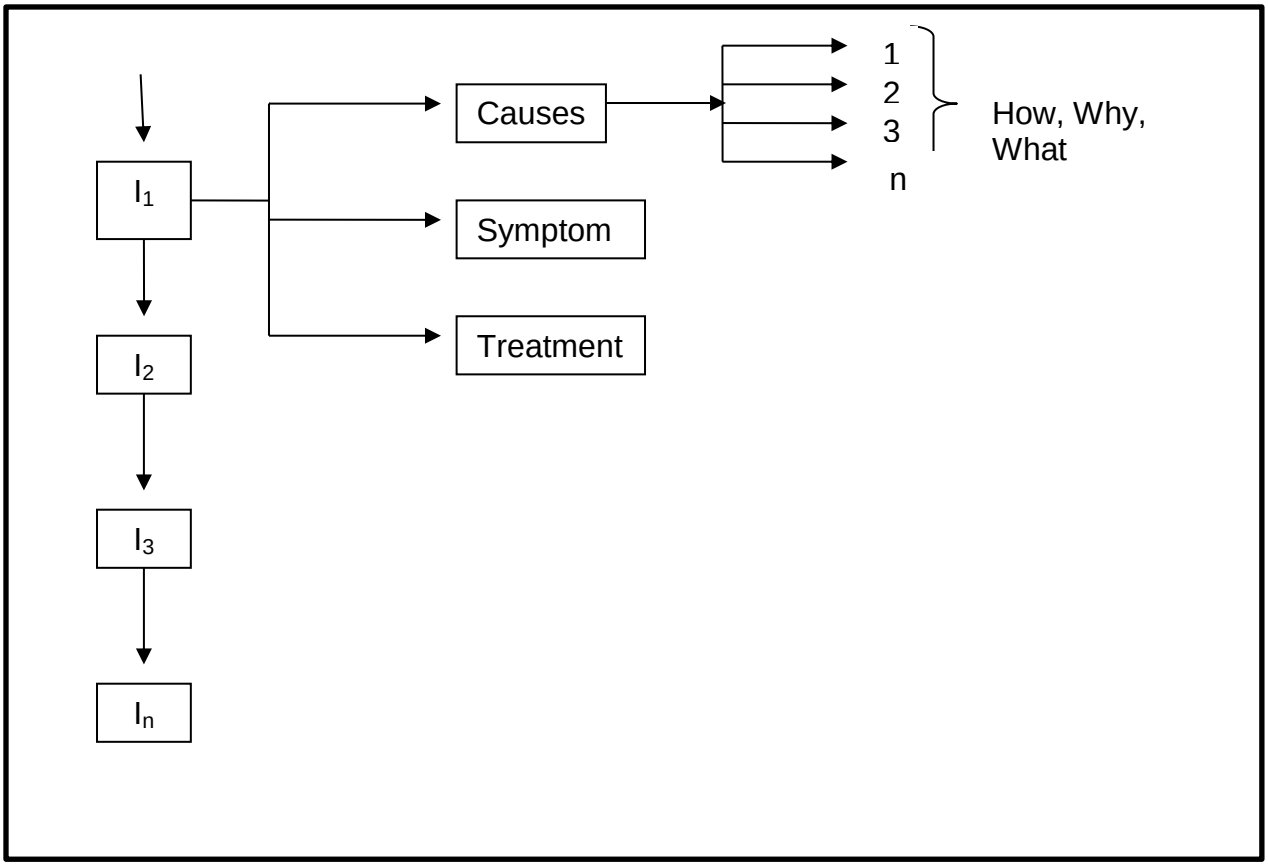


Figure 5- 2. Conceptual representation of the successive free listing with extended interviews (Note: I= Illness). This representation model refers to one informant only.

My method has both advantages and disadvantages. The disadvantage is that it limits the broader and detailed relationship and variation of all mentioned illnesses one would have gotten from informants in the community. The inclusion of causes, signs, and treatments of all mentioned illnesses could possibly change the relationship

between the four illnesses I examined. However, focusing on already identified major illnesses could show a more refined and targeted relationship between them and how informants discriminate them one from the other that has a major influence in treatment seeking. This is particularly important for health policy makers who would like to see how people diagnose these illnesses and how they seek treatment for them. Furthermore, eliciting causes, signs and treatments of all mentioned illnesses could be time consuming making it a very tiring interview process for informants.

5.5 Survey Data Collection

Sampling: This dissertation used a purposive sampling method in an effort to include individuals from all social groups and environments in Mwea. Purposive sampling enabled me to focus on targeted group within the population, which I wouldn't had been able to do with probabilistic or random sampling method. The only disadvantage of this method is the potential bias and limited generalizability. Two hundred-fifty individual informants were recruited to provide detailed answers to specific questions (see questionnaire in the appendices). Each informant was asked the same questions about demographic, social, environmental, and cultural variables, along with their history of malarial infection. Most of the questions centered on demographic and economic characteristics such as socioeconomic status, occupational, educational status, and village of residence, as well as cultural beliefs about malaria, questions about the local environment. The sample recruited an equal number of men and women. The study population was drawn from three villages in the non-irrigated area, four from the irrigated area, and one from Mwea town, which is also located in the irrigated area. An irrigated village refers to any village that is completely encircled by irrigation rice farms. Non-irrigated villages were identified as villages that did not share a

common boundary with rice irrigation paddy fields. Men and women above the ages of 18 were included in the study.

This sample included 30 individuals from each of the seven villages and 40 from Mwea town. People of all education levels, socio-economic status, and age are represented. The interview processes began with the explanation of the research policy and inclusion criteria to village authorities and village chiefs. We provided each chief our research authorization document from the Kenyan Medical Research Institute (KEMRI) that solicits their assistance with the project. Once the village chief agreed then we requested for a point person in the village who would nominate informants and give us their names and address. This point person, who knows each informant in the village, took us to each informant's residence to conduct the interview. Once we read the consent form to the informant and agreed, then we administered the structured questionnaire.

Data was collected in the summer of 2011 after 7 months the ethnographic data was collected. The survey data was collected with the assistance of two local full time research assistants (one male and one female). They have a university degree from Kenyan universities. One of them has a BA in sociology and the other a BS in biological and environmental sciences. They are well trained in field methods and worked with KEMRI and other agencies working in the district.

5.6 Variables Extracted from Survey Data

Sociocultural factors: Sociocultural variables include income, occupation, presence/absence of bed nets, and educational status of individuals. Income is measured as low, medium, or high based on local concepts of this gradation. Furthermore, locally appropriate data on socio-economic indicators such as land, and

livestock were collected. I asked key informants and focus groups about the wealth structure in the division and provided me the three gradients of wealth and what each wealth strata entails. This classification is based on land ownership, livestock, and business ownership (in Mwea town). Occupation refers to jobs for cash income. Education is categorized as: no formal education, elementary education, secondary education, and post-secondary education. The distance to the nearest heath clinic was measured in kilometers based on informants recall. The travel time to nearest hospital and waited time was measured in hours. Absence or presence of bed net is noted.

Cultural variables include individual understanding, perception, and treatment decisions for malaria. Measurements for these categories are based on the most salient items as defined by the output of a free listing technique for each category. Each participant was asked a yes or no question for each item selected.

Environmental factors: Environmental variables include irrigated or non-irrigated village residence, housing conditions, and distance of water source to the household in meters. The distance of the nearest water source to the house was noted in meters. Housing conditions are categorized as walls made of stone, mud walls with iron sheet roof, mud walls with grass roof, grass for walls and roof, and other.

Health outcome variables: Malaria risk was measured on the number of episodes a person experienced within the last 12 months from the day of the interview. Health seeking treatment behavior was measured in a person's treatment-seeking route. I identified three routes from participant observation, focus groups, and un-structured interviews. One of the routes was directly to go to hospital. The second route was first go to pharmacy and if things do not get better go to a hospital. The third and

final route was to go to herbalist. However, I merged the last two routes and coded them as “self-treatment.” Furthermore, I asked informants a yes or no question on whether malaria can be avoided in their villages, and whether doctors diagnose them with the illnesses, they believe they have.

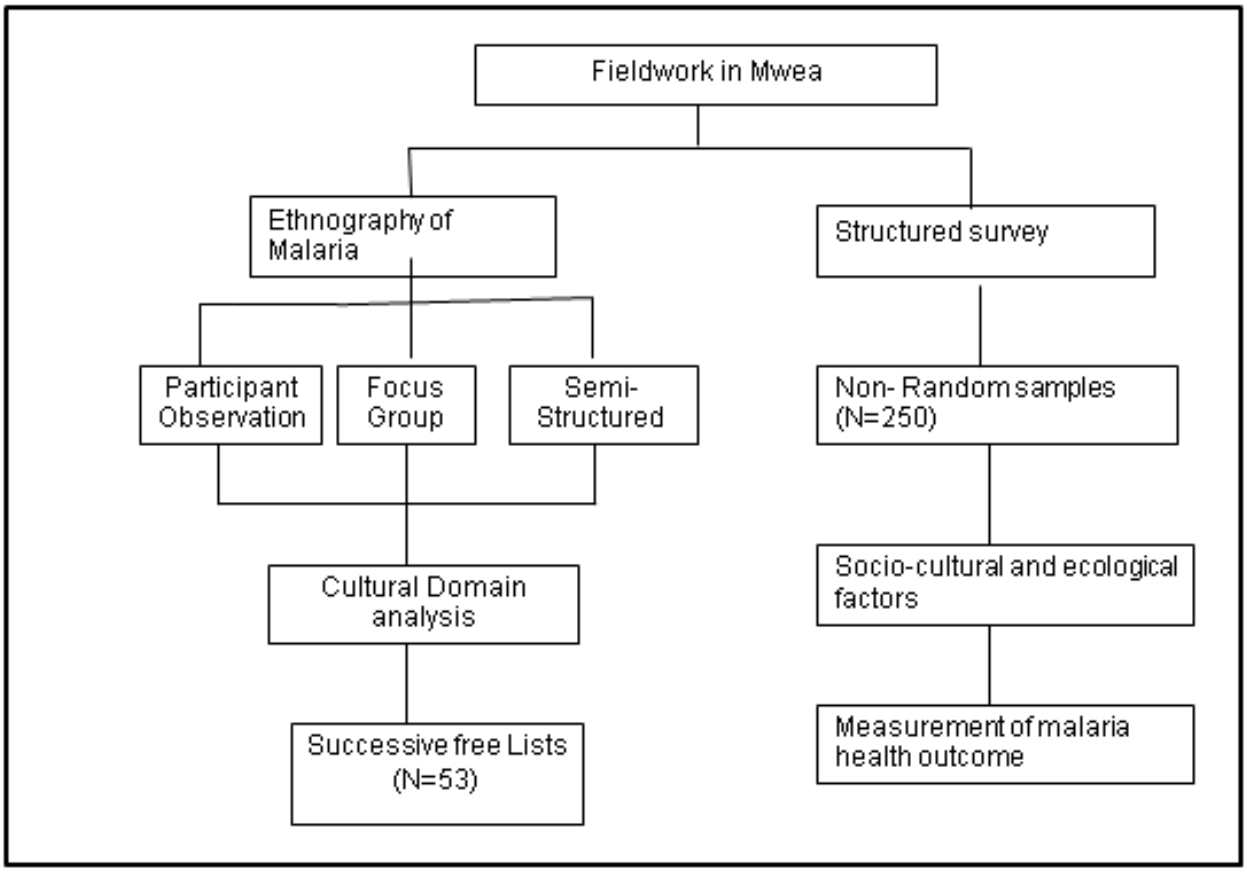


Figure 5- 3. Summary of the malaria research design in Mwea (NB.designed based on Gravlee 1998. Skin Color, Blood Pressure, and The Contextual Effect of Culture in Southern Purto Rico (Page 115, Figure 4-4). Ph.D dissertation submitted to the University of Florida Graduate School

CHAPTER SIX
ETHNOGRAPHIC DATA ANALYSIS: CULTURAL EXPLANATORY MODELS OF MALARIA IN MWEA DIVISION

This chapter presents the analysis of all ethnographic data collected from Mwea Division of Kenya and it presents successive free-list data analysis to identify a cultural understanding of malaria and the other three infectious illnesses included in the study. This chapter maps out the relationship between the four major illnesses with a focus on causes, symptoms, and treatments. To further examine and measure the relationship among the selected illnesses and the extent of intracultural variation that occurs within the illness categories, this chapter presents a correspondence analysis using ANTHROPAC.

The ethnographic analysis also includes the text analysis of the 53 informants to explore how men and women understand and experience malaria in the Mwea division, which are supplemented by in-depth interview narratives by the informants.

6.1 Free-List Data

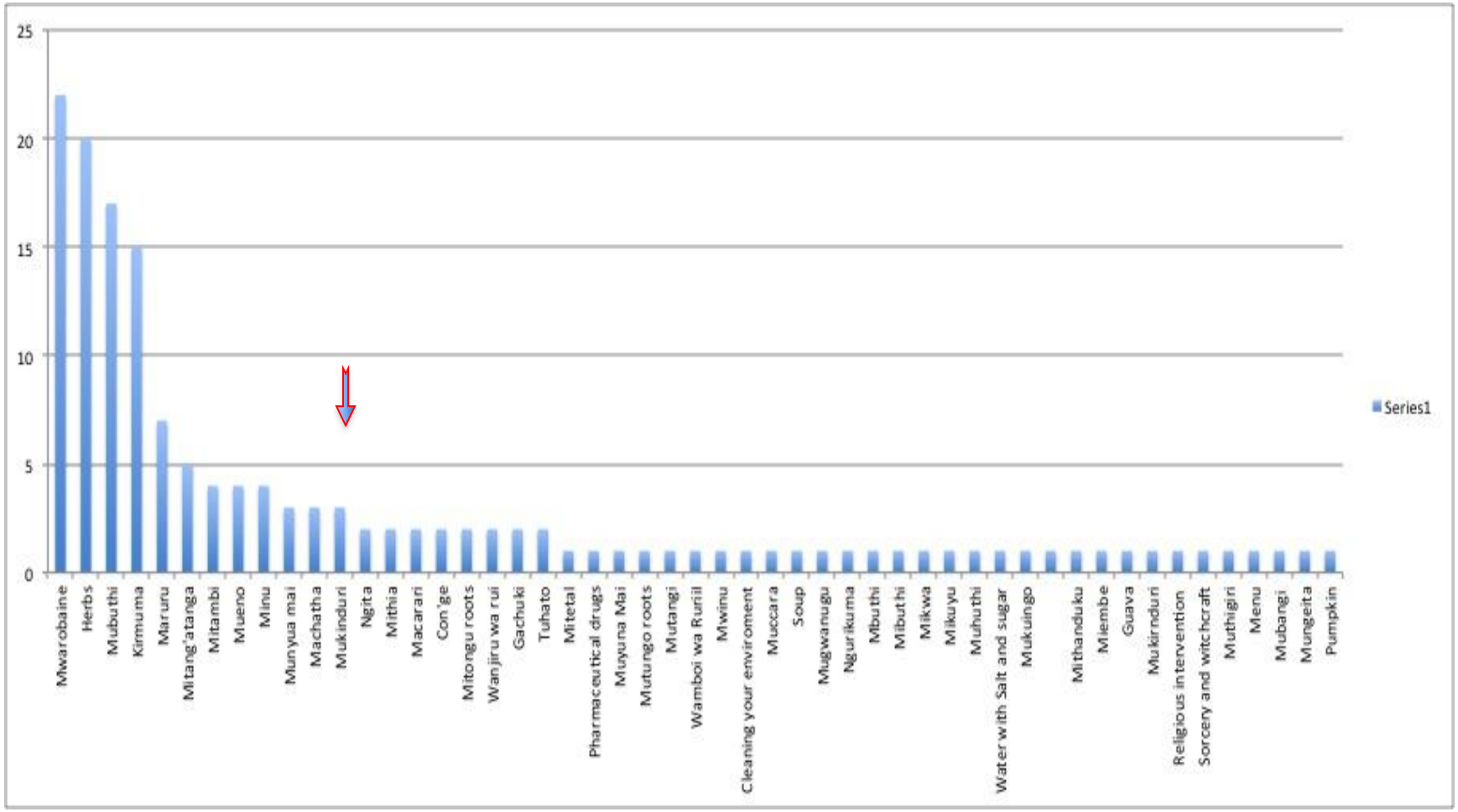
All free-list data collected were coded and converted to ANTHROPAC 4.98 (Borgatti 1996) entry format. Initially, respondents identified eighty-three symptoms, ninety-eight causes, and fifty-seven treatments for the four illnesses. Before the analysis began, similar responses were pooled together. For example, eating mosquito eggs and drinking water with mosquito eggs are similar and were combined into one item. After pooling similar responses, a free-list analysis was conducted with all illnesses listed by the fifty-three informants. The ANTHROPAC free-list analysis produced a total of thirty-eight illnesses. The following table (Table 6-1) shows the top ten illnesses identified by respondents and their ranking. The selection of the top illnesses is based on a frequency drop from two digits to a single digit figures (see figure 6-1 as an example).

Table 6-1. Free-list Output of the Top ten Illnesses

	Items	Freq	Resp. pct	Avg. Rank	Smith's Rank
1	Malaria	53	100	1.189	0.963
2	Typhoid	45	85	3.022	0.563
3	Worms	35	66	4.171	0.305
4	HIV	21	40	3.810	0.218
5	Tuberculosis	17	32	5.118	0.122
6	Pneumonia	15	28	4.267	0.133
7	Diabetes	14	26	5.429	0.102
8	Bilharzia	11	21	3.091	0.133
9	Chest problems	10	19	3.700	0.109
10	Common cold	10	19	3.800	0.115

I selected malaria, typhoid, worms (*schistosomiasis*), and tuberculosis for further analyses on causes, symptoms, and treatments. I selected the top three and tuberculosis for further analyses on causes, signs and symptoms, and treatments. Even though tuberculosis was not one of the top four illnesses in our free-list data, it was selected because focus group and medical reports identified it as one of the top illnesses in the district. Second, it is the fifth infectious illness in the free-list below HIV. I could not include HIV in my interview because it requires additional IRB/KEMRI approval. Once the four illnesses were selected, a free-list analysis was done using ANTHROPAC to identify the frequency and salience of items in the aggregate lists for causes, symptoms, and treatment. The free-list output of each aggregated data set was dichotomized into an illnesses-by-cause, illness-by-symptom, and illnesses-by-treatment matrix. Items of each aggregate data set were extracted along a natural break (identified by a drop in frequency). When there were several frequency drops in a graph additional criteria such as the importance of an item in the list to one of the four illnesses was considered.

