# UTILISATION OF LOCAL KNOWLEDGE IN HOUSEHOLD ADAPTATION TO MALARIA ENDEMICITY IN THE OKAVANGO DELTA, BOTSWANA

**BY**

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## DECLARATION

I, Dirontsho Maphane, do hereby declare that this thesis is the product of my own investigation except where otherwise acknowledged. This work has not been previously accepted for any degree/diploma and is not being currently submitted in award for any other degree/diploma.

**Signed:……**

**Date:……**

## DEDICATION

To my mommy dearest Lelerilwe Maphane, for her unconditional support, encouragement and unwavering faith in me throughout the ups and downs, not just in the entire duration of my study, but my whole life as well. This is for you.

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## ACRONYMS

WHO- World Health Organisation

IEC- Information, Education and Communication

ITN- Insecticide Treated Net

IRS- Indoor Residual Spraying

MoH- Ministry of Health

NMCP-National Malaria Control Programme

SADC- Southern Development Committee

KBAP- Knowledge Attitude Behaviour Practices

TEK- Technical Ecological Knowledge

VDC-Village Development Committee

CSO-Central Statistics Botswana

SPSS-Statistical Package for Social Sciences

FAO-Food and Agriculture Organisation

## ABSTRACT

Malaria is a persistent health challenge in developing countries. The African continent is the most affected, with nearly 90% of malaria-related mortality in the world. In Botswana, malaria is endemic in the northern region where the Okavango Delta is situated. This wetland ecosystem and its biodiversity is a major source of livelihoods for rural communities along its fringes. However, it also provides a suitable habitat for breeding anopheles mosquito, the malaria vector. Controlling malaria is a socio-ecological phenomenon that cannot be addressed solely through national level biomedical interventions. Local knowledge, perceptions, beliefs and adaptation strategies are also key aspects that can enhance biomedical malaria prevention efficacy.

This study assessed utilisation of local knowledge on the prevention and adaptation strategies to malaria endemicity, in the Okavango Delta, Botswana. The study engages a critical appraisal of the Health Service Utilisation framework Andersen and Newman and a conceptual framework of Utilisation of local knowledge in adaptation to malaria endemicity to guide this study.

Data in this study is from a retrospective cohort of 79 households that reported malaria cases/incidences during the first community level household survey, which was conducted from October-November 2015. Data were also collected from 16 key informants' interviews and two focus group discussions (FGDs). Data collected through participatory rural appraisal methods using tools such as seasonal calendars and livelihood rankings were also used. Inferential and descriptive statistics as well as content analysis were applied in data analysis.

Households observed that malaria occurs mostly during the rainy season, flooding season and throughout the year. Overall, households' local knowledge included burning dry elephant and cow dung), and a combination of these with Insecticide Treated Nets (ITN) to repel mosquitoes. Specific combinations included, ITN with herbs ITN with elephant dung ITN with cow dung and peppermint tree (*schinus molle)* leaves were also observed as the most effective. Households practiced several livelihood activities; gathering grass/reeds at the river, rain fed farming, harvesting water lily. Chances of mosquito bites were reported to be very high during subsistence fishing commercial fishing and *molapo* arable farming. Adaptive strategies against malaria included application of knowledge received from community

education information workshops, modifications of housing structures and timing activities by restricting movement at certain times of the day. Households have positive perceptions about health institutions utilization of local knowledge prevention/treatment on malaria. Concerns were raised with regard to collaboration between traditional healers and health institutions and the timing of Indoor Residual Spraying (IRS).

The households in the Delta could benefit more from their local knowledge of malaria prevention, provided the Ministry of Health embarks on investigating and improving upon the measures which actually do repel mosquitoes. Exposure to malaria transmission was very high for livelihood activities, which take place by or at the river compared to others. The positive perceptions towards health institutions practices could catalyse the malaria elimination progress in Botswana. Although environmental health education is crucial for capacity building against malaria endemicity, improved housing structural adaptation could be enhanced by assisting household to install gauzes on eaves.