Figure 6-1.Treatment Frequencies (Note: Pharmaceutical drug is absent in the graph to correct the graph resolution)



After the extraction, a univariate analysis was conducted for each of the four illness matrices to calculate the frequency and percentage of reported cause, symptom, and treatment (see table 6-2).

Table 6-2. Items Before and After Extraction

Items	Number of items before extraction	Number of items after extraction	Percentage
Causes	43	17	39%
Signs and Symptoms	54	19	35%
Treatment	51	13	25%

The results are presented in the summary tables in the following sections and are organized by cause, symptom, and treatment respectively. The most frequently reported items are also explained in depth in the discussion section, which incorporates the more detailed ethnographic description and narratives.

6.1.1 Causes

The free-list collection and analysis involved enumerating of the causes of malaria, typhoid, worms, and tuberculosis in order to establish the cultural understanding of each illness causes. As shown in (Table 6-3), 90% of informants who mentioned malaria listed mosquito as the most frequent mentioned cause of malaria, and close to 50% mentioned mangoes as the second frequent cause. In addition to mangoes, any fermented food or fruit is considered a risk for malaria. Drinking dirty water and eating dirty food are the most frequent listed causes of worms at 97% and 77% respectively. The same risk factors (dirty food and water) are listed as the most frequent causes of typhoid at 77% and 60% respectively. Dirty air, dust, and sharing the same environment are identified as the most important causes of TB accounting for 53%, 15.3%, and 15.3% of responses respectively. Generally, with the exception of

typhoid and worms, the causal factors are distinct and illnesses specific. This means malaria and TB causes are distinct and do not overlap with worms and typhoid or with each other (see table 6-3).

Table 6-3: Frequency and percentage of causes of the four major illnesses

Causes	Malaria (N=53)		Typhoid (N=45)		Worms (N=35)		TB (N=13)	
	Freq	%	Freq	%	Freq	%	Freq	%
Bushes	5	9.4	0	0	0	0	0	0
Dirty air	0	0	0	0	1	2.8	7	53.8
Drinking mosquito eggs	5	9.4	0	0	0	0	0	0
Drinking dirty water	6	11.3	35	77.7	34	97.7	1	7.6
Dirtiness	1	1.8	1	2.2	1	2.8	0	0
Dust	0	0	2	4.4	2	5.7	2	15.3
Eating dirty food	1	1.8	27	60	27	77.1	1	7.6
Eating dirt	0	0	2	4.4	2	5.7	0	0
Exposure to cold	12	22.6	0	0	0	0	0	0
Fermented Porridge	3	5.6	0	0	0	0	0	0
Mosquito	48	90.5	1	2.2	0	0	0	0
Mangoes	26	49.5	0	0	0	0	0	0
Stagnant water	12	22.6	1	2.2	1	2.8	0	0
Sharing the same environment	0	0	0	0	0	0	2	15.3
Wet fields	2	3.7	2	4.4	2	5.7	0	0
Wind	0	0	1	2.2	1	2.8	1	7.6
Unhygienic behavior	0	0	16	35.5	15	42.8	0	0

6.1.2 Symptomology

In addition to causes, free-list of symptoms of the four illnesses were collected and analyzed to see the most frequent signs and symptoms of each illness. Unlike the identified causes, most symptoms are as shown in table 6-4 are highly shared among the four illnesses. Shivering, fever, headache, and vomiting are mentioned by informants as the most readily identifiable symptoms of malaria, with shivering showing the highest frequency at 34% and the other three symptoms have a frequency of 24.4% each. Diarrhea, general body weakness, and stomachache are mentioned among the most important symptoms of typhoid, with diarrhea accounting for 66.6% of responses

while the other two symptoms account for 60% each. Similar symptoms to typhoid are mentioned as the most important diagnostic signs for worms including loss of appetite. Stomachache is mentioned as the most recognizable symptom of worms with 74.2% of responses and loss of appetite showing up as the second most frequent response at 68.5%. Diarrhea and general body weakness are the next most indicative symptoms of worms at 60% and 51.4% respectively. Tuberculosis is unique: prolonged coughing; chest pain and general body weakness are mentioned as the most frequent symptoms. Prolonged coughing is considered the most frequent symptoms with 92.3% of all responses. Chest pain and general body weakness are the next most mentioned signs for TB at 61.5% and 41.6% respectively. Prolonged coughing is exclusively associated with TB and not with any other illnesses.

Table 6-4. Frequency and Percentage of signs and symptoms of the four major illnesses

Signs and symptoms	Malaria (N=53)		Typhoid (N=45)		Worms (N=35)		TB (N=13)	
	Freq	%	Freq	%	Freq	%	Freq	%
General body weakness	12	22.6	27	60	18	51.4	6	41.6
Stomachache	4	7.5	27	60	26	74.2	0	0
Diarrhea	2	3.7	30	66.6	21	60	0	0
Vomiting	13	24.4	21	39.6	6	17.1	1	7.6
Loss of appetite	6	11.3	9	20	24	68.5	1	7.6
Headache	13	24.4	16	35.5	16	45.7	1	7.6
Joint weakness	12	22.6	15	33	4	11.4	1	7.6
Fever	13	24.4	9	20	2	5.7	1	7.6
Shivering	17	32	5	11	0	0	0	0
Backache	9	16.9	5	11	0	0	0	0
Dizziness	3	5.6	8	17.7	3	8.5	0	0
Prolonged coughing	0	0	1	2.2	0	0	12	92.3
Constipation	1	1.8	6	13.3	5	14.2	0	0
Ring worms	0	0	0	0	11	31.4	0	0
Body rashes	0	0	1	2.2	10	28.8	0	0
Scratches	0	0	0	0	10	28.8	0	0
Chest pain	0	0	0	0	0	0	8	61.5
Bloating	0	0	2	4.4	5	14.2	0	0
Nausea	3	5.6	0	0	3	8.5	0	0

6.2 Correspondence Analysis

To further understand the relationship among the four illnesses and the extent of intracultural variation that occur within illness categories, I conducted a correspondence analysis using ANTHROPAC. Correspondence analysis is used to explore and describe categorical data in two-dimensional space (Ryan et al. 2000). The relative distance between items in the graph is used to indicate the relative association that occurs between the items. In this project, I performed an illnesses-by-item description matrix correspondence analysis for each category. This data includes the responses from the fifty-three informants with seventeen cause descriptions, nineteen symptoms, and thirteen treatments. In the following figures, I present the illnesses-by-item description correspondence analysis for the four illnesses. All graphs are plotted in SYSTAT 12, with graphs of intracultural variation plotted at a 95% confidence interval.

As shown in Figure 6-2, typhoid and worms have a very close relationship and are almost indistinguishable. However, malaria and TB are distinct. The causes associated with typhoid and worms include unhygienic behavior, drinking dirty water, eating dirty food, dirtiness, eating dirt, and wet fields. Malaria is associated with mosquitos, mangoes, drinking mosquito eggs, and exposure to cold, bushes, fermented porridge, and stagnant water. Tuberculosis has fewer associated causes, showing just dust, wind, dirty air, and sharing the same environment.

6.2.1 Correspondence Analysis of Symptoms

When it comes to symptoms, there is a strong association and overlap among malaria, typhoid, and worms. Figure 6-3 shows how similar these illnesses are by the degree of overlap and lack of distinct boundaries between them. Chest pain and

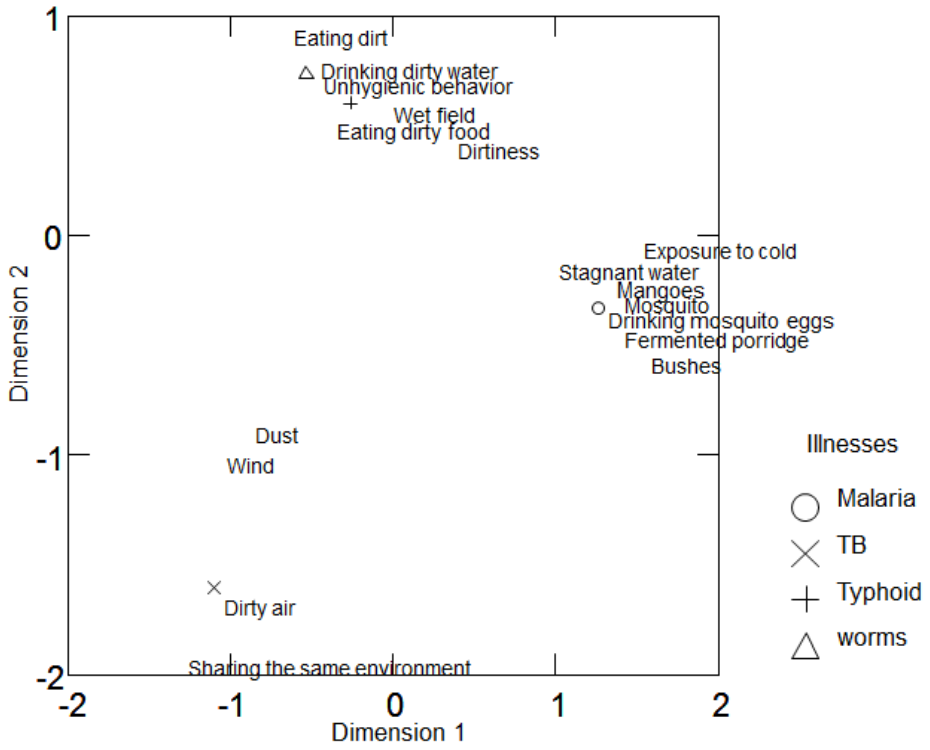


Figure 6-2 Aggregate correspondence analyses of causes by four infectious illnesses

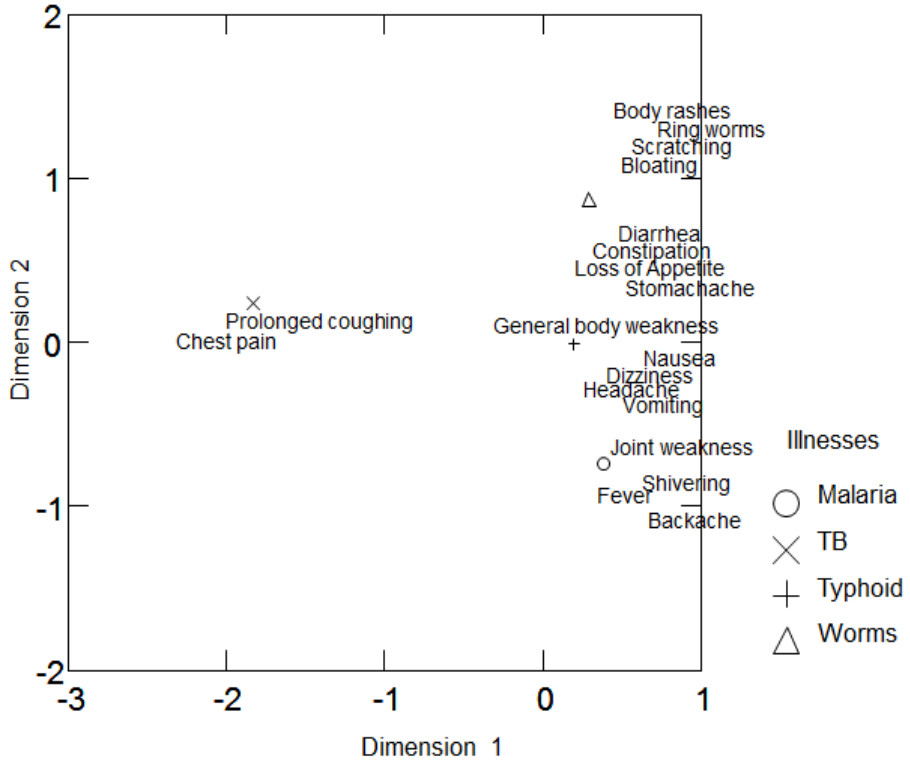


Figure 6-3. Aggregate correspondences analysis of signs and symptoms by four infectious illnesses

prolonged coughing are exclusively associated with TB, while body rashes, scratching, ringworms, and bloating are only associated with worms. The association of symptoms between the three illnesses is more visible when TB is excluded.

6.3 Intracultural Variation in Causes, Signs Symptoms, and Treatment

To examine the intracultural variation in causes, symptoms, and treatment for each illness, I performed separate individual informant-by-item description matrix correspondence analysis with results from fifty-three of the informants for each category. As with the aggregate correspondence analysis, I used the same number of causes, symptoms and treatments to run the analysis. In the figures for these analyses, the size of the ellipse represents the degree of cohesion of responses about causes, symptoms, and treatments between informants. This means that even though informants mentioned different causes for an illness, the number of informants and the number of causes they mentioned all determines the extent of cohesion or variation for a particular illness. Dense clustering represents the presence of greater agreement and less variation among individuals in a group. Figure 6-3 shows that intracultural variation of causes among informants is higher for TB (least cohesive) and least for malaria (most cohesive). Typhoid and worms show higher variation between individual than malaria.

When it comes to symptoms, malaria shows the least variation while both TB and worms indicate high intracultural variation (see figure 6-4). Typhoid shows relatively less variation compared to worms and TB, but more variation than malaria. This indicates that the informants who mentioned malaria have more agreement about the symptoms of malaria than informants who mentioned typhoid, worms, and TB.

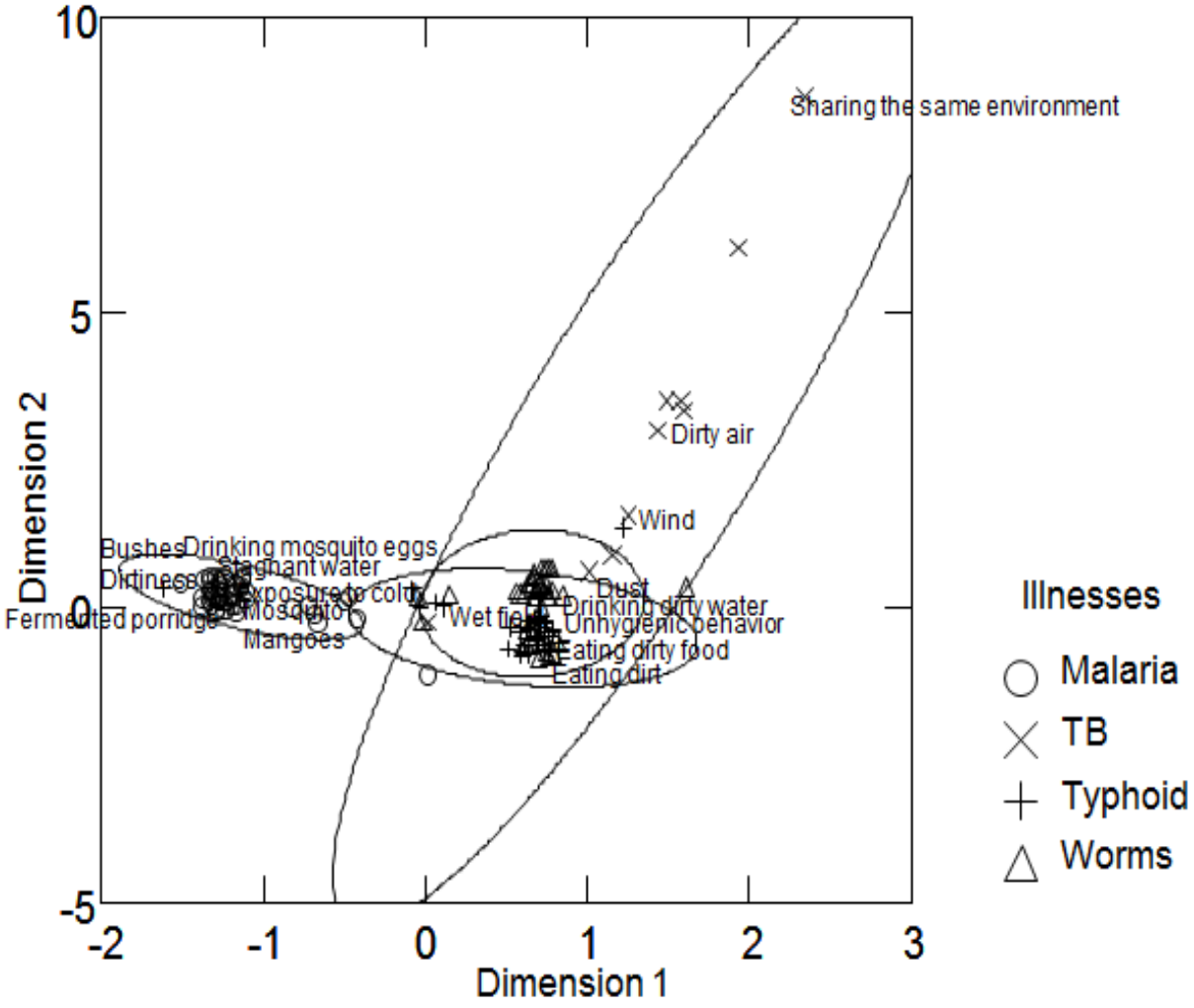


Figure 6-4. Individual correspondence analyses of causes of the four major illnesses

The intracultural variation in treatment is diverse among all illnesses except TB (see figure 6-5). Informants who mentioned TB show the least variation when it comes to types of treatment with 100% of informants reporting the use of pharmaceutical remedies. The other three illnesses have a variety of different treatment options. Worms and malaria show the highest amount of intracultural variation. The intracultural variation among informants for typhoid treatment is also very high, but less than malaria

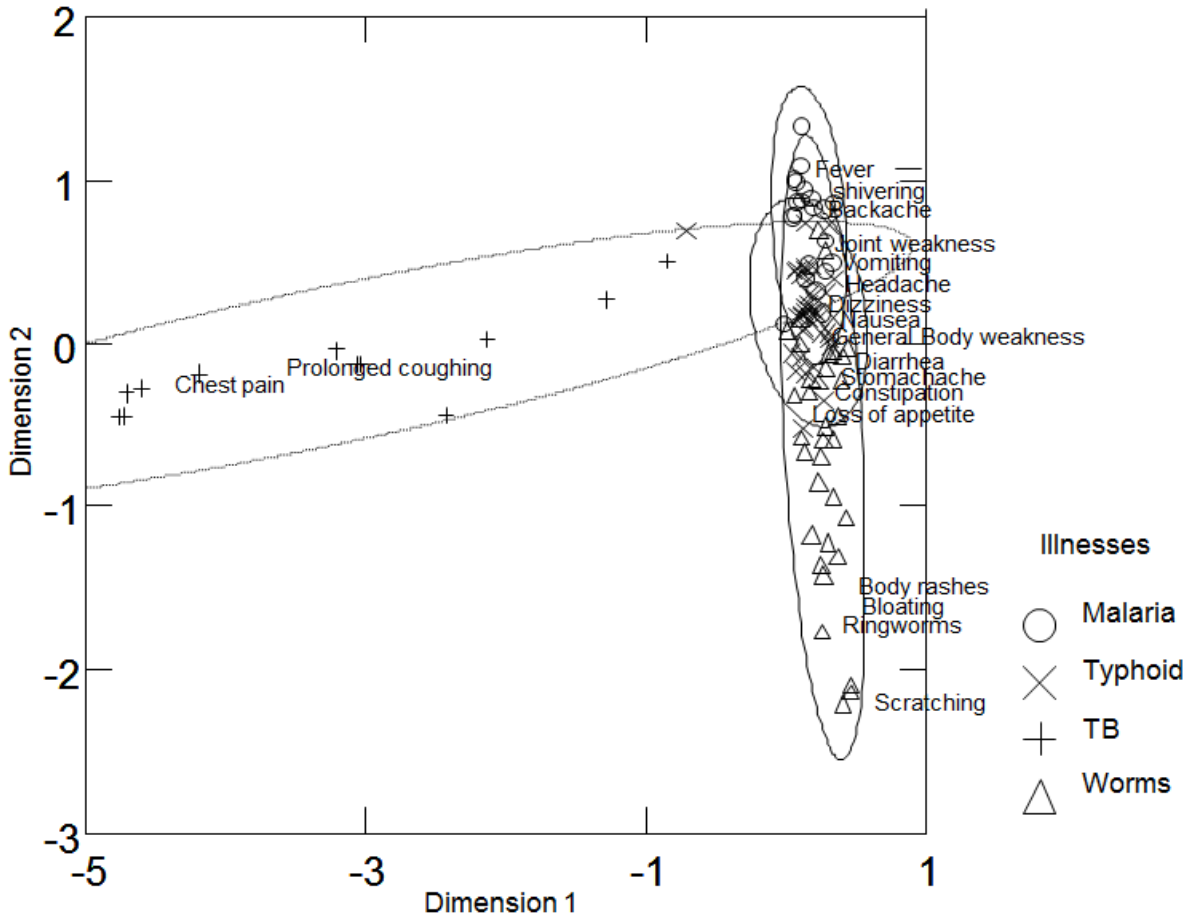


Figure 6-5. Individual correspondence analysis of signs and symptoms of the major four illnesses

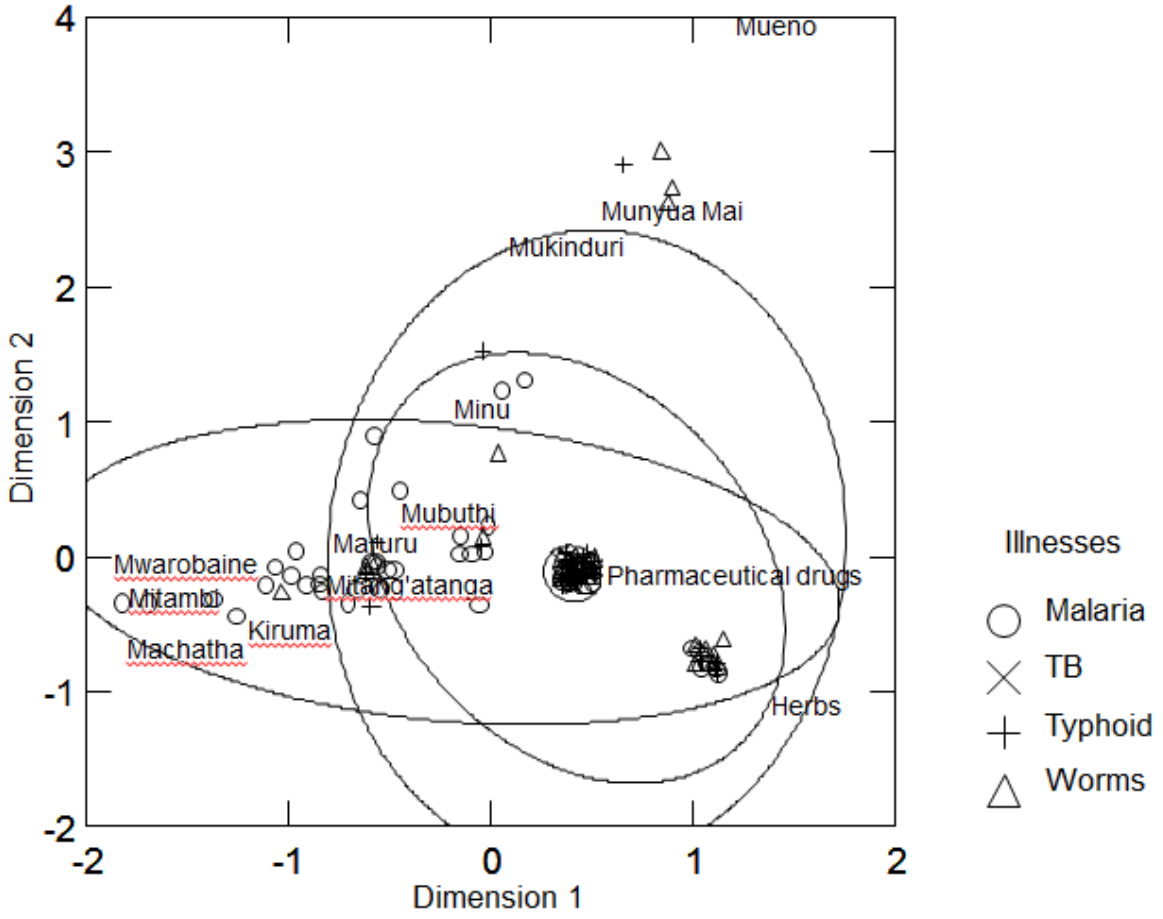


Figure 6-6.Individual correspondence analysis of treatment of the four major illnesses

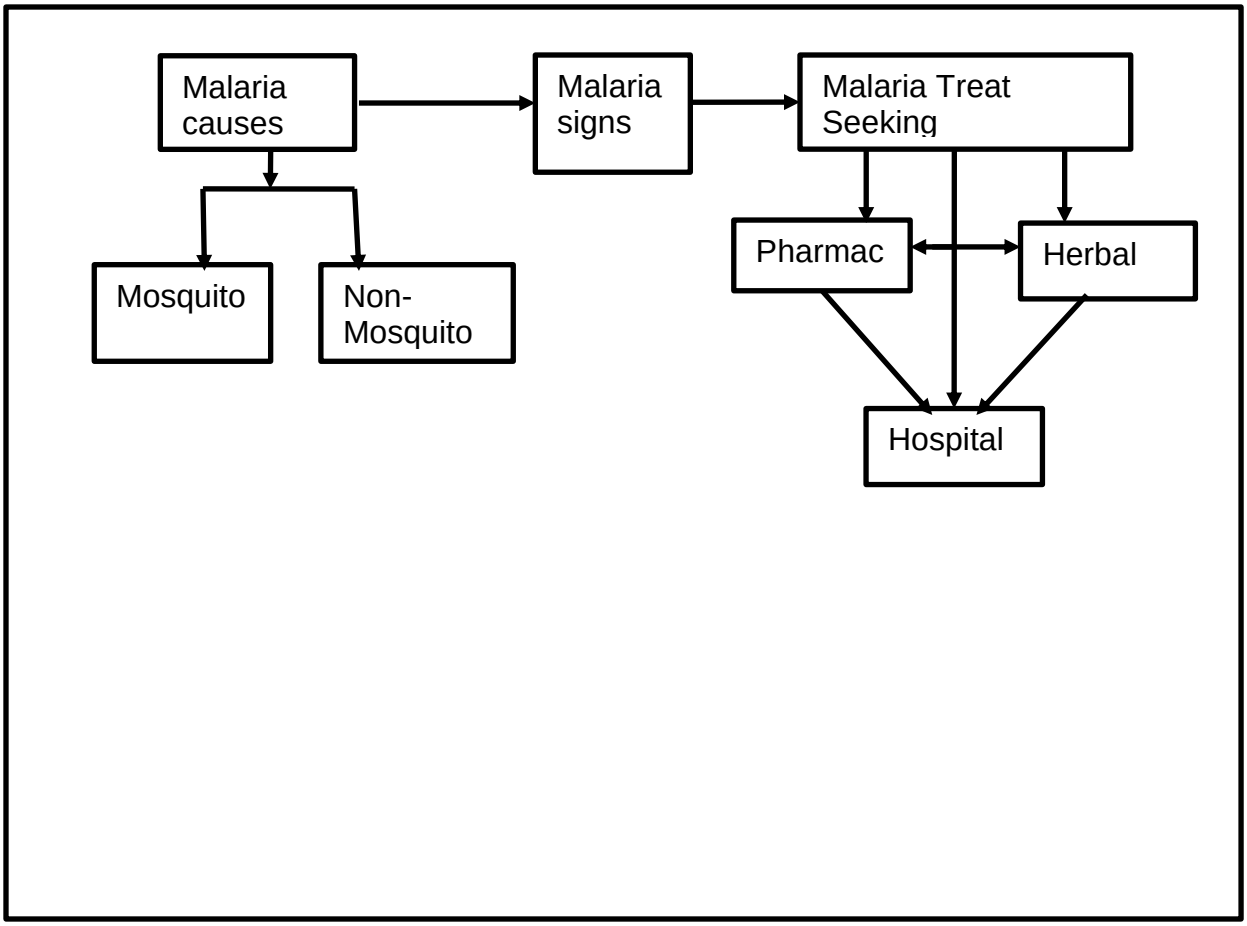


Figure 6-7. Cultural explanatory model of malaria in Mwea Division

and worms. The variation structure in malaria is also very different from worms and typhoid in that informants are relatively well spread in the ellipse. Generally, the cultural understanding of malaria and treatment-seeking behavior in Mwea division can be represented in the model illustrated in Figure 6-7.

6.4 Text Analysis

In this dissertation, I used text analysis to examine how men and women in the agricultural communities of Mwea division explained why one gender was at a higher risk of malaria than the other. First, Interviews from semi-structured interviews were transcribed and coded. These interviews were particularly focused on gender differences regarding the understanding of malaria risk. I coded and analyzed the text

using text analysis software (MAXQDA) to examine gender differences in the understanding of why women are at greater risk of malaria than men. Based on participant observation and unstructured interviews I identified six themes of expression on the understanding of malaria risk, that can be generally categorized in to biological and gender roles and socioeconomic status difference between men and women. The six themes mentioned by informants (as shown in table 6-5) include, dressing style, work type, weak blood/immunity, household responsibility, poverty, and equal risk for both genders.

Table 6-5 Themes identified from text analysis on the reasons why women are at higher risk of getting malaria than men

Malaria risk factors	Gender		Total
	F (N=26)	M(N=27)	N=53
Dressing style	2(2.9%)	3(3.4%)	5(7.3%)
Equal risk	3 (4.3%)	5(7.1%)	8(11.4%)
Household responsibility	9(12.9%)	3(4.3%)	12(17.1%)
Poverty	2(2.9%)	0(0%)	2(2.9%)
Type of Work	17(24.3%)	4(5.7%)	21(30%)
Weak blood/immunity	6(8.6%)	16(22%)	22(31.4%)
Total	39(55.7%)	31(44.3%)	70 (100%)

Dressing style refers to the adoption of modern or western dressing styles. Informants believe that the adoption of western dressing style exposes a large portion of a woman's body to mosquito bites. This is not a very commonly mentioned risk, only 2.9% of women and 3.4 % of men mentioned it. For example, a 50-year-old male informant described the link between malaria and the women's dressing styles as follows:

> Women are always at higher risk because they dress very well. Most of their body is exposed and is easily available for mosquito bite. Women also have weak blood and cannot resist well for malaria infection.

Work type is a widely mentioned risk factor that put women at a greater risk than men. In this context work type refers to the role of women in the agricultural and irrigational sector. Informants believed women are at greater risk of malaria than men counterparts because they are engaged in the most risky aspects of the rice irrigation particularly wedding and planting rice. As shown in the next chapter (page 113) women are mostly engaged in the wet aspect of the rice irrigation, while men are mostly engaged in the dry aspect of the rice irrigation particularly plowing, threshing, and transportation. There is a clear gender difference when it comes type work as a major factor to women's greater malaria burden, 24.3% of women believe work type is the main reason behind the disparity in malaria risk; only 5.7% of men think the same way. Even though women often do the wet aspect of the irrigation, they are also very much involved in the dry aspect of the irrigation sector except ploughing. A 23 year old female informant explained why work type put women at higher risk of getting malaria than their men counterparts as follows:

> Women are at higher risk than other groups. Planting, weeding and sometimes harvesting is done by women. You know the rice field is infested with mosquitoes and malaria worms so they get it easily. Mothers are also close to their sick children and they can get it very easily.

Poverty or being poor, known in Kikuyu as *Uthini,* is another risk factor mentioned by informants as major factor that put women at disproportionate malaria risk than men. Poverty in this context refers to the lack of material and cash resource to alleviate the malaria problem in the household. This is mentioned by only 2.9% of women and men do not mention it at all. Despite its low percentage, this is a major problem in the community, particularly among single mothers. A 31 year old female

informant explains the kind of health risk women, and single mothers in general, face as follows:

Figure 6-8 Women weeding in a rice field in Mwea Division of Central Kenya.

Figure 6-9. Women in Mwea Division weeding a maize field

> I see women get sick more often than men. Maybe it is because they are poor. Especially if the woman is divorced, it is very hard to get money for medication and to buy bed nets. For example, I am divorced with kids and most of the time, it hard for me to get money to buy food, medication, and bed net.

In the absence of land and other income sources, single mothers are vulnerable to malaria and its consequences. Most of these mothers work in the rice field, as laborers and if they get sick the entire family do not have an income source for basic needs.

Weak blood or weak immunity, known in Kikuyu as *Thakame nini*, is mentioned as one major factor for the differences in malaria burden between men and women. Informants consider this biological factor as something that puts women at a greater vulnerability to malaria and other infectious illnesses. Traditionally, women in this case are considered to be naturally weak; that has to do with their weak blood, and as a result, affects their ability to resist illnesses. As for work type, women and men strongly differ on this issue. About 22 % of men believe that women are at a greater risk of malaria than men because of their weak blood and only 8.6% of women feel the same way. As the figure shows, this is a widely held belief among men than among women. A 52-year-old male informant explain why women are at a greater risk of malaria than men:

> Women are at high risk because women have weak blood. If you have weak blood, all the mosquito worms can easily infect you. I think also most women do not drink alcohol. Alcohol helps to make your blood strong and protect you from malaria infection.

Household responsibility in this case refers to household chores and family related responsibility within the household. This refers to daily activities in the house such as cooking, fetching water, cleaning, and a larger responsibility for the mother in the household as a caretaker of sick family member, seniors, and children. More than

12% of women believe these household responsibilities put women at a much greater risk of contracting malaria than men, but only 4.3% of men believe the same way.

Figure 6-10. Cooking and washing in the Open: Mother and Daughter doing household chores in Mwea Division of Central Kenya.

Cooking and fetching water are usually done in early morning and evening when mosquitoes are active, while taking care of a sick family members increases the chance of women contracting malaria.

About 4.3% of women and 7.1% men think both men and women are at equal risk of getting malaria. Most of these individuals think of a collective illnesses burden related to environmental risk related to the rice irrigation. In general, these individuals assume people are not safe because they all live in the same area that is infested with mosquito regardless of their social position and gender roles.

Table 6-5, generally summarizes the results of men and women understanding of why women suffer disproportionately more from malaria compared to men. The results show that 40.1% women associated women's higher risk of malaria with the type of work, household responsibility and poverty. Only 10% of men think women's higher malaria risk is explained by the aforementioned risk factors. On the other hand, 25.4 % of men explained women's higher malaria risk of malaria is explained by weak blood or immunity and the adoption of a modern clothing style. Only 11.5% of women think women's higher malaria risk is associated with weak blood or immunity and adoption of modern dressing style.

The difference between men and women for the reasons behind women's higher risk of malaria than their men counterpart is statistically significant with p-value < 0.003. In this case while most men think women's health problems are associated with biological vulnerability or behaviors, most women think their health problem are associated with culturally sanctioned gender roles and responsibilities. Therefore, based on these results, men and women view malaria risk very differently.

CHAPTER SEVEN
QUANTITATIVE DATA ANALYSIS AND RESULTS

This chapter presents the results of a structured survey to investigate the cultural understanding of malaria and treatment-seeking behavior among Mwea communities from 250 non-random individuals from three non-irrigated villages, four irrigated villages, and Mwea town. The sample includes an equal number of men and women aged 18 and above. Here, I examine the association between different socio-cultural and environmental factors and malaria health outcomes. I conducted logistic regression analysis to examine what variable or variables best predict malaria health outcome and treatment-seeking behavior in Mwea communities. Most of these analyses complement some of the analyses done in the qualitative (Ethnographic analysis) section in chapter 5. The main goal of these analyses is to test hypotheses that attempt to answer questions about how certain socio-cultural and environmental variables are associated or related with malaria health outcomes. Furthermore, the analyses also include how certain cultural belief systems about malaria are related to demographic characteristics of the target population and their environment of residence.