**Keywords:** adaptation, livelihood, local knowledge, malaria, Okavango Delta, perceptions, utilisation

# CHAPTER 1

## 1 INTRODUCTION

Malaria is a public health problem in more than 100 countries worldwide (Shiff *et al.*, 2011; WHO, 2014). In Africa, malaria generally affects immunity compromised populations such as children, pregnant women and refugees in many highland and semi-arid areas in sub-Saharan (SSA) countries (Akinbobola and Omotosho; Abeku, 2007; WHO, 2014). Notwithstanding implementation of successful control programmes compared to the rest of the African continent, malaria is still a health problem in southern African countries, such as Madagascar and Zambia (Mabaso *et al.*, 2004).

In general, malaria constitutes a major health problem in Botswana. In the north-western parts of the country, where the Okavango Delta is located, local communities experience seasonal malarial transmission (Simon *et al.*, 2013). The Okavango Delta is a malaria endemic area (see attached Appendix A and B) as a result of frequent outbreaks of malaria within the population. Malaria endemicity persists, mainly in the area despite the initial efforts of the country's Ministry of Health to eliminate it as a public health threat by the year 2015 (Ministry of Health, 2009). The malaria prevention strategy in Botswana adheres to the World Health Organisation (WHO) recommended intervention strategies. However, this is a Western approach to malaria prevention which emphasises vector control through indoor residual spraying and use of insecticide treated nets.

To date, Western medical approach dominates both prevention and treatment process of malaria. Key features of this approach include information dissemination, public education and communication meant to raise community awareness of malaria and promote positive behavioural change in terms of personal protection. Effectiveness of this approach is challenged by inadequate operational research data including Knowledge Attitude Behaviour Practices (KBAP) (Ministry of Health, 2009). Local knowledge based interactions between the cultural, social and environmental context in which disease prevention and treatment takes place and the traditional aetiology of the disease, are largely disregarded (Koo, 1987) cited in Kipsisey (2008). This happens, despite the fact that formal health care in rural parts of Africa, (including rural Botswana) is sought only if initial self-medication and or traditional treatment intervention fail (Kazembe *et al.*, 2007). The localised response measures to signs

of disease are influenced by several factors that include, but are not limited to: knowledge, attitudes and practices (KAP) towards malaria. Therefore local understanding of the illness has implication for designing malaria control programme with effective public health education and preventive treatment (Kroeger *et al.*, 1996; Comoro *et al.*, 2003; Essé *et al.*, 2008).

Local knowledge about malaria prevention and treatment is accumulated by communities over time and therefore becomes encoded as facts and information relevant to a specific locale and socio-cultural and environmental context. Local knowledge can also include specific skills or experiences made in a particular location (Srinivas, 2015). In this regard, local knowledge can be understood as knowledge communities draw upon to perform and or act in response to several phenomena, including malaria. It is the platform for decision making, as it is gained through experiences and familiar comprehension of the surrounding as well as the cultural practices (Warren and Rajeskran, 1993). This body of knowledge comes about as outcomes arise from weather, labour and financial constraints necessitate practical strategies for adjustment as response to these changes (Hatch, 1976) Local knowledge as a logical adaptation tool to pre-existing conditions such as malaria endemicity, helps reach consensus with local actors and compatibility of interventions with the affected community (Srinivas, 2015). Local knowledge in health issues encompasses both generalised and specialised prevention and treatment competencies at individual, group and community levels.

In Tanzania, for example Gessler *et al* (1995) suggest that traditional healers have specialized knowledge of the treatment of malaria with plant remedies. A number of traditional approaches of controlling malaria are known and have been practised by communities living in malaria endemic zones. None of these approaches have been investigated and this raises serious sustainability questions of the effectiveness in malaria control (Waako *et al.*, 2010). Currently systematic research on local knowledge in southern Africa is very limited. In Swaziland for example, Hlongwana (2009) recommended that SADC countries provide baseline information about local communities' perceptions and practises regarding malaria. This was recommended based on the conclusion that, although knowledge, attitudes and practices related to malaria in that study area were reasonable it was shown that as the level of transmission and disease prevalence decrease so does the importance attached to malaria control activities ( Hlongwana *et. al.,* 2009). Adaptation refers to adjustments in a system's

behaviour and characteristics as a response to enhance its ability to cope with external stresses (Brooks, 2003). It is making a change as a response to another change (usually external). This includes reacting to disturbances to lessen the adverse impacts and possibly restore the pre-perturbation state in a sustainable manner, such that the strategies put in place are long term (Lints, 2010). It is simply learning how to live with a situation and maintaining the changes made, over a long period of time. There is a need to systematically analyse ways in which adaptation to malaria endemicity in the Okavango Delta builds on pre-existing local knowledge to enhance adaptive capacity of affected community. Due consideration therefore must be given to the historicity local knowledge developed by the local communities against disease transmission trend and prevalence in the past (Nyong *et al.,* 2007: Chikaire and Nnadi, 2011).