7.1 Gender and Malaria: Do Gender Roles Influence Risk for Malaria in Mwea Division?

Gender is an important factor in malaria research because the social and cultural roles assigned to men and women have different impacts on their risks for malaria and other illnesses. It becomes even more important in places like Mwea where gender roles are culturally arranged and where several infectious illnesses are present. To understand how the differences in gender roles and other cultural beliefs about gender affect the malaria health difference between men and women in Mwea, I conducted

descriptive and chi-square test with the survey data to investigate the cultural understanding of which gender is at a greater risk of contracting malaria.

Table 7-1 Cross-tabulation of gender and people's belief about which gender is at high risk of malaria (95% confidence interval)

Gender			Who is affected by malaria			Total
			Woman	Man	Both	
	Female	Count	109	7	9	125
		%	87.2%	5.6%	7.2%	100.0%
	Male	Count	88	21	16	125
		%	70.4%	16.8%	12.8%	100.0%
Total		Count	197	28	25	250
		%	78.8%	11.2%	10.0%	100.0%

X^2 (2, 250) = 11.20, P-value =0.04

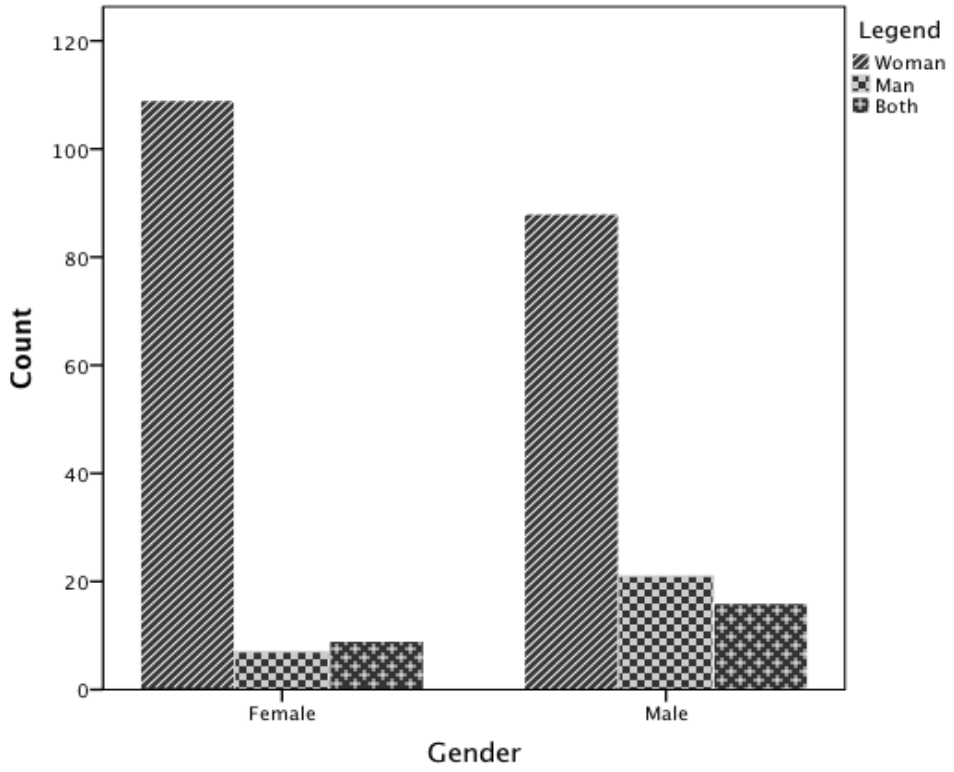


Figure 7-1. Bar chart of gender by individual's response on which gender is at greater risk of malaria

As shown in table 7-1, both men and women think women are at a greater risk of contracting of malaria than men. About 87 % of women and 88% of men think women are at a greater risk of contracting malaria. The association between the two variables is statistically significant with a p-value <0.004.

To examine the extent of gender difference in malaria risk, both chi-square test and regression analyses were conducted to understand whether gender is associated with malaria risk, as measured in reported episodes of the illness over a 12 month period of time. First a chi-square test was done to see the association between gender and episodes of malaria, and the result showed a significant association with a p-value <0.03.

Furthermore, to test whether gender predicts malaria health outcomes, I ran a binary logistic regression model putting gender as the independent variable and episodes of malaria as the dependent variable.

Table 7-2. Regression of episodes of malaria and gender

Variable	Odds ratio	P-value
Gender		
Male	Ref	
Female	1.741	0.031

According to this model, the result of the regression showed that a woman is 0.603 times more likely to experience high episodes of malaria than low episodes of malaria. In reference to men, the model significantly explained that the odds of women experiencing episodes of malaria are 1.741 times higher than men.

From ethnographic observation we know that men and women's roles in rice irrigation agriculture and in the agricultural sector in general are very different. Ethnographic observation and unstructured interviews revealed that women are mostly

engaged in the wet aspect of the irrigation sector while men are mostly engaged in the dry aspect of the irrigation or agricultural sector. To test this hypothesis, I conducted a chi-square and regression analysis with gender as the independent variable and work type (Table 7-3) as the dependent variable. Work type refers to the kinds of works people do in the irrigation and agricultural sectors in Mwea division throughout the season.

Table 7-3 cross-tabulation of Gender and work type (95% Confidence Interval)

			Work type			Total
			Wet	Dry	Both	
Sex	Female	Count	43	4	22	69
		%	62.3%	5.8%	31.9%	100.0%
	Male	Count	31	20	33	84
		%	36.9%	23.8%	39.3%	100.0%
Total		Count	74	24	55	153
		%	48.4%	15.7%	35.9%	100.0%

X^2 (2,250)=13.47, P-value=0.01

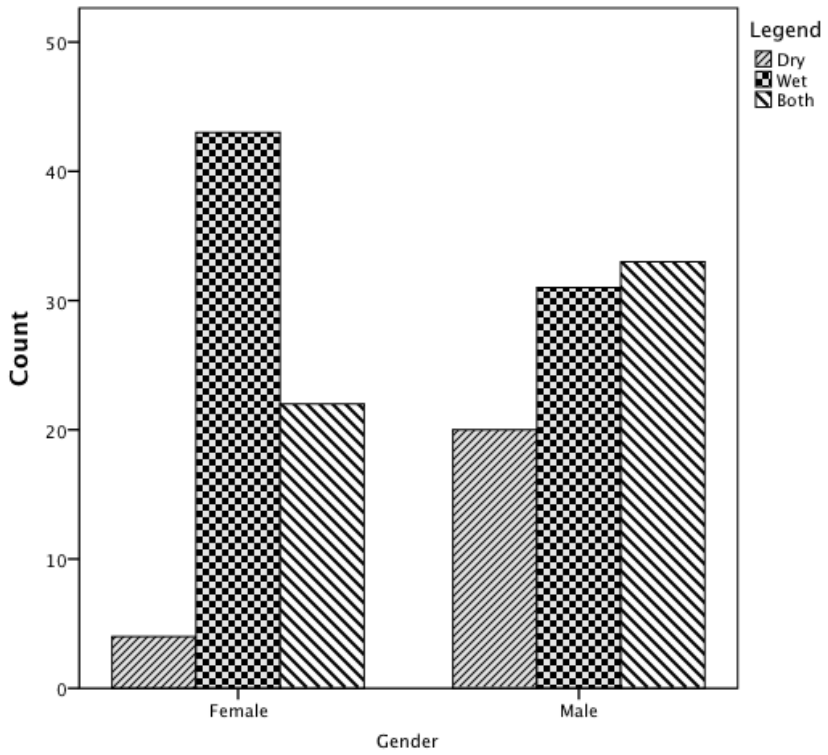


Figure 7-2. Bar chart of gender by work type

As shown both in the tabulation table and bar chart, 63% of women are engaged in the wet aspect of the irrigation sector while only 36.9% of men are engaged in the same activity. On the other hand, only 5.8% of women are engaged in the dry aspect of the irrigation activity but 23.8% of men are engaged in the same work type. Both genders report they are engaged in both work types with 31.9% of women and with 39.3% of men. The association between gender and men's and women's role in the irrigation or agricultural sector is statistically significant with a p-value <0.01.

I ran a multinomial regression analysis, with work type as the dependent variable and gender as independent variable. The result of the regression analysis showed that the odds of women working in the wet aspect of the irrigation or agricultural sector is 6.9 times that of those in the dry aspect of the irrigation with a significant p-value <0.001. Similarly the odds of women working in the wet sector are 3.3 times that of those working in both work types. On the other hand the odds of men working in the dry sectors is 6.9 times that of those in the wet sector with a significant p-value <0.00.

7.2 Illness Progression: Testing the Association between the Cultural Belief on Non-Mosquito Malaria Causes and the Progression of Malaria to Typhoid.

Based on ethnographic research, I found a widely held belief among individuals in Mwea community about the progression of malaria into typhoid. I collected data on this topic in the survey to understand the extent of this cultural belief in the division from a larger sample.

As shown in the table, 79% of women and 59% of men believe that malaria progresses to typhoid. Fifty five percent of the total informants believed severe malaria progresses into typhoid. Chi-square tests show that, the association between gender and this cultural belief system is statistically significant with a p-value <0.01.

Table 7-4 cross tabulation of gender and malaria to typhoid progression cultural beliefs

			Malaria to typhoid		Total
			No	Yes	
	Female	Count	46	79	125
		%	36.8%	63.2%	100.0%
	Male	Count	66	59	125
		%	52.8%	47.2%	100.0%
Total		Count	112	138	250
		%	44.8%	55.2%	100.0%

X^2 (1,250)=6.47, P-value=0.01 (N.B all percentages are within specific gender).

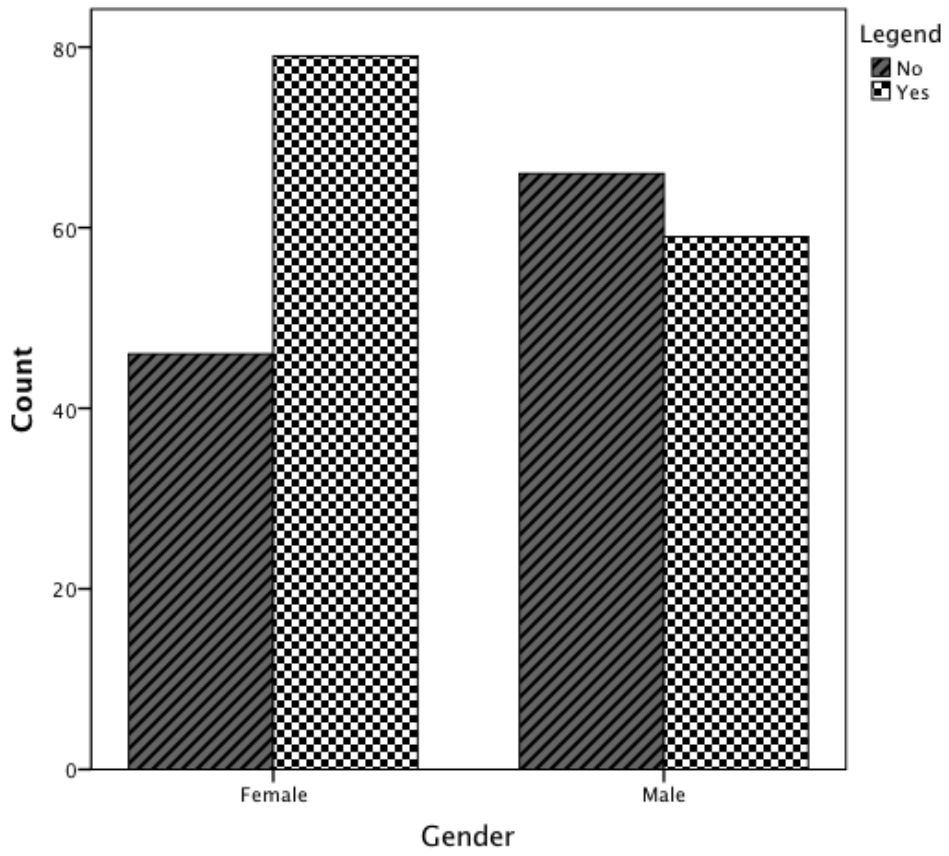


Figure 7-3 Bar chart gender by individual beliefs of malaria to typhoid progression

Furthermore, I examined whether this cultural belief is associated with the cultural belief in non-mosquito malaria causes. A cultural belief in non-mosquito malaria causes was treated as an independent variable with gender, education and age while cultural beliefs

about malaria-typhoid progression was a dependent variable in the regression model (see table 7-5). The analysis did not find any correlation between cultural beliefs in non-mosquito malaria causes and malaria to typhoid progression. If there is no correlation it means there is no regression relationship between the two variables, which means believing in non-mosquito malaria causes does not explain believing in malaria to typhoid progression.

Table 7-5 Regression analysis of malaria to typhoid progression on standard covariates of gender, education, age, and non-mosquito malaria cause beliefs

Variables progression	Odds ratio
Gender (M)	1.955*
Age (>30)	
31-55	1.112
<55	1.33
Education (No education)	
Primary	2.171
Secondary	2.208
Tertiary	2.073
Hosmer and Lemeshmow Test	0.994

* P-value<0.05

However, malaria to typhoid progression is significantly associated with gender with a p-value <0.01. This means that a belief in malaria to typhoid progression is highly associated with women. In this regression model gender is the only variable that predicts malaria to typhoid progression with p-value < 0.013. According to this model, the odds of women believing malaria to typhoid progression is 1.955 times higher than men. Even though both age and education are significantly associated with beliefs about malaria to typhoid progression but the regression analysis shows there is no significant predictive power.

7.3 Testing the Association between Age, and Education and The Cultural Belief of Malaria Avoidance.

This section tests whether age and education are associated with the cultural understanding of the Mwea community that malaria is unavoidable in the division. In this analysis I tried to test whether older people hold this cultural belief more than young people in Mwea. At the same time I want to test if people of lower educational levels hold those cultural beliefs more than people of higher educational level.

Table 7-6. Cross tabulation of age by beliefs of malaria avoidance (95% confidence Interval)

Avoid malaria			Age			Total
			<30	31-55	>55	
	No	Count	23	38	20	81
		%	28.4%	46.9%	24.7%	100.0%
	Yes	Count	50	85	34	169
		%	29.6%	50.3%	20.1%	100.0%
Total		Count	73	123	54	250
		%	29.2%	49.2%	21.6%	100.0%

X^2 (2,250)=0.684, P-value=0.71

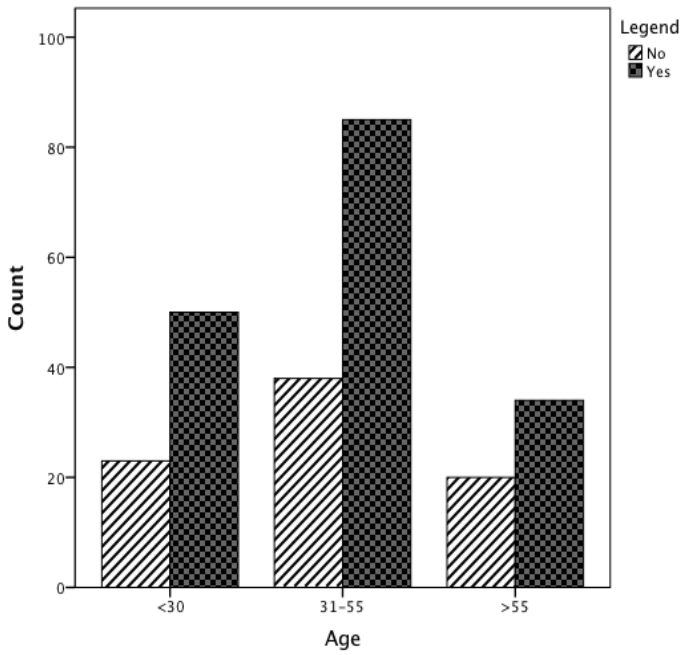


Figure 7-4. Bar chart of age by cultural belief of malaria avoidance

The results show that 58% of people older than 55 believe that malaria can not be avoided in their division, 46% of people aged between 31-55, and 44% of people younger than 30 believe the same way. However, the association between age and people's beliefs about malaria prevention is not statistically significant with a p-value <0. 710.

Table 7-7. Cross tabulation of education by belief of avoidance of malaria (95% Confidence interval)

Education			Avoidance of malaria		Total
			No	Yes	
	No education	Count	10	15	25
		%	40.0%	60.0%	100.0%
	Primary education	Count	52	77	129
		%	40.3%	59.7%	100.0%
	Secondary education	Count	17	69	86
		%	19.8%	80.2%	100.0%
	Tertiary education	Count	2	8	10
		%	20.0%	80.0%	100.0%
Total		Count	81	169	250
		%	32.4%	67.6%	100.0%

X^2 (3,250)=11.31, P-value=0.01

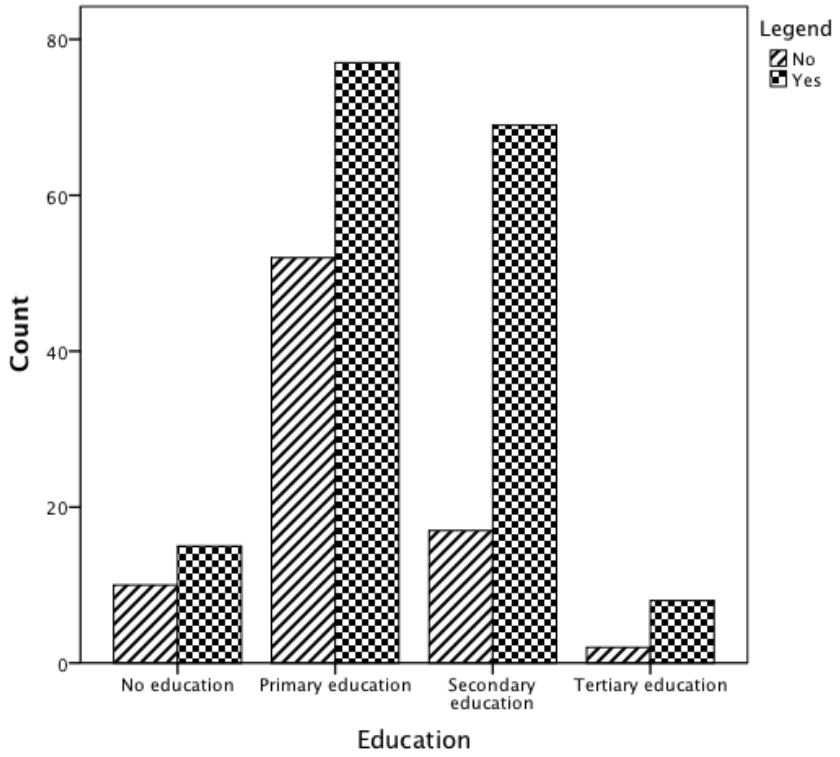


Figure 7-5. Bar chart of education by cultural belief of malaria avoidance

However, when it comes to education the association between education and the cultural beliefs about malaria avoidance is statistically significant with a p-value <0.01. About 67% of both people with no education and primary education said malaria is unavoidable in their division. However, only about 25% of people with high school and tertiary degrees believe the same way.

I ran a regression model to test the relationship between education and beliefs about malaria avoidance in Mwea division.

Table 7-8. Logistic regression model of malaria avoidance belief on education covariate

Education	Odds ratio	P-value
Education (No education)	Ref	
Primary	.987	0.977
Secondary	2.706	0.042
Tertiary	2.66	0.270
Hosmer and Lemeshow Test	1.00	

The result shows that the odds of people with no education believing malaria is non-avoidable in their division is 2.706 times that of people with high school degrees. The odds ratios of people with no education do not have a significant relationship people who have tertiary and primary degrees.

7.4 Testing the Relationship between Socio-Cultural and Ecological Variables and Malaria Health Outcome

There are several factors that could affect malaria health outcomes in Mwea, and understanding these factors and how they are associated and affect people's health is very important. In this section I did a statistical analysis from the 250-person sample included in this survey. Initially, I did a chi-square test of all independent variables against the dependent variable, which was an episode of malaria to see if each variable was associated with the dependent variables. All variables that had significant

association with episodes of malaria were selected to be included the binary logistic regression analysis. As shown in table (7-9) the variables that had significant association include socio-cultural and ecological factors.

Table 7-9. Logistic regression analysis of episodes of malaria on standard covariates of age, gender, education, landownership, point man ascribed socio-economic status, ecological residence, distance to hospital, wait for care at the hospital and work type in the irrigation or agricultural sector.

Predictor variables	Unadjusted odds ratio	Adjusted odds ratio
Age (<30)		
31-55		3.704*
>55		7.44**
Education (No education)		
Primary	1.8	1.20
Secondary	0.65*	0.29
Tertiary	0.28	0.15
Gender (Female)		
Male		0.32*
Land ownership (No land)		
1-2 Hectares		0.95
>2 Hectares		4.96**
Point man ascribed SES (Low)		
Medium	0.39	0.64
High	1.58	1.71
Residence (No irrigated)		
Irrigated	0.51*	0.87
Urban	0.43*	3.78
Work type (Dry)		
Wet	0.33	0.67
Both	0.16	0.43
Distance of hospital/clinic (Less than 1 hour)		
About 2 hours	1.82	0.56
Wait time to receive care (<1hour)		
About 2 hours		5.215**
More than 2 hours		2.195
Cox and Snell R-Square		0.308
*p-value		<0.05
**p-value		<0.01
Hosemer and Lemeshow Test		0.89

Age as a predictor variable that is associated with episodes of malaria can significantly explain or predict episodes of malaria. As shown in the table above, the odds of people aged between 31-55 experience high episodes of malaria 3.7 times that of those less than 30 years old. Similarly, the odds of people older than 55 years old experience high episodes of malaria 7.4 times that of people less than 30 years old.

Gender is highly associated with episodes of malaria and significantly predicts the outcome variables. According to the regression model, the odds of women experiencing high episodes of malaria is 3.12 times greater than men with a p-value <0.05.

Another variable that predicts episodes of malaria is land ownership. The results from the regression analysis indicate that the odds of people who own more than 2 hectares of land are experiencing high episodes of malaria are 4.9 times greater than people who do not own land with a p-value<0.006.

People spent hours to get care in hospitals in Mwea division. As shown in table (6-9), the result show that the odds of people who said they wait up to 2 hours to receive care experience 5.2 times greater episodes of malaria than people who said they wait less than one hour.

Despite a significant association between education and episodes of malaria, educational categories do not predict or explain episodes of malaria when added into the integrated multiple variable regression analysis. Table (6-10) shows the decrease in high episodes of malaria from the lowest educational level to the highest educational level, except between high school and tertiary degrees.

However, I ran education and episodes of malaria separately in a binary logistic regression model, the results showed that the odds of people with no education are four times greater to experience high episodes of malaria than people with Tertiary education with a p-value<0.004.

Table 7-10. Education and Episodes of malaria cross tabulation

			Episodes of malaria		Total
			Low	High	
Education	No education	Count	10	15	25
		%	40.0%	60.0%	100.0%
	Primary education	Count	60	69	129
		%	46.5%	53.5%	100.0%
	Secondary education	Count	62	24	86
		%	72.1%	27.9%	100.0%
	Tertiary education	Count	7	3	10
		%	70.0%	30.0%	100.0%
Total		Count	139	111	250
		%	55.6%	44.4%	100.0%

X^2 (3, 250) = 17.10, P-value =0.001

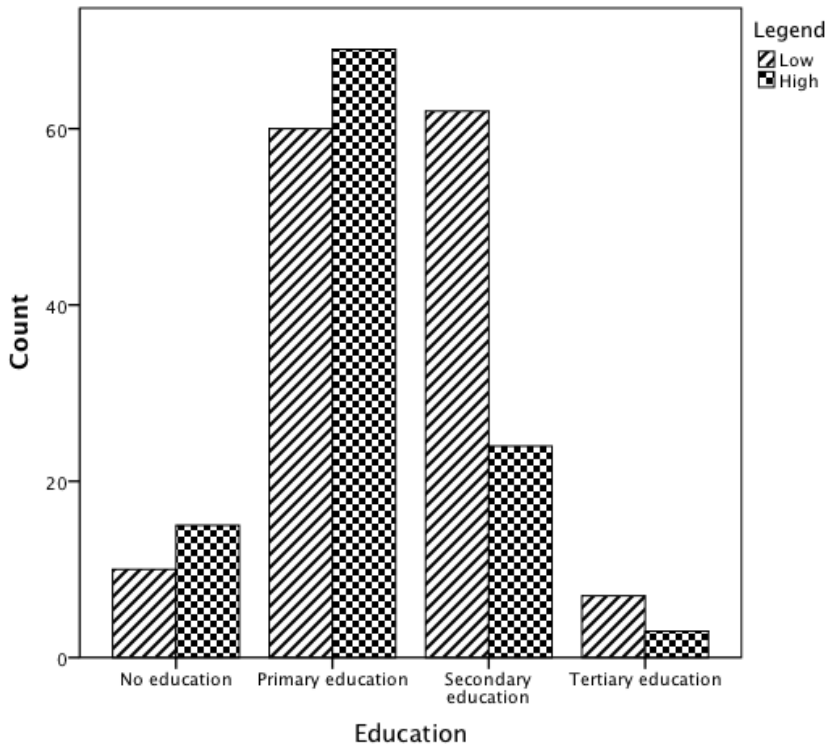


Figure 7-6 Bar chart of education by episodes of malaria

Similarly, point man ascribed socio-economic status, ecological residence, and work type in the irrigational or agricultural sectors did not significantly predict episodes of malaria in this regression model. However, separate regression analyses of each of these predictor variables, except for work type, have shown a significant relationship with episodes of malaria. For example, a regression analysis between point man ascribed socio-economic status and episodes of malaria showed that people of lower socio-economic status are 2.5 times likely to experience high episodes of malaria than people of medium socio-economic status with a p-value <0.01. Similarly, people who reside in the non-irrigated villages are 2 times more likely to experience high episodes of malaria than people in the irrigated villages and 2.5 times than people in Mwea town with a p-value < 0.05.

To examine the association between socio-economic status and village of residence I conducted a chi-square test. This analysis is done to see if there is a relationship between socio-economic status of people and their place of residence. The association between the two variables is significant and clearly showed that a high proportion of low socio-economic status people live in non-irrigated villages than irrigated or urban areas.

Table 7-11. Association between point man ascribed SES and village of residence

SES		Residence			Total
		Non Irrigated	Irrigated	Urban	
Low Income	Count	56	55	9	120
		46.7%	45.8%	7.5%	100.0%
Middle Income	Count	33	64	30	127
		26.0%	50.4%	23.6%	100.0%
High Income	Count	1	1	1	3
		33.3%	33.3%	33.3%	100.0%
Total	Count	90	120	40	250
		36.0%	48.0%	16.0%	100.0%

Fisher's Exact Test P-value < 0.001

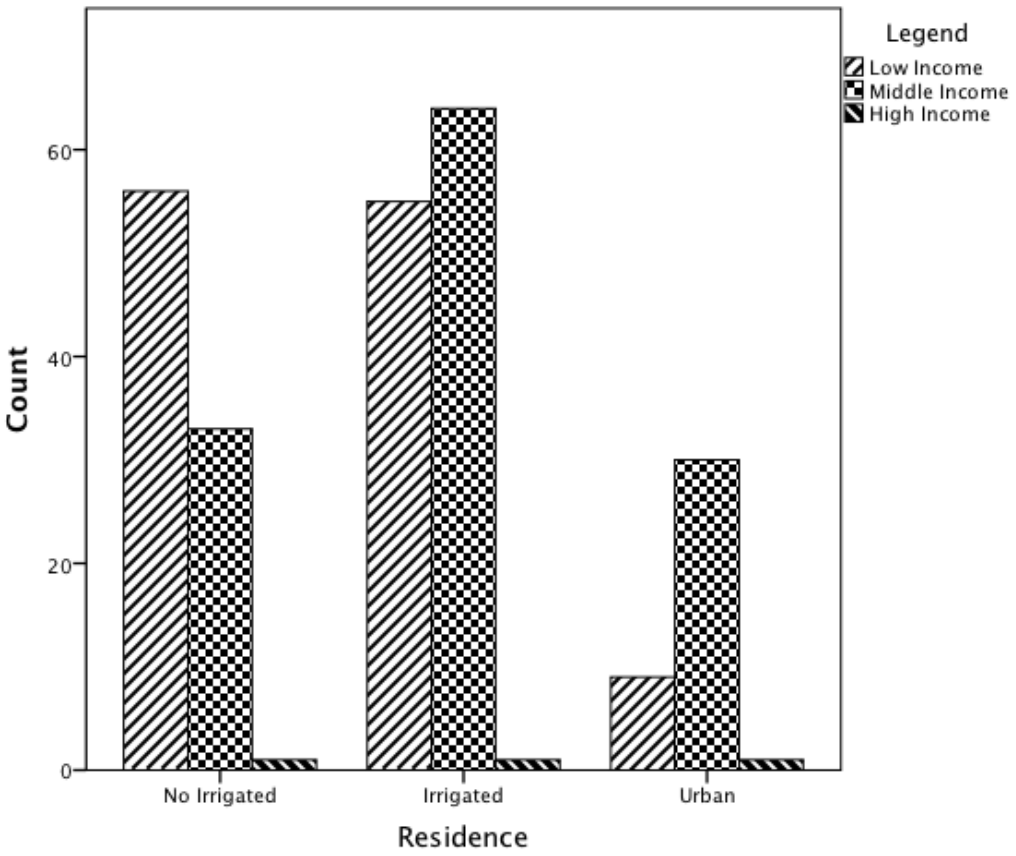


Figure 7-7. Bar chart of village of residence by point man ascribed socio-economic status

7.5 Testing the Relationship between Socio-Cultural and Ecological Variables with Malaria Treatment Seeking Behaviori In Mwea Division

Treatment-seeking behavior is an important health study in several non-western societies because people seek treatment from different sources for several reasons such as economic, accesses, and cultural. In Mwea division, like in many other societies in Africa tend to self-treat themselves either by buying drugs from drug stores or pharmacies or seek traditional treatment such as herbal and spiritual healing practices. However, people also seek treatment from hospitals and clinics.

To examine the pattern of treatment-seeking behavior in this division, I conducted both chi-square tests and regression analysis with all possible variables that

could potentially affect individuals' decisions to seek malaria treatment. Like in section 6.4, I ran a chi-square test with targeted variables against treatment-seeking behavior. All variables that show significant association were included into a regression model to see what best explain treatment-seeking behavior in these communities.

Table 7-12. Logistic regression analysis of malaria treatment-seeking behavior on standard covariates, landownership, distance to clinic/hospital (both time and metric distance measures), time wasted to receive care, village of residence, and point man ascribed socio-economic status (SES) (95% confidence interval).

Predictor variables	Unadjusted Odds ratio	Adjusted odds ratio
Nearest clinic/hospital		
<1km	Ref	Ref
5-9km	1.21	0.48*
>9km	0.00	0.00
How far clinic/hospital		
<1 hour	Ref	Ref
>2 hours	0.64	0.40*
Land ownership		
No land	Ref	
1-2 Hectares	0.342**	
>2 Hectares	0.75	
Point man ascribed SES		
Low	Ref	
Medium	3.11**	
High	1.03	
Residence		
No irrigated	Ref	
Irrigated	2.52*	
Urban	0.93	
Malaria avoidance		
No	Ref	Ref
Yes	1.2	1.93*
Cox and Snell R-square	0.157	
*p-value	<0.05	
**p-value	<0.01	
Hosmer and Lemeshow Test	0.89	

The results of the regression analysis, as shown in table 6-12, indicate that individual residence, point man ascribed socio-economic status, and land ownership in

hectares are the variables that best predict malaria treatment-seeking behavior with statistical significance. However, cultural belief of malaria can be avoided or prevented, and nearest hospital or hospital in kilometers and time were not significantly predictive of malaria treatment-seeking behavior when they are added in to the integrated regression model.

The odds of people without land to seek self-treatment is 2.94 times that of people who own 1 or 2 hectares of land with a p-value of <0.01. On the other hand the odds of people who reside in the irrigated villages are 2.5 times greater to seek self-treatment than people who live in non-irrigated regions with a p-value of <0.05.

Based on the point man ascribed socio-economic status, the odds of people of middle socio-economic status to seek self-treatment is 3 times than people of lower socio-economic status with a p-value of <0.01.

As the previous regression analysis, I ran all a one on one regression analysis against the outcome variable (treatment-seeking behavior) with all variables that did not show a significant result in the multiple variable regression model but have significant association.

The odds of people who live more than 5 kilometers from a health facility seek self-treatment 2 times than those who live less than 5 kilometers. Similarly, the odds of people who live about 2 hour away from a health facility seek self-treatment 2 times than those who live less than 1 hour away from a health facility. Both analyses are statistically significant with a p-value <0.05.

With regards to whether people believe malaria can be avoided in their division and their treatment-seeking behavior, the result one on one regression analysis showed

that the odds people who said yes malaria can be avoided in the district seek self-treatments 1.9 times more than people who believe malaria is unavoidable in their division.

In general the best variables that best predict treatment-seeking behavior are the one that showed significant p-value to explain treatment-seeking behavior when all factors that have significant association with the outcome variable are added in the integrated regression model. However, independently ran regression analyses of each independent variable showed a significant relationship as well.

7.6 The Distribution and Frequency of Malaria, Causes, Signs and Symptoms and Treatments.

The first phase of this dissertation project had uncovered several cultural beliefs on malaria causes that include both mosquito and non-mosquito causes. In the flowing tables, I present the frequency and percentages of these two malaria cause categories based on the survey data. The main goal of these descriptive statistical analyses is to examine if education and age are associated with cultural beliefs on malaria causes.

Table 7-13. Association between education and cultural beliefs of mosquito causes

Education		Mosquito causes		Total
		No	Yes	
No education	Count	13	12	25
	%	52.0%	48.0%	100.0%
Primary education	Count	26	103	129
	%	20.2%	79.8%	100.0%
Secondary education	Count	42	44	86
	%	48.8%	51.2%	100.0%
Tertiary education	Count	6	4	10
	%	60.0%	40.0%	100.0%
Total	Count	87	163	250
	%	34.8%	65.2%	100.0%

X^2 (3, 250) = 25.72, P-value <0.001

According to these analyses education is significantly associated with both cultural beliefs of malaria causes. The trend in cultural beliefs of mosquito causes

showed that a high percentage of people with both secondary and primary degrees believe mosquito as a cause of malaria but more than 50% people with no education and tertiary degree believe that mosquito does not cause malaria. Similarly, high percentages of people, with primary education (86%), believe on non-mosquito malaria causes. Close to 40% of the rest of educational categories believe non-mosquito malaria causes.

Table 7-14. Education and cultural beliefs on non-mosquito malaria causes (95% confidence interval)

			Non-mosquito causes		Total
			No	Yes	
Education	No education	Count	15	10	25
		%	60.0%	40.0%	100.0%
	Primary education	Count	43	86	129
		%	33.3%	66.7%	100.0%
	Secondary education	Count	48	38	86
		%	55.8%	44.2%	100.0%
	Tertiary education	Count	6	4	10
		%	60.0%	40.0%	100.0%
Total		Count	112	138	250
		%	44.8%	55.2%	100.0%

X^2 (3, 250) = 13.347, P-value =0.002

Table 7-15 Age and cultural belief on non-mosquito malaria causes (95% confidence interval)

			Non-mosquito causes		Total
			No	Yes	
Age	<30	Count	30	43	73
		%	41.1%	58.9%	100.0%
	31-55	Count	50	73	123
		%	40.7%	59.3%	100.0%
	>55	Count	32	22	54
		%	59.3%	40.7%	100.0%
Total		Count	112	138	250
		%	44.8%	55.2%	100.0%

X^2 (2, 250) = 5.827, P-value =0.054

Table 7-16. Age and individual belief on mosquito malaria causes (95% confidence interval)

			Mosquito causes		Total
			No	Yes	
Age	<30	Count	24	49	73
		%	32.9%	67.1%	100.0%
	31-55	Count	39	84	123
		%	31.7%	68.3%	100.0%
	>55	Count	24	30	54
		%	44.4%	55.6%	100.0%
Total		Count	87	163	250
		%	34.8%	65.2%	100.0%

X^2 (2, 250) = 2.851, P-value =0.240

However, as shown in table 7-15, age is only associated with cultural beliefs of non-mosquito causes. People younger than 30 years and people 31-55 years old have higher percentage of cultural beliefs of non-mosquito malaria causes than people older than 55 years old.