In this thesis local knowledge of malaria prevention and adaptation is defined as a system of concepts, practises, beliefs and perceptions that people utilise to prevent (avert) malaria transmission in the malaria endemic villages along the fringes of the Okavango Delta area in north-western Botswana, with particular reference to Shakawe and Ngarange village. This includes the way people in the area observe and utilise knowledge and practices accumulated over time, to adapt to changes in their surroundings by reducing vulnerability to disease transmission, how they perceive risk and solve problems, how they access services and validate information' (Warburton and Martin, 1999).

## 1.1 Statement of the problem

Malaria transmission levels in Botswana vary by district with more cases being reported in the northern part of the country, particularly Chobe, and Ngamiland Districts. About 51 % of the population is living in the northern part of the country where over 80% of national malaria cases are reported (Ministry of Health, 2009). Even though malaria transmission has declined over the years in other parts of Botswana, prevalence became restricted to the districts along the borders with Zambia, Zimbabwe and Namibia. These districts (Chobe, Okavango-sub and Ngami) were the significant malaria hotspots during 2008-2010. In 2011significant malaria hotspots were reported to be the Chobe and Ngamiland districts only (Simon *et al.*, 2013). From 2009 to 2012 Okavango-sub District accounted for 22% of total cases reported in Botswana (Ministry of Health, 2009; Simon *et al.*, 2013).

The primary factor for the persistent malaria outbreaks in the Okavango Delta is the presence of perennial surface water. The malaria vector in Botswana is known to breed in fresh sunlit water and the Okavango Delta is known to be a freshwater inland Delta (Ministry of Health, 2009). The population living in the fringes of Okavango Delta are vulnerable to malaria transmission due to several factors; these include socio-economic and cultural activities and environmental factors. Most livelihood activities such as cultivation in the Okavango sub-District are seasonal, usually coinciding with malaria seasons. Crop cultivation has been reported among the several livelihood activities that increase mosquito productivity, mosquito biting exposures and hence malaria transmission intensity (Mboera *et al.*, 2013). Lindblade *et al* (2000) study in Uganda revealed that on average all malaria indices are higher near cultivated swamps, due to vulnerability/exposure to mosquito bites in the process of tending for crops.

Malaria transmission mostly occurs in the rainy season between November and May with a peak from mid-February to April (Ministry of Health, 2009). Even outside the rainy season the hoof prints left by animals on the edges of water channels and permanent swamps within the Delta area serve as breeding sites for the malaria vector (*Anopheles* mosquito) (Chimbari and Magole, 2009). The occurrence of malaria during and outside the rainy season (due to permanent presence of breeding sites), result in perennial malaria transmission in the Delta (WHO, 2007), hence the need for full time protection and adaptation in the long run. Chimbari and Magole (2009) reported that even though the malaria control programme in the Okavango sub-District of Ngamiland District is functional, there are other confounding

institutional factors such as limited accessibility to healthy facilities during the rainy season and in times of high floods.

The Government of Botswana has done a lot in terms of control and prevention of malaria through the Ministry of Health targeted vector control interventions since the 1950s. In addition to annual Indoor Residual Spraying (IRS), the National Malaria programme (NMP), distributes long lasting insecticidal nets (LLINs) door-to-door in every district. These interventions have reduced the cases and deaths of malaria. However, there are still [high] cases of malaria [in specific 'hot spots' areas such as the Okavango Sub district regardless of these efforts of the Government. Furthermore transmission has been known to occur even after full universal coverage with effective ITNs and IRS in many parts of Africa, regardless of effective implementation of vector control interventions due to residual transmission (Killeen, 2014). Controlling residual transmission requires a different approach from the current measures. Hence capturing local knowledge in malaria prone areas in Botswana about 'observed' mosquito behaviours in communities' relation to specific livelihood activities as well as of households interaction with their surrounding environment would add value to current vector control to tools to target residual transmission.