In addition to malaria causes, the survey stage included all the signs and symptoms identified in the free-listing stage of the ethnographic phase. The questionnaire, asked each informant who participated in the study a yes or no question for each signs and symptoms. The following table shows the frequency distribution of all signs and symptoms.

Table 7-17 Frequency of signs and symptoms of malaria

	Yes	%	No	%	Total
Fever	241	96.4	9	3.6	250
Joint weakness	243	97.2	7	2.8	250
Headache	246	98.4	4	1.6	250
Vomiting	234	93.4	16	6.4	250
Shivering	246	98.4	4	1.6	250
Backache	236	93.4	14	5.6	250
Dizziness	231	92.4	19	7.6	250
General body weakness	240	96	10	4	250
Stomachache	213	85.2	37	14.8	250
Loss of appetite	233	93.2	17	6.8	250
Constipation	124	49.6	126	50.4	250
Diarrhea	192	76.8	58	23.2	250

As shown in the table above most of the signs and symptoms received more than 90% Yes responses. Only Stomachache, constipation and Diarrhea got less than 90% Yes response at 85%, 49.6% and 76.8% respectively. Shivering, fever, headache, and joint weakness got the highest yes response rate than other signs and symptoms with more than more than 96%.

CHAPTER EIGHT
DISCUSSION OF ETHNOGRAPHIC AND SURVEY FINDINGS

8.1 Cultural Understanding of Malaria Causes in Mwea

Different communities in non-western societies attribute illness causation to several factors including natural and spiritual forces. In general, causal beliefs about illness among Mwea communities are attributed to natural causes that include several non-biomedical causes. Based on ethnographic observation and survey analysis, beliefs on malaria causes are influenced by education and age. The results from free-list analysis indicate that the main causes of malaria identified by people in Mwea includes mosquitoes (90.0 percent), mangoes (49.5 percent), exposure to cold (22.6 percent), stagnant water (22.6 percent), drinking dirty water (11.3 percent), drinking mosquito eggs (9.4 percent), bushes (9.4 percent), and four other additional factors constituting less than 5 percent. The survey data also showed a similar trajectory to the ethnographic data but slightly different. Sixty five percent of the 250 informants believe mosquito causes of malaria and 55% believe non-mosquito causes of malaria. Elderly (people older than 55) tend to believe in non-mosquito and mosquito malaria causes than other age groups. When it comes to education, people with primary and secondary degrees, believe more in non-mosquito and mosquito causes than people with tertiary degrees or people with no education. This is interesting because the frequency of biomedical causes of malaria actually diminish in the structured survey than in the successive free-listing enumeration. This is probably related to the nature of interview design. It could simply be related to the diverse but not well-defined knowledge of all these malaria causes in Mwea division.

For example, the mosquito, known in Kikuyu as *rwagie*, is the most mentioned malaria cause identified by people in Mwea. However, people's beliefs about how it contributes to malaria transmission tend to vary. Some informants believe mosquitos' carry "germs" from dirt, stagnant water, and fruits and bring the "germs" to their body. These "germs" could also get into the body through the skin or through drinking. Some people also believe that mosquitoes can transmit the disease from another malaria-infected person through biting and transmitting the malaria "germ." Traditionally, malaria is assumed to exist in the body persistently and, for some, forever by people in Mwea. It only needs triggering factors to show the symptoms of the sickness. A significant proportion (i.e., 62 percent) of the informants believe a single mosquito bite does not cause malaria. You have to be bitten several times because the body has to get a lot of "germs" to trigger malaria symptoms.

> When you get several mosquito bites and keep drinking the dirty water that has germs, then you become so ill and the malaria that was asymptomatic started to show up. Said by a 69 year-old male informant

The idea that malaria exists persistently in the body and does not go away is illustrated by the following informant's comment about malaria.

> A child can be born with malaria. Malaria transfers from the mother to the child. When my child was born, she was born with malaria and I think she got it from her mother before birth. Said by a 34 year-old male informant

However, this individual understanding of mother to child transmission is not the same, as the biomedical transmission of malaria from the mother to the child during pregnancy known as congenital malaria or placental malaria (Menendez et al.2000).

Mangoes and exposure to cold are the second most frequently mentioned non-mosquito causal factors for malaria. Exposure to cold is considered a triggering factor for symptoms of malaria. It becomes even more apparent if the person already has

some mild form of malaria. The chilling or the shivering effect of cold is considered to be a risk or triggering factor for malaria. Informants say that cold penetrates the body tissues and makes joints weak, thus causing shivering which automatically turns into malaria.

> Cold affects people who already have malaria. It increases the malaria quantity in their bodies. In this case the person has to vomit a yellow substance. If not, the person will continue to suffer from the disease. Said by a 40 year-old female informant.

Informants also identify mangoes as a cause of malaria. There are two explanations by people in Mwea why mangoes are risk factors. One explanation is mosquitoes bite the mangoes and suck the malaria "germs" and then transfer them to humans. The second explanation is related to the sour nature of mangoes. The sour taste triggers the gallbladder to release certain chemicals that cause malaria. This is also true for other sour-food types mentioned in the free-list like fermented milk and porridge.

> Eating raw mangoes is acidic. The acidic juice causes the gallbladder to rupture and then it becomes malaria. Said by a 30 year-old male informant

The other risk factors for malaria that were mentioned include water, fermented porridge, bushes, dirtiness, and wet fields. Stagnant water and bushes are a favorable breeding ground for mosquitoes, hence for "germs." Informants believe that these "germs" can directly or indirectly infect the human body via mosquitoes.

The intracultural variation of malaria causes is very small compared to the other top illnesses in the division. The small variation observed in the correspondence analysis could be related to age, education, and possibly gender. Focus groups, ethnographic data, and survey results indicate that most young and college-educated informants tend to have a very different causal model of illness from the rest the informants. Their concepts are very close to a biomedical model. However, in the

survey analysis only 40% of people with college degrees said mosquito causes malaria. Obviously this could be a result of small sample but it could possibly be that the colleges educated are thinking more of the underlying causes of the illnesses than the immediate cause. It could be possible that the cultural beliefs (they acquire from the community) about malaria causes among college educated people is much stronger (dominant) than the knowledge their acquire about malaria in school. However, focus groups and unstructured interviews show that there is a social stigma that is associated with the non-biomedical malaria causes that young people sometimes even deny their existence when you ask them if they know anyone who adheres to them. They believe it is something people believed and practiced in the past.

The cultural belief of malaria causes in Mwea has some unique characteristics compared to other studies conducted in Kenya and neighboring African countries. Most of the malaria causes in Mwea are from physical interaction between humans and the natural environment, known as “naturalistic” illness causation. However, this does not necessarily imply the causal model in this division is in full adherence to a biomedical model. The malaria model in this division overlaps with biomedical concepts, but it has also a non-biomedical component. Most people in Mwea see mosquitoes as the primary cause of malaria.

However, the malaria-mosquito link is not well understood in its biomedical sense. The mosquito-malaria transmission role becomes very unclear from a large proportion of the informants reports. Most people in this division also believe that there are other sources of causes of malaria that have nothing to do with mosquitoes or the malaria parasite, but are not associated with spiritual or supernatural causes either.

The co-existence of these two malaria explanatory models in this division makes it unique and is similar to the syncretism explanatory model of malaria put forth by Hausmann et al. (2002). Hausmann and his colleagues studied how biomedical knowledge of malaria is transmitted in health messages and co-exists, interacts, and merges with local pre-existing ideas among the Ifakara semi-urban community of southeastern Tanzania. Their findings show that people living in Ifakara have a mixed understanding of malaria, which include spiritual or divine elements, and biomedical, and seek different treatment options both from the hospital and traditional treatment.

There are several historical, social, and environmental characteristics that both Mwea and Ifakara communities share that probably influence their understanding of malaria. The first characteristic is both communities live in malaria-endemic areas. The second characteristic is that both communities have been historically exposed to biomedical knowledge and practices for so long. Ifakara and Mwea have been malaria research sites and centers in their respective countries for decades. Third, their respective medical systems allow people to choose different treatment options. Furthermore, Hausmann et al. (2002) also argue that these three characteristics are the hallmarks of medical syncretism and populations with these characteristics are more likely to have a more complex form of understanding about malaria.

As I indicated above, no spiritual or supernatural causation of malaria, whether in the free-list or ethnographic observation, was mentioned in Mwea. This is unique from other similar studies conducted in Kenya and in the wider region. For example, Nyamongo's (1999, 2002) research among the Gusii of southwestern Kenya indicated some attributes of the spiritual and supernatural that are associated with malaria

causes. Kamat (2008) and Langwick (2007) both found some aspects of supernatural causation of serious forms of malaria known as *degedege* in Tanzania. *Degedege* is caused by a coastal sprit in the form of a bird shedding its light on vulnerable children in the moonlight and can only be treated by spiritual healers (Kamat 2008). *Degedege* is considered a separate illness from malaria by lay people who believe anti-malaria injections worsen the illness (Langwick 2007, Comoro et al. 2003, Winch et al. 1995). Okeke et al. (2006) found that traditional healers and lay people among ethnic groups in southeastern Nigeria believe a spiritual cause of malaria occurs when someone comes in contact with an evil sprit.

Focus groups and unstructured interviews with key informants show that the ascription of malaria in Mwea changes with increases in the intensity and severity of the symptoms. The intensity and severity of malaria is associated, then, with an increase in the quantity of malaria "germs," which might lead the illness to progress into typhoid. This is also reflected in informants' health-seeking behavior. Typhoid is the most severe form of malaria, and people do not self-treat the disease but rather seek hospital treatment. However, this does not mean that typhoid is entirely caused by malaria. As shown in Figure 6-2 and Table 6-4, most people attribute typhoid causes to other factors. Nonetheless, this implies that the local understanding of the cause of malaria is related to the quantity of malaria "germs" in the body. This understanding might not be necessarily the same as a parasite load understanding of biomedicine. As noted by Nichter (2008), perception of the progression of illness is a common phenomenon in some cultures in Africa and around the world.

Results from the survey data support this ethnographic observation with 55% of the population of people believing excessive malaria causes typhoid. Testing the association between cultural beliefs on non-mosquito malaria causes and malaria to typhoid progression showed no association. However, individual belief of malaria to typhoid progression is significantly associated with age, gender, and education but regression analysis only show a significant relationship with gender. Women's beliefs on malaria to typhoid progression are higher than men's. Women's educational and mobility opportunities, access to resources, and decision making are more likely to make them culturally loyal and to hold more cultural beliefs than men.

8.2 Cultural Understanding of Malaria Signs and Symptoms in Mwea

Signs and symptoms are important in malaria studies because they are critical for determining treatment as well as malaria control measures. Understanding how people diagnose malaria and respond to it could have significant clinical and public health implications. This becomes even more important in communities where self-treatment is very common and other infectious illnesses are prevalent. In the absence of proper technology and malaria screening in clinics and hospitals in the developing world, health professionals can misdiagnose malaria and prescribe the wrong drug for the wrong disease. In addition, clinical malaria symptoms could be classified into several distinct illnesses by lay people. Based on the severity of the symptoms, lay people might also see malaria progress into another category.

My study in Mwea also has similar characteristics to what has been observed in various parts of Africa by (Nichter 2008, Font et al. 2001, Olaleye et al. 1998 and others) showing that illness misdiagnosis and confusing one illness with other illnesses is a major health challenge. More specifically the cultural understanding of malaria

signs and symptoms is consistent with what has been reported in other malaria studies in Kenya and neighboring countries (Nayamnogo 1999, Mwenesi et al. 1995, Kamat 2006, Ng'anga et al. 2009). However, this study further explores systematically the complexity and challenges of understanding the signs and symptoms of malaria in relation to other common illnesses in the division. The successive free-listing section of this study is designed to examine how informants' diagnoses of malaria overlap with other infectious illnesses they listed. Most informants' first suspicions of any sickness is malaria. This is because malaria is an endemic disease in this division due to the presence of rice irrigation. In addition to anti-malaria campaigning and other media publicity, public perception has heightened.

As you can see, in Figure 6-3 there is an overlapping of signs and symptoms, at least among three of the four illnesses on which the study focuses (i.e., malaria, worms, and typhoid). As in any malaria-endemic region in Africa, signs and symptoms are very important because informants believe that their treatment-seeking behavior is determined by the signs and symptoms of the illness and not by causes. Informants think that typhoid and malaria are linked and that they have similar characteristics. The later manifests the more severe forms of the shared signs and symptoms. Even though informants think ascribing an illness based on signs and symptoms is not a big problem, this study and others show how complicated ascribing an illness can be.

As demonstrated in Figure 6-3, general body weakness, vomiting, shivering, fever, headache, joint weakness, and backache are the most frequently mentioned signs and symptoms of malaria. Some of these signs and symptoms are also mentioned by the informants in the other three top illnesses. Shivering, vomiting, fever, headache,

backache, and joint weakness are exclusively associated with malaria. Malaria shares nausea and dizziness with typhoid. Typhoid also shares stomachache, diarrhea, and constipation with worms. Ringworms, scratching, rashes, and bloating are exclusively associated with worms. Typhoid is in between worms and malaria, but slightly closer to malaria. However, there is still enough room to confuse malaria with any of the common illnesses prevalent in the division.

When we talk of malaria, generally informants think shivering and fever are critical to assign the illness as malaria. Nonetheless, informants also admit that because of the prevalence of malaria people are quick to assign any illness that has any of the signs mentioned as malaria. In fact, other illnesses could be easily missed because people in the community feel that malaria is quite prevalent and it is their primary concern. Vomiting is seen as a sign of relief and indicates the person is getting better.

> If I have a headache and feeling weak, I do not doubt it is malaria, even if my body does not have fever or shivering. What else can it be? Malaria is everywhere in this area! said by a 76 year-old village chief

This kind of public concern and anxiety about malaria is probably also reinforced by the continuous campaign against malaria by governmental and private institutions. These campaigns might have created a notion among the public that malaria is inevitable and its causes ubiquitous. Anti-malaria campaigns are important, but they can have a negative effect if the message is not culturally sensitive and locally meaningful. For example, in the Mwea case, if the anti-malaria campaign only focuses on mosquitoes, people might think it is very difficult to eradicate mosquitoes and it is unachievable. In fact, this is a widely held belief among the Mwea communities (see results chapter 5 section 6.3 and the discussion below). At the same time, people think

malaria is caused by other factors such as mangoes, cold, and dirty water, so even if you stop mosquitoes, these factors still could cause malaria.

In this study, the intracultural variation of malaria is very small compared with other top illnesses. However, this does not imply that lay people's malaria self-diagnosis is consistent and accurate. Despite the absence of a major variation among individuals, people could still confuse malaria with typhoid, worms, or possibly with TB. Furthermore, it is not only confusing malaria with other illness, but also confusing other illnesses with malaria.

The result of the survey analyses also shows that even though more than 90% of people mentioned fever, shivering, and headache as the symptoms of malaria, the other sings and symptoms that are not technically clinical malaria signs such as dizziness, diarrhea, stomachache, and constipation are mentioned between 50%-90%. Therefore, cultural understanding of malaria signs and symptoms includes both the biomedical signs of the illnesses and beyond.

Analysis of public perception of whether malaria can be avoided in the division showed majority of people (67.6%) believe malaria is unavoidable. This means that most people believe malaria is unpreventable but treatable. People in the division do not think of eradication of malaria as possible but treat it when it is contracted. A chi-square test between age and this cultural belief shows no significant association, which means age has no influence on this belief system. However, there is a significant relationship between education and cultural beliefs of malaria avoidance, that people with no education are more likely to believe malaria is unavoidable in the division. Education

helps people to some extent to have a more defined knowledge of malaria and people can easily understand and accept malaria public education and campaigns.

The results and the informants' testimonies provide important information about the patterns of self-diagnosis and treatment. Beyond the complication of assigning an illness, this shows that public understanding and diagnosis of the illness differs substantially from the biomedical model. Therefore, the sharing and overlap of symptoms among the four common illnesses has significant health implications particularly for treatment seeking behavior where the course of treatment may be chosen based on symptomology rather than laboratory testing. Any assumption that people will correctly perceive and diagnose malaria in biomedical terms is not always true.

General public perception is that other illnesses are not considered a big threat or exist at very small rates as compared to malaria. Besides being a major illness, people choose various forms of medication for their sicknesses, starting with herbalists to hospital treatment. Informants feel that malaria has co-existed with them for centuries, and it will continue to co-exist; moreover, it is important for them to mobilize sufficient resources to treat malaria when they become ill. Despite some challenges, the current array of practices associated with malaria in Mwea is based on an accumulation of knowledge that draws its origins from different cultures and times. Therefore, understanding these for appropriate malaria intervention is paramount.

8.3 Cultural Beliefs about Malaria Treatment and the Treatment-Seeking Behavior in Mwea

Malaria self-medication is a worldwide practice. The reasons for self-medication include distance, cost, and cultural belief systems (Foster 1995,Mwenesi et al.1995). In

several African communities, most self-treatment occurs at home, using drugs from pharmacies (Jones and Williams 2004, Mwenesi et al. 1995, Okeke et al. 2006). Furthermore, local communities and health workers may have different priorities, and perception of severity and vulnerability to an illness (Young in press). For example, malaria treatment studies among children in the Kifili district of Kenya showed that people do not believe malaria is preventable, but that it is treatable (Mwenesi et al. 1995). This is also the case in Mwea communities. Similar to the worldwide phenomena, in most cases Mwea informants' treatment-seeking behavior is determined by the perceived severity of the illness, access to health care, and the cost of health care. Almost all of the informants think that the severity of the illness is important in deciding whether to self-treat the disease or go to the hospital. This study shows that while most people seek biomedical treatment for most illnesses, this might not include going to a hospital and/or visiting a doctor. Most people self-treat and get their drugs from informal sectors such as shops, chemists, and pharmacies. As shown in table 5, malaria presents a more diversified range of treatment options among the four salient illnesses.

People still use herbal medications, either obtained by themselves or from professional herbalist. Talking to herbalists and informants shows that herbal use is common in the community, especially in remote villages, and for people who cannot afford to pay hospital fees. Others prefer taking herbal medicines because they do not like to go to a hospital or take biomedical drugs. It is still interesting to ask why malaria has more diversified treatment options than other illnesses. One plausible explanation would be that malaria has existed as a major illness in the region for centuries. People

were thus able to acquire different treatment options on their own, or borrowed from other societies over many years.

The micropolitics of the diagnosis and treatment of malaria and other infectious illnesses is also very important. Micropoltics in this case implies that there is variation in terms of how each family deals with an illness (Nyamongo 1998). For example, a mother or a father in most cases makes those important decisions for all family members. Even though there is individual- or family-based variation in diagnosis and treatment what is probably unique about this community is the urgent and quick decisions people make for treatment. In most instances, whenever symptoms worsen and the treatment from the pharmacy/chemist is no longer working (self-treatment), people go to the hospital immediately. This health treatment-seeking behavior shortens the time and steps that might have been taken by other communities to deal with the illness. This is because Mwea communities have relatively more treatment options compared with other neighboring communities or any average administrative division in sub-saharan Africa. In general, in rural communities where resources and health options are limited, people treat the illnesses at home, while looking for other treatment options (Nyamongo 2002). Furthermore, anti-malaria campaigns have been conducted by the Kenyan Medical Research Institute (KEMRI) and the Ministry of Health in Mwea that could influence the awareness and treatment seeking behavior in this division. Therefore, the availability of relatively good treatment options and campaigning probably resulted in the diminishment of traditional (spiritual) views of illnesses in these communities. In addition, elderly informants talk about the legal and political discrimination against traditional belief systems during the colonial and post-colonial

periods. Therefore, even though most people seek biomedical treatment, in most cases it is not used correctly. For example, some people do not visit hospitals at the right time; in most cases, medications are not used properly; people take the wrong medication for a specific illness; and people sometimes get medication from unreliable sources.

In general the treatment-seeking behavior in the Mwea community follows three routes. The first route is to go pharmacies and treat the illness and if doesn't get better or get worse then you go to a hospital. The second route is to go to a herbalist or use herbs and if the illnesses does not go way or get worse then you go to hospital. The third and final route is to go directly to hospital and seek doctor's treatment.

Results from the ethnographic data show that about 83 percent (44 out of the 53 informants) reported their treatment-seeking behavior follows the pharmacy/chemist to hospital route. Close to 40 percent (21 out of 53) of the informants said they would try herbal treatment before they would go to a hospital. Only 18 percent (10 out of 53) of the informants said that they would seek direct hospital treatment if they get sick. Different types of herbs are mentioned by informants as treatments for illnesses, mostly malaria and, to a lesser degree, worms.

> Herbs sweat you and diarrheal you. That way, they clean the disease from the body and they also give you strength. Said by an 80 year-old female informant

Similarly, the survey analysis showed that 62.8% of the 250 people surveyed mentioned they use self-treatment and only 37.2 % of them use hospital treatment. These show people in the division use both drugs from stores and pharmacies and herbs for treatment. A substantial portion of the population does not go to the hospital for treatment until the illness is considered serious. This treatment-seeking behavior could have major health consequences, such as delays in disease reduction, disease

elimination, or saving lives from acute illnesses. Delay in seeking hospital treatment can result in the development of drug-resistant disease parasites.

In this case, drug efficacy is one important consequence of the self-treatment behavior. We do not know if the drug is being used for the right disease or the specific dosage people are taking for a specific disease episode. Jones and Williams (2004) expressed self-treatment as the single cause for anti-malaria drug resistance in Africa and concluded that this has compromised the reduction or elimination effort in several parts of the continent. Furthermore, as documented by (Nayyar 2012, Amin et al.2005, Thoithi et al. 2008, and Atemnkeng et al. 2007, and Kibwage 2005) most of the drugs available in the market in Kenya and other sub-Saharan African countries are low quality drugs that even worsen the emergence and re-emergence of drug resistant strains of the malaria parasite.

Further investigation with the survey data to test what socio-cultural and ecological factors predict malaria treatment-seeking behavior in Mwea showed that economic and ecological factors are among the main reason why people seek-self treatment. Access to resources and distance to hospitals and health clinics are major constraints in Mwea division. People in remote villages and people with out land, and people of low socio-economic status are negatively affected by malaria and are more likely to seek self-treatment than going to hospitals. One finding that slightly differs from the others is the result on village of residence that showed more people in the irrigated villages seek-self treatment than people in non-irrigated villages. The two major hospitals and other private clinics in the division are in Mwea town, closer to many of the irrigated villages than to non-irrigated villages. This result might show the

importance of cultural beliefs people hold with regards to biomedical treatment in general and the nature of doctor and patient interaction. We know most poor segment of the population live in the non-irrigated villages than in irrigated villages. However, we also know that Mwea has relatively better health facilities compared to any average sub-Saharan African administrative division (but most of the health facility are very far from the non-irrigated villages). Even though it is not the majority of the people but there is a general understanding within the public that doctors do not correctly diagnose malaria and prescribe them the right medication. For example, 36% of the 250 people surveyed believe doctors do not correctly diagnose malaria and prescribe them with medication they feel will treat the illness. Similarly, 26% of the surveyed people feel uncomfortable seeing a doctor. Therefore, in addition to structural reasons, cultural reasons could also contribute to the preference of self-treatment and contribute to challenges in the eradication of malaria in the division.

Therefore, based on the ethnographic and survey analysis socio-economic status measured in land ownership, point man ascribed socio-economic status, distance to health facilities, and time wasted in hospitals to receive care are considered among the most important reasons why people seek self-treatment. However, cultural beliefs such as the incompetence of doctors to treat the illnesses, the broader non-biomedical beliefs of malaria, and the lack of well-defined knowledge of the biomedical causation and diagnosis of the illness also contribute to malaria treatment-seeking behavior in the community. The findings of these researches supports the economic or structural arguments of malaria treatment-seeking behavior advocated by (Foster 1995, Nyamongo 2002,Packard 1986, Chuma et al. 2006, Dike et al 2006 and others) and

cultural belief argument forwarded by (Mwenesi et al. 1995, Kamat 2008, Nichter 2008, and others). Overall this research indicates the interaction between several factors plays into people's treatment-seeking behavior.

8.4 Gender Roles and Malaria Risk in Mwea Division

As outlined in chapter 4 women and men have different culturally prescribed roles in agriculture and households in most sub-Saharan African societies and other developing world. The current social, economic and cultural arrangements in general in these countries have a major impact on gender health disparities. Both agricultural and non-agricultural sectors could affect the health of men and women differently. Some studies have shown that women are at greater risk of contracting malaria than men (Ghebreyesus et al. 2000. Lampietti, et al, 1999, WHO 2007), however, how and why this malaria health disparity occurs are systematically unexplored research questions. This dissertation made a systematic examination of the cultural understanding of why and how women are at a greater risk of malaria. As shown both in the ethnographic and survey results, women disproportionately suffer from malaria in Mwea division. Annual malaria reports from 2008-2010 in Kimimbibi sub hospital also show that women have higher incidence and prevalence rates of malaria than men. In all measures the results indicate that the relationship between gender and malaria health outcomes is very strong. The reasons why women are at greater risk of malaria encompass both economic and occupational risks related to gender roles that exist in these agricultural communities. As the results shows women carry out most of the wet aspect (62.3%) of the rice irrigation in this division, which include weeding, and rice planting. However, the survey result show close to 39% of men said they work in both wet and dry jobs, ethnographic result, and my own observation in the agricultural field contradict this

result. Throughout my stay in the field, I rarely saw a man weeding or planting rice and similarly, none of the informants in the unstructured interview mentioned this and no one in the focus group argued when women said the nature of their work in the rice field makes them more vulnerable to malaria than men. Therefore, the kind of work they do in the field is associated to women's malaria health outcomes in the division. The other reason is that women are relatively poor and cannot afford to seek treatment in both public and private clinics or even buy drugs from pharmacies. Even if they report that they have land or belong to a medium or high-income category decision-making about treatment and access to other important health resources is in most cases out of their control.

However, more importantly, how men and women see women's malaria risk is a critical research question that is hardly addressed in previous research. As shown in the text analysis men and women's understanding of why women are at a greater risk of malaria, shows the biological and socio-cultural reasoning divide that existed for years between biomedical and social or behavioral sciences. As text analysis indicates most men think women's biological weakness is to blame for their malaria burden, however, women believe their malaria risk is related to their roles in the agricultural field and lack of resources when the need for treatment arise. Previous studies by Dike et al. 2006, WHO 2007, Chuma et al. 2006 and others support the women's reasoning of women's higher malaria burden in the Mwea division. These previous studies indicate that structural, cultural, and ecological forces constrain women from attaining the same level of malaria health outcome as men in most developing world especially in African countries. Women are the largest labor force in the Mwea irrigation sector, the most

viable economic sector in the division; however, they have very little control over resources (with the exception of store owners that trade the rice outside of the division). Despite the existence of a strong legal system that protects women's right in Kenya, in most cases, cultural beliefs override the legal systems and domestic abuses are not reported. These cultural beliefs provide men power to make decision in the household and beyond, which means produced agricultural products are usually managed by men in the household.

8.5 What Best Predicts Episodes of Malaria in the Mwea Division?

Socio-cultural and ecological factors are important in shaping the epidemiology of malaria in most tropical developing worlds. However, an integrative approach to systematically investigate the effect or contribution of each factor to malaria problem has been generally lacking. Despite its own limitations (as listed below), this dissertation analyzed the effects of several socio-cultural and ecological factors on malaria heath outcomes in the Mwea division. The integrated logistic regression analysis results clearly show that age, gender, and socio-economic status, access to health care, and ecological factors are among the most important factors that influence an individual's malaria health outcome in the division. Older people and women are at greater risk of malaria than any other demographic group. From a socio-cultural perspective, while there is more information as to why women experience higher episodes of malaria (as explained in the gender and malaria section), there is no clear evidence as to why older people experience higher episodes of malaria than young people. The reason could simply be a biological reason that older people are immunologically compromised or it could simply be cultural that older people hold more traditional and non-biomedical perspectives of malaria than young people and are less likely to seek biomedical

treatment. In fact, my observation is that I saw a lot of older people at the herbal clinic taking malaria medication. The herbal clinic doctor said most of his clients are older people who strongly believe in herbal treatments. Besides that unlike the pharmacies and hospitals, most of the herbal doctors do not require their clients to pay immediately. This does not mean that traditional treatments are not effective but in the presence of other illnesses in the district the accuracy of diagnosis and the prescription of drug dosage could hinder treating the targeted illness effectively.

Figure 8-1. Herbal treatment clinics in Mwea town

Besides age and gender, economic status and access to health care as well as village of residence are associated with people's risk to malaria. For example, people of

lower socio-economic status and people who wait about 2 hours to get care experience higher episodes of malaria than people who wait less than an hour to get treatment. Therefore, there is a strong economic argument to be made with regards to the malaria risk in Mwea.

The survey analysis also indicted that people who live in non-irrigated villages have higher episodes of malaria than people in the irrigated villages and Mwea town. There are several reasons why people from non-irrigated villages show high episodes of malaria. One of the reasons is poverty. Based on point-man ascribed socio-economic status 62% of people in the irrigated villages are poor compared to 45% of people in the irrigated villages and only 22% of people in Mwea town. Land ownership also show a similar result that about 48% of people in the non-irrigated villages do not have land compared to 39% in the irrigated village and 30% in Mwea town. Land ownership in the irrigated villages is more profitable than in non-irrigated villages because of water availability and rice irrigation. The second reason is access to healthcare. All hospitals and private clinics are based in Mwea town closer to the irrigated villages than to non-irrigated villages. The third reason is that most people from the irrigated villages work as labors in the rice irrigation fields and are exposed to malaria and other water borne illnesses. This result shows that the ecological factors might not be an important factor to malaria risk in the face of poverty and access to health care. Therefore, poverty and access to health care are more important to malaria health outcomes than whether people live in irrigated or non-irrigated villages.

Even though the regression analysis shows no significant relationships between village of residence and the nearest hospital, it indirectly demonstrates that distance to

health care in fact matters because people in non-irrigated villages show higher episodes of malaria than people in the irrigated villages and Mwea town.

Generally, the results of this study support the economic and structural argument of malaria risk forwarded by (Acemolgu et al. 2003, Malaney et al. 2004 and Humphrey 2001, Packard 2007, Leatherman and Goodman 2011, and others). Poverty and access to healthcare greatly contribute to people's exposure to malaria and the social and biological consequences of this illness in Mwea. Even in the irrigated villages, despite the presence of health care, people might not be able to afford the treatment.

Therefore, the impact of poverty, access to health care and place of residence that is closely associated to malaria health outcome in Mwea can best be explained by critical biocultural anthropological theory forwarded by Leatherman and Goodman (2011) who advocate the examination of how political-economic and socio-cultural forces can shape the health and biological outcome in populations. The historical injustice, the current economic arrangement in one of the largest rice irrigation fields in east Africa, and lack of well funded public health infrastructure in Mwea continue to affect the reduction and elimination of malaria and other infectious illnesses in the division.

Overall the result of this study contributes to the growing trend for the consideration of local concepts and understanding and responses to illnesses. This dissertation shows that concepts such as "causation", "diagnosis" and "treatment" to malaria are conceptualized and operationalized differently from the biomedical knowledge or hybridized with it. Furthermore, this raises some important questions about malaria research in non-western settings and the contribution of these questions

in designing appropriate malaria intervention public policies. These intervention policies could target both the clinical encounter between patients and doctors and the larger structures of public health in the division and beyond. Furthermore, this dissertation contributes to the debate of whether irrigation, as an ecological variable, is a malaria risk or not.

However, this research also has its own limitations. First it leaves out children, a major demographic group, severely affected by malaria. According to hospital reports the mortality and morbidity rate of children is the highest among all demographic groups in Mwea. Second, this dissertation lacks the application of much robust cultural domain analysis methods, such as pile sorting, ranking and triads, which directly measure the similarity and differences within and among illnesses. These cultural domain methods are more powerful to detect the intracultural variation within malaria and the relationship of malaria with the other common illnesses, than using the free-list data. Third, despite a common practice in social science research to use categorical data in statistical analysis it is worth mentioning that you lose statistical power when you categorize a continuous variable, which this research used in few variables. Finally, episodes of malaria are measured based on individual reports not based on hospital medical records of the patients. It is possible that individuals might not be able to remember their malaria experience over 12 months.

CHAPTER NINE
CONCLUSION

Malaria is a major health problem in several developing worlds claiming the lives of a million people every year in these developing worlds, especially in Sub-saharan Africa. This dissertation employed a systematic ethnographic and epidemiological survey research approach to understand the socio-cultural and ecological factors of malaria transmission in Mwea division. Mwea communities of central Kenya are ideal for this study since they share the characteristics of many African populations where poverty and social inequality is still a major problem. There is also an environmental malaria risk created by the rice irrigation and the presence of swamps throughout the year. Malaria is generally an endemic to the Mwea communities and historically populations that are politically marginalized during the British colonial system. People today still benefit from the irrigation only marginally. Furthermore, the region has experienced an immigration influx to work in the rice agricultural sector from some poor segments of the Kenyan population that exacerbated the malaria problem.

The ethnographic approach in this dissertation involves participant observation, focus groups, and unstructured interview with key informants, and successive free-listing method. This ethnographic exploratory phase focused on defining the cultural models of malaria causation, diagnosis, and treatment. The ethnographic data was used to explore the relationship between malaria and other common illnesses in the district. It examined the intracultural variations that exist within the four major illnesses included in the study.

The epidemiological survey data was employed to collect data on demographic, socio-cultural, and ecological variables that potentially influence individuals' malaria risk

in the Mwea division. The main goal of the survey data was to explore the association and relationships between the different demographic, socio-cultural and ecological variables of malaria health outcomes and malaria treatment-seeking behavior in the Mwea division.

The cultural belief about malaria causation in Mwea includes both biomedical and non-biomedical causation. The non-biomedical malaria causation does not involve spiritual or supernatural causation. Public understanding of the biomedical malaria causation is not well defined and in most cases the mechanism of mosquito malaria causation does not concur with the biomedical model.

Similarly, people's understanding of malaria signs and symptoms overlap with other common illnesses in Mwea making it difficult to accurately diagnose the illnesses and seek the right treatment at the right time. Furthermore, there is a general perception in the community that any sickness is considered malaria and people rush to take anti-malaria drugs from unreliable treatment sources.

The treatment-seeking behavior in Mwea is similar to what has been reported in other parts of the African continent. Self-treatment is the most common treatment that involves drugs from pharmacies and chemist, and from traditional herbal centers. Very small people seek hospital treatment at the onset of sickness. Most people do not go to the hospital until the illness get serious or all self-treatment options fail.

From the survey analysis, Mwea communities understanding, diagnoses, treatment seeking-behavior and their malaria health outcomes are related to their socio-economic status, access to health care, and gender. Gender as a major social factor that is strongly related to malaria health outcomes, showing women disproportionately

carry the malaria burden in Mwea. Most importantly while men and women believe women are at greater risk of malaria they differ on why women experience higher episodes of malaria. Women's higher malaria burden is possibly associated with their role in irrigation, in the household and in society in general.

While irrigation might be a factor in malaria risk, the regression analysis in this dissertation show that socio-economic factors, gender, and access to health care are among the most important factors that influence the malaria health outcome in Mwea.

The result of this dissertation supports the ongoing dialogue by social scientists who voiced that current malaria treatment and eradication programs are unsustainable because they failed to understand and consider cultural understandings of malaria and local responses to the illness. This study provides a systematic overall picture of the local understanding of malaria causes, symptoms, and treatment practices in the Mwea division using the mentioned ethnographically grounded empirical research. Most importantly this dissertation demonstrates the gender and socio-economic implication for malaria risk in Mwea community. Furthermore, the cultural construction of malaria and its management in Mwea provides convincing evidence that socio-cultural factors do matter in malaria treatment and prevention efforts. Uncovering the various causes of malaria, the complex nature of ascribing illnesses, and the different treatment of illnesses in Mwea are very important, especially in malaria intervention and the development of prevention strategies. Public health officers, doctors, and policy makers can benefit from these results to design appropriate public health and clinical policies that reflect the local and cultural context.