This calls for a need to tap into the communities' adaptive capacity by exploring how local communities in the malaria endemic use local knowledge to prevent malaria transmission. The Botswana strategic plan towards malaria elimination intends to promote community participation through empowerment with appropriate knowledge, attitudes and behaviour (Ministry of Health, 2009). It is not yet clear what the strategy means by appropriate knowledge and what empowerment processes are envisaged. However it is clear that the strategic plan faces some challenges due to over-reliance on clinical diagnosis, low community acceptance of vector control interventions, lack of community participation and involvement, communication barriers due to different languages and cultural factors affecting vector control interventions (Ministry of Health, 2009).

Community participation in health promotion is one of the central tenets of the World Health Organisations. The majority of national malaria control programmes (NMCP) follow the biomedical approach, with the tendency to disregard the target population's knowledge, attitudes and practises in the transmission and control of the disease and tend to concentrate mainly on parasite and vector control (Vijayakumar *et al.*, 2009). The biomedical approach is

also evident in Botswana (Chirebvu *et al.*, 2013). There is a knowledge gap with regard to how households in malaria endemic areas of the Okavango Delta utilise their local knowledge to prevent and adapt over the years across generations, and their vulnerability to the disease transmission. This calls for a need to tap into hitherto undocumented communities' adaptive capacity by exploring how households in the malaria endemic areas in Botswana use local knowledge to prevent malaria transmission.

The assessment of such knowledge will be within the framework of Botswana Strategic Plan towards malaria elimination. The aim of the Plan is to promote community participation and empowerment with appropriate knowledge, attitudes and behaviour (Ministry of Health, 2009). It is not yet clear how this Strategy would source and harness and or integrate "appropriate knowledge" and, what or how the empowerment processes envisaged would entail. It is clear however that, the Strategic Plan faces some challenges with regard to over-reliance on biomedical interventions, low community acceptance of vector control interventions and poor of community participation (Ministry of Health, 2009).

One of the central tenets of the World Health Organisations is community participation in health promotion interventions. Even though the Botswana NMCP acknowledges that the role of the community is vital to malaria elimination (Ministry of Health, 2009), in practice, promotion of interventions uptake tend to be top-down and prescriptive measures (for instance of IRS and ITNs). Similarly, there is poor identification/analysis of what community participation methods would mobilize and capitalize on local knowledge production in ways that would enhance/complement biomedical knowledge systems. Subsequently; there is lack of integration of local knowledge into formal health care service delivery system (Ministry of Health, 2009). It has been observed that in other operational contexts, local knowledge has enabled communities to withstand past and present vulnerabilities to climatic extremes (Chikaire and Nnadi, 2011) and other stressors, including malaria outbreaks. Given the world is currently experiencing extreme events due to climate change, in addition to direct health impacts (injury, death and traumatic stress), there are indirect impacts such as increased risk of contracting infectious diseases (McMichael *et al.*, 2003)

Climate change variables such as extreme temperatures, floods, droughts and air pollution in Africa generally and in Botswana in particular, is likely to aggravate public health threats. Locally, in the Okavango Delta, these extremes could extend the geographic range of the

vector and thereby increase hospitalizations, morbidity and mortality of climate sensitive diseases such as malaria. Hence there is a need to consider the infusing local knowledge in the health and other relevant sectors (Kolawole, 2012). It is important to narrow the gap between local knowledge practices and modern techniques such that both knowledge systems could complement each other to produce optimum strategies for sustainable development (Kolawole, 2012). Recognising local initiatives, identifying what works, and seeking to work within the local context are essential for making progress (Dunn, 1979). This study will, therefore, provide an insight into local communities' knowledge of malaria prevention and adaptation in order to avert risk of infection in the Okavango Delta by filling in this gap.

This study, therefore, answers the following research questions: 1) what are the local knowledge used in the prevention of malaria transmission in Shakawe and Ngarange villages? 2) How do communities perceive the relationship between livelihoods activities and malaria transmission in the study area? 3) How do households adapt to malaria endemicity in the study area? 4) What are the perceptions of households on health institutions' practices regarding malaria?

## 1.2 Study objectives

The general objective of the study is to:

Assess utilisation of local knowledge on the prevention and adaptation strategies against malaria endemicity, in the Okavango Delta, Botswana.

The specific objectives are to:

1. assess the local knowledge used by households in the prevention of malaria in Shakawe and Ngarange villages;
2. analyse local knowledge on the relationship between livelihood activities and exposure to malaria transmission in the study area;
3. determine households adaptive strategies against malaria transmission; and
4. assess household perspectives on formal and informal health institutions practices regarding malaria.

## 1.3 Significance of study

Information regarding service utilisation and preferences can be used to improve the appropriateness of the medical and health care services offered. It also improves the body of knowledge that exists regarding health care seeking behaviour locally and developing countries in general. This information also provides insight into the health dynamics at the community level regarding malaria, which will be very useful in the efforts to eliminate malaria in the country. This study might reveal the misconceptions at community level, or inappropriate practices regarding malaria at community level. The thesis also fills an important gap in malaria control as the country and Southern Africa at large progresses towards malaria elimination.

## 1.4 Structure of the thesis

The first chapter above has already provided background information on malaria dynamics, globally down to the study area. It also states the problem of the study, including research questions, objectives and the significance of the study. The second chapter reviews literature on related studies; definition of concepts, malaria transmission dynamics, determinants of local knowledge utilisation and conceptual frameworks. Chapter three follows, with a description of the study area, including sites, methodology in detail and data dissemination plans. Results and discussion section form the fourth chapter of the study, where results for all the study objectives are presented, then followed by the discussions and conclusions. The summary and conclusion and recommendations of the study are found in chapter six. The last part of this thesis is chapter seven, which provides the references of the literature reviewed in the thesis.

# CHAPTER 2

## 2 LITERATURE REVIEW

This chapter reviews literature on related studies; definition of concepts, malaria transmission dynamics, determinants of local knowledge utilisation and conceptual frameworks. It starts with conceptualisation of the term 'local knowledge' and interrelated concepts, elaboration of local knowledge utilisation in malaria endemic regions, followed by the role of institutions in the utilisation of local knowledge in adaptation to malaria endemicity. Literature review on malaria prevention, elimination and residual transmission also forms part of this chapter, followed by the importance of social capital in production and progression of local knowledge. Background on malaria transmission dynamics is provided, followed by determinants of local knowledge utilisation and lastly a review of theoretical and conceptual frameworks, in relation to local knowledge and utilisation of health service.

### 2.1 Conceptualizing local knowledge and interrelated concepts

Knowledge is defined as "stored information drawn from vital structures, processes and functions of the system producing it ... and which therefore generates evaluative processes" (von Cranach, 1995: 25). Knowledge is stored in individuals and written documents, as well as routine practices and material objects. Hence people cultivate knowledge and become informers through practices informed by their community's body of knowledge (Antweiler, 1998).

Brouwer (1998) defined indigenous knowledge systems (IKS) as the general structure that conceptualises the theories and perceptions of nature and culture. The practical part of these locally generated theories, where they are actually implemented in various fields such as health, agriculture, forestry and others, forms the indigenous technical knowledge (ITK).

Traditional ecological knowledge (TEK) has been defined as the holistic knowledge base acquired by indigenous and local people over many hundreds of years (natural history) through direct contact with the environment (Gadgil *et al.*, 1993). TEK parallels the scientific disciplines of ecology. TEK includes an intimate and detailed knowledge of plants, animals,

and natural phenomena, the development and use of appropriate technologies for hunting, fishing, trapping, agriculture and forestry (Inglis, 1993).

The description of non-western/scientific knowledge has diverse terms which are usually used interchangeably most of the time including traditional knowledge, indigenous knowledge and local knowledge. These terms (local, traditional and indigenous knowledge) are used to separate knowledge derived from certain communities from the knowledge developed through academic institutions and other educational organisations, thus the global knowledge system commonly known as 'western education/system' (Brouwer, 1998).

However these concepts that commonly refer to non-scientific knowledge or non-main stream knowledge found in different communities carry different connotations. Traditional knowledge for instance, when used, gives a static impression of knowledge with a low level of change (Antweiler, 1998). Whereas indigenous knowledge, the most globally used concept, implies culturally integrated knowledge associated with small marginal/non-Western groups (Antweiler, 1998). Local knowledge concept implies less locality specific restrictions, that is, the form of knowledge is not confined to any tribal group, rather, all communities possess local knowledge: rural and urban, settled and nomadic, original inhabitants and migrants). Local knowledge is rooted in local or wider regional culture and ecology; and thus encompasses the local environment, participation in the development process, linking current local technical solutions to local capacity and institution building (Antweiler, 1998). The concept embraces a larger body of knowledge systems, including those classified as "traditional" and "indigenous". Local knowledge tends to speak to spatial, historical and contemporary needs in an environment rooted in a wider regional ecosystem and cultural landscape.

Local knowledge is the knowledge that has been developed over time, and continues to be developed. It is based on experience, tested over centuries of use, adapted to the local culture and environment, embedded in community practices, institutions, relationships and rituals, held by individuals or communities (Warburton and Martin, 1999). It is a continuous process of accumulation and integration of current information and experience. Local knowledge in a narrow sense refers to knowledge resulting from intellectual activity in a traditional context and it includes the know-how, practices, and skills and innovations (World Intellectual Property Organization, 2013).

Ways of knowing (or epistemology) implies that local knowledge is necessarily dynamic as the knowledge production process is simultaneously cumulative over historical time (diachronic, observations based on historical continuity of resource use through trial and era process) and contemporary infusions (synchronic, observations on which western science is based) for people to constantly adapt to changing environmental and socio-political structural contexts. These knowledge systems are likely to co-evolve due to the dynamic nature of local knowledge, it is sometimes the boundaries blurred between past and contemporary, making it often difficult to categorically say whether knowledge and or practice is inherently local or mixed/ infused knowledge from elsewhere sources. Most likely, local knowledge will be a combination/crucible of different sources of knowledge systems and information types that have become embedded in a particular ecosystem and cultural landscape. However it is still very crucial to assess what is available within the community environment first before assuming that nothing exists by imposing new technologies and or standardized solutions from outside. In such cases, a prior decision can be made to determine what the type of knowledge can be harnessed in ways that could be more relevant/efficacious to addressing problems in specific situations/environments (Warburton and Martin, 1999) for sustainable management of the natural resources. Local knowledge is not just a cultural heritage of local communities, it also a form of human capital in possessed by humanity (Antweiler, 1998).

Local knowledge is restricted culturally and economically to its spatial spaces of provenance, consequently limiting its utilisation as an alternative to western science globally (Briggs, 2013). There is still a challenge scaling up the utilisation of local knowledge in development practice/policy beyond the immediate environment of origin. Some reservations evolve around the validity and reliability of local knowledge. In some instances, measures have been taken to subject forms of local knowledge to receive a stamp of approval from western scientific methods. The agricultural sector, particularly in the soils and range management, has benefited from the integration of local knowledge and formal western science (Briggs, 2013). However, insistence on western authorizing stance invariably devalues local knowledge as a system in its own right (Briggs, 2013), and has made it difficult to institutionalise local knowledge, hence the persistence and transfer of western science and technology, often uncritically, and its failure to change the lives of the many people especially sub-Saharan Africans (Briggs, 2013).

As an attempt to increase the contribution of local knowledge widely in policy/programme formulation and development, there has been a focus on production of hybrids knowledge from formal science and indigenous knowledge. Still, the prevailing sentiments are to 'professionalize' local knowledge, which, on its own, cannot be trusted without the necessary stamp of approval by formal/western science. At the same time local knowledge cannot simply be an 'add-on' or 'quick-fix' to preconceived interventions (for instance in health or development programs/policies).

Berkes (2009) has argued that less focus should be given to the content (information passed from one person to another) of local knowledge and more on the process (the ways of observing, discussing, questioning, analysing and making sense of information, whether received or new. Briggs (2013) and Marschke *et al* (2008) concur with (Berkes, 2009) that focus on content stresses the information that can be transferred down from another person another, whereas process focuses on ways of knowing (through observations, discussions, questions, analysis and making sense of both new and received information). Therefore a shift to epistemology (they ways of knowing) creates an opportunity whereby local knowledge extends beyond cultural and spatial boundaries. Focus on local communities' ways of knowing on the one hand acknowledges the fact that local knowledge is indeed heterogeneous and complicated; on the other hand, the process requires long-term engagement with communities as participants in the intervention process as equal partners from inception through to implementation. Briggs (2013) advances the idea of mutual engagement "learning with" rather than "learning from" communities (Wilson, 2007) in order to expand the boundaries of what is already known in the spirit of active engagement.

However the concept of 'process' has a general connation attached to it, which may imply that indigenous knowledge is just a concept without actual outcomes. In