Future research in the region should focus on how these cultural belief systems about malaria causation, diagnosis, and treatment influence children's malaria health outcomes. Similarly, it should examine how socio-cultural and ecological variables are related to more clinically and laboratory confirmed health outcomes in Mwea with larger samples. Future research direction in Mwea should strengthen the collaboration between different stakeholders including the local population, government agencies, international donors, and diverse scientific disciplines to alleviate malaria and other infectious illnesses.

APPENDIX A
LIST OF CURRENTLY COMPILED VARIABLES FROM SURVEY DATA

Demographic Variables (N=250)	*Type of Data*	*coded*
Age	Categorical	<30, 31-55, and >55
Gender	Categorical	F/M
Socio-economic status	Categorical	Low, Medium, High
Education status	Categorical	No education, Primary education, Secondary education, and Tertiary education
Occupational status	Categorical	Farmer, Teacher, police, student etc.
Work type in the rice field	Categorical	Weeding, planting, harvesting, plow, threshing/ loading, and cereal transportation.
Environmental variables		
Distance between residence and hospital	Continuous	Km
Travel time to the hospital	Categorical	< 1 hour, ~ 2 hours, and > 2 hours.
Village of residence	Categorical	Irrigated/non-irrigated
Nearest water source	Continuous	In meters
Sociocultural variables		
Cultural belief of malaria causes	Categorical	Mosquito and non-mosquito
Perception of doctor's competency	Categorical	Yes /No
Perception of malaria avoidance/prevention	Categorical	Yes/No
Perception of progression of malaria to typhoid	Categorical	Yes/No
Treatment seeking and health outcomes		
Episodes of malaria	Categorical	Low/High
Treatment seeking	Categorical	Self-treatment/hospital

APPENDIX B
SURVEY TOOL USED FOR DATA COLLECTION IN 2011

Socio-cultural and environmental risk factors for Malaria infection in Mwea Division of Central Kenya

Structured Survey Questionnaire

ID#_____

A) Demographic information/Maundu ma umundu

1. Village____ Gichagi
2. Age :_____Miaka
3. Sex: gwato
   - ☐ Male Mundurume……1
   - ☐ Female Mutumia……0

4. Occupation: Wera
   - ☐ Farmer Murimi……..1
   - ☐ Businessmen/women, Mwanabiashara……2
   - ☐ Student Murutuo……3
   - ☐ Housewife -Mutumia wa mawira ma mucii……..4
   - ☐ Government employee muruti wira wa thirikari……5

5. If you are farmer do you work in the rice irrigation field?/ Angikoruo wi murimi ,urutaga wira wa urimi wa muchere na mai
   - ☐ Yes / Niguo [***skip to question 7***]……1
   - ☐ No / Tiguo [***continue to question 6***]……0

6. If no, where do you normally farm? Angikoruo tiguo, wii urimaga atia?
   - ☐ Vegetable fields / migunda ya mboga……1
   - ☐ Fruit fields Migunda ya matunda……2
   - ☐ Maize fields Migunda ya bebe……..3.
   - ☐ Other Kindu kienge_____……77

7. If you work in the irrigation field which one of the following do you usually do? Ko urutaga wera migundaine ya maii ni wera uriko urutaga?
   - ☐ Weeding / Riya……..1
   - ☐ Planting / Kuhanda……2
   - ☐ Harvesting / Magetha……3
   - ☐ Threshing and loading / Gutinia mahuti na kungania……..4
   - ☐ Plough / Kurima Kwa Murau……5
   - ☐ Transportation of the cereal / Gukua kwa magetha ma mahuti……6

8. Marital status: Niuguranite kana Nduguranite

- ☐ Married / Nihikanitie……1
- ☐ Single / Ndihikanitie……..2
- ☐ Widowed/ Ninguithitie……..3
- ☐ Divorced/ Nitutiganite……4
- ☐ Separated ……5
- ☐ Cohabiting……6

9. Number of children currently living with you_____: Ciana iria cikaraga nawe
10. Socio-economic Status: / Uhoro wa mundu guthii na mbere na maendeleo kana gutherema

10a. Self-ascription –Umundu waku mwenyewe

- ☐ Low income / mierenamo mikunderu……1
- ☐ Middle income/ mieranamo ya gatagate……..2
- ☐ High income/mieranamo ya utonga……..3
- ☐

10b. Point man ascription-Wikinyia wa mundu

- ☐ Low-income/mierenamo mikunderu……1
- ☐ Middle-income/mieranamo ya gatagate……2
- ☐ High-income/ mieranamo ya utonga……..3

11. Education: Githomo

- ☐ No education /Githomo hatire……1
- ☐ Primary education /Githomo kia unini……2
- ☐ Secondary education /Githomo kia gatagate……3
- ☐ Tertiary education/Githomo kia unene……..4

12. How many livestock are there living in your compound_____: /Wina makiria mahiu maita makiria mamatatu thiinii wa iriuku/githaku giaku
13. Do you have chicken living with you in the house? /Wina nguku cikara gwaku nyumab

- ☐ Yes/Niguo……1
- ☐ No/Tiguo……....0

14. How many hectares/acres of land do you own? Mugunda waku ni ika cigana

- ☐ None……1
- ☐ Less than one hectar/acre……2
- ☐ One hectares / ika imwe……...3
- ☐ Two hectares/ika igere……..4
- ☐ Three hectares/ika thatu……5
- ☐ More than 3 hectares/ika ithatu na makeria. ……6

B) Environmental and Structural factors information / Mohoro na mikire yamaundu maria matuthurukiirie

15. Village: ituura
    - ☐ Irrigated/ uhei mai wamimera……1
    - ☐ Non-irrigated kuaga kuhe maii mimera……...0
16. Nearest water source in meters:_____
17. Housing condition: Miikarire
    - ☐ Stone wall/ rugiri rua ihiga……..1
    - ☐ Mud with grass roof/muturiro rua ndaka na nyeki……...2
    - ☐ Mud with iron sheet roof/rugiri rua shuma…….3
    - ☐ Grass/Nyeki……4
    - ☐ Other / Kindu kenge ……...77
18. Mosquito bed net: Gitanda kia neti
    - ☐ Present/Reo reo……1
    - ☐ Absent/Gutire……...0
19. Use of mosquito bed net: Miitumire ya gitanda kia neti.
    - ☐ Never/Ndareatumera……1
    - ☐ Sometime/ renge na renge……2
    - ☐ Most of the time / muno makeria…….3
20. Do you think mosquito bed net is effective to prevent malaria?Gitanda kia neti nikigiragereria murimo wa ruage.
    - ☐ Yes/Niguo……1
    - ☐ No/Tiguo……0
21. Nearest health hospital in Kilometers_____. Ni thibitare ireko ihakuhe uthimete?
22. How long does it take to the hospital? Woya mathaa maigana gukinya thibitare
    - ☐ Less than one hour/ hakuhe itha. ……1
    - ☐ About 2 hours/ta mathaa mere……..2
    - ☐ More than 2 hours/ mathere mere na makeria……..3
23. How many hours do you wait for care? Wetagerera mathaa magaina kuona dagitari?
    - ☐ Less than one hour/ hakuhe itha……1
    - ☐ About 2 hours/ ta mathaa mere……...2
    - ☐ More than 2 hours/ mathere mere na makeria……3

C. Malaria information / uhoro wa mariiria?

24. Does …. Cause malaria? / Ruagi nirurehaha mariira?

a. Mosquito / ruagi
    - ☐ Yes / Niguo……...1
    - ☐ No / Tiguo……..0

b. Mangoes / maembe
    - ☐ Yes / Niguo……1
    - ☐ No / tiguo……0

c. Fermented porridge / curu wamugagatio

- ☐ Yes / Niguo……1
- ☐ No /Aca tiguo……...0

d. Drinking mosquito eggs Kunyua matumbi ma ruagi

- ☐ Yes / Niguo……1
- ☐ No / Aaca tiguo……..0

e. Stagnant water / Maii mamiaraho

- ☐ Yes / Niguo……1
- ☐ No / Aca tiguo……0

f. exposure to cold / Kuhuruo niheho

- ☐ Yes / Niguo ……1
- ☐ No / Tiguo……...0

g. wet field / mugunda wi nambura

- ☐ Yes / Niguo ……1
- ☐ No/ Tiguo……0

h. Eating dirty food / kuria irio cii na giko

- ☐ Yes / Niguo ……1
- ☐ No / tiguo……0

25. Does excessive malaria cause typhoid? / Wuingi wa mariria

- ☐ Yes / Niguo……1
- ☐ No / Aca tiguo……0

26. Signs and symptoms of malaria / Ndariri na imenyithia cia murimu waruagi

a. Fever / gucamuka / kana kugia na urugagri.

- ☐ Yes / Niguo ……..1
- ☐ No / Tiguo ……0

b. Joint weakness / Irungo kwaga hinya

- ☐ Yes /Niguo……1
- ☐ No/ Tiguo……...0

c. Headache kuriyo nimutue

- ☐ Yes /Niguo……..1
- ☐ No/ Tiguo……0

d. Vomiting Gutahika

- ☐ Yes/ Niguo……..1
- ☐ No/ Tiguo……0

e. Shivering kuinaina

- ☐ Yes /Niguo……1
- ☐ No/ Tiguo……...0

f. Backache Guturwo ni mugongo

- ☐ Yes/ Niguo……1
- ☐ No/ Tiguo……..0

g. Dizziness Thiurura

- ☐ Yes/ Niguo……1
- ☐ No/ Tiguo……...0

h. General body weakness/ Gigakwaga hinya

- ☐ Yes/ Niguo……1
- ☐ No/ Tiguo……..0

i. Stomachache /Kuriyo ni nda

☐ Yes/ Niguo……1

☐ No/ Tiguo……...0

j. Loss of appetite/ Kuremwo ni kuria

☐ Yes/ Niguo……1

☐ No/ Tiguo……..0

k. Constipation/Kuhonerera nda

☐ Yes/ Niguo……1

☐ No/ Tiguo……...0

l. Diarrhea/ Kuuharwo

☐ Yes/ Niguo……1

☐ No/ Tiguo……..0

Treatment of malaria/ Dawa cia mariiria

27. Do you use the following treatment for malaria? Niuhotheraga dawa cia mariiria?

a. Hospital treatment/Dawa ya thibitare

☐ Yes ***(skip to b***)/ Niguo (***ruga kwe numba b***)……1

☐ No (***ask next question***) / Ko tiguo uria kiuria kenge ……..0

a(i). Do you know someone else who use it?/Ni owe mundu onge uhotheraga dawa ichio?

☐ Yes/Niguo

☐ No/Tiguo

b. Mwarobaine

☐ Yes ***(skip to c)*** /Ko ni nguo thie kwe numba c ……1

☐ No ***(continue)*** /Ko tiguo thienambere ……..0

b (i) Do you know someone else who use it?/Ni uwe mundu onge uhotheraga dawa ichio?

☐ Yes/Niguo ……1

☐ No/Tiguo ……..0

c. Mubuthi

☐ Yes ***(skip to d)*** /Niguo ***ruga kwe numba e*** ……1.

☐ No ***(continue)*** /Tiguo ***thienambere*** ……0.

c(i) Do you know someone else who use it/Ni uwe mundu onge uhotheraga dawa ichio?

☐ Yes/Niguo ……1

☐ No/Tiguo ……...0

d. Kiruma

☐ Yes ***(skip to e)*** /Niguo ruga kwe numba f. ……1

☐ No ***(continue)*** /Tiguo thienambere ……0.

d(i) Do you know someone else who use it Ni uwe mundu onge uhotheraga dawa ichio?

☐ Yes/Niguo ……..1

☐ No/Tiguo ……0

e. Maruru

☐ Yes ***(skip to f)*** /Niguo ruga kwe numba g ……..1.

☐ No ***(continue)*** /Tiguo thienambere ……..0

e(i) Do you know someone else who use it Ni uwe mundu onge uhotheraga dawa ichio?

☐ Yes/Niguo ……1

☐ No/Tiguo ……0

f. Mitang'atanga

☐ Yes ***(skip to g)*** /Niguo ruga kwe numba h …….1

☐ No ***(continue)*** / Tiguo thienambere ……0.

f(i) Do you know someone else who use it/ Ni uwe mundu onge uhotheraga dawa ichio?

☐ Yes/Niguo …….1

☐ No/Tiguo ……..0

g. Mitambi

☐ Yes ***(skip to h)*** / Niguo ruga kwe numba i ……1

☐ No ***(continue)*** / Tiguo thienambere ……..0.

g(i) Do you know someone else who use it/ Ni uwe mundu onge uhotheraga dawa ichio?
Ni uwe mundu onge uhotheraga dawa ichio?

☐ Yes/Niguo ……1

☐ No/Tiguo ……..0

h. Mueno

☐ Yes ***(skip to i)*** / Niguo ruga kwe numba j …….1

☐ No ***(continue)***……0

h(i) Do you know someone else who use it/Ni uwe mundu onge uhotheraga dawa ichio?

☐ Yes/Niguo ……1

☐ No/Tiguo ……..0

i. Munyua Mai

☐ Yes ***(skip to j)*** / Niguo ruga kwe numba k ……1

☐ No ***(continue)*** /Tiguo …….0

i(i) Do you know someone else who use it /Ni uwe mundu onge uhotheraga dawa ichio?

☐ Yes/Niguo ……1

☐ No/Tiguo ……..0

j. Machatha

☐ Yes ***(skip to k)*** / Niguo ruga kwe numba l……1

☐ No ***(continue)*** /Tiguo thienambere ……0.

j(i)Do you know someone else who use it/Ni uwe mundu onge uhotheraga dawa ichio?

☐ Yes/Niguo ……1

☐ No/Tiguo ……..0

k. Mukinduri

☐ Yes ***(skip the next question)*** /Niguo ruga kiuria keu kenge ……1.

☐ No ***(continue)*** /Tiguo thienambere ……0.

k.(i). Do you know someone else who use it/Ni uwe mundu onge uhotheraga dawa ichio?

☐ Yes/Niguo ……1

☐ No/Tiguo ……..0

28. Which one of the following drugs do you use to treat malaria from the pharmacy/chemist? Ni dawa ireku uhotheraga kuuma dagitaari nigetha uhone mariiria

- ☐ A……1
- ☐ B……2
- ☐ C……3
- ☐ D……4
- ☐ E……5
- ☐ F……6

29. When you get malaria what do you do? Waruara mariiria niki wekaga?

- ☐ Pharmacy/chemist-hospital/Thibitare……1
- ☐ Directly to the hospital/Thiaga thibitare uremwe……..2
- ☐ Herbalist-hospital/Thibitari ya dawa cia miiti……...3

30. After how many days do you seek treatment? Wii uikaraga thiku ciigana nigetha unyue dawa.

- ☐ 1-2 days /Imwe-Igere……1
- ☐ 3-4 days/Itatu-Inya……2
- ☐ One week/Wiki imwe……3
- ☐ More than one week/Gukiria wiki imwe. ……..4

Malaria risk/ Mariiria kurwara

31. How many episodes of malaria have you had:Urwarete mariiria thiku ciigana.

a. Within this week (_____) Wiki iino
b. Within the last 6 months (_____) mieri
c. With in this year (_____) mwakaine oyo

32. Have you tested positive for malaria? Niure wathimwo ugakorwo wena mariiria thakameine

a. Within this week/Wiiki iino (Yes/Niguo____.....1, No/Tiguo____.....0)
b. Within the last 6 months/ mieri itadatu(Yes/Niguo____.....1, No/Tiguo____.....0)
c. Within this year/ mwakaine oyo (Yes/Niguo_____.....1, No/Tiguo_____.....0)

33. Who is mostly affected by malaria?Nuu onyitagwo ni mariiria mainge?

- ☐ Men/ Arume……1
- ☐ Women/Atumia……0

34. Do you feel uncomfortable when you visit a Doctor/nurse? Niukoragwo na nguoya wathie kuona dagitaari?

- ☐ Yes/ Niguo……1
- ☐ No/Tiguo……0
- ☐ I don't know/Ndiowe……2

35. Do you feel uncomfortable when you visit a herbalist or traditional healer? Niukoragwo na nguoya wathie kuona dagitaari wa miiti?

- ☐ Yes/Niguo……..1
- ☐ No/Tiguo……0

- ☐ I don't know/Ndiowe……2

36. Do doctors usually diagnose you with the disease you originally suspected?/Dagitaari nimakoragwo makemenya ni murimu ureko wenaguo rita ria mbere?

- ☐ Yes/Niguo……1
- ☐ No/Tiguo……0
- ☐ I do not know/Ndiowe……2

37. Do you think someone can avoid getting malaria in this area?Niugweciria ati mundu nuahote kwerigereria mariiria uturarere?

- ☐ Yes/Niguo……1
- ☐ No/Tiguo……..0

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BIOGRAPHICAL SKETCH

Dawit O Woldu was born and raised in Mai-Mine Sub-zone in Southern Eritrea. He finished his elementary school at Mai-mine elementary school in 1991 and did his junior and secondary school in Adi-Qula sub-zone in southern Eritrea. Dawit joined the University of Asmara, Eritrea (only university in the country) after passing a competitive secondary school leaving examination in 1996. He studied his undergraduate degree in African archaeology and anthropology. After finishing his B.A in 2000, Dawit worked as a graduate assistant in the department of Anthropology at the University of Asmara. Dawit taught introductory classes in anthropology and archaeology. In addition to his teaching responsibilities Dawit also worked on natural and cultural resource management sponsored by USAID, the university of Asmara and other stakeholders.

Dawit came to the United States in fall 2003 to do his graduate school at the University of Florida with a fellowship from the Leakey foundation and assistantship from the center for African Studies. He finished his master's degree in 2005 in anthropology and registered for his Ph.D in 2006.

Dawit has a wide range of experience in African languages and Area studies with a focus on curriculum development and language evaluation. Currently Dawit holds a certification from the American Council for the Teaching of Foreign Languages (ACTFL). Dawit works for ACTFL,as a proficiency tester, quality control and interviewer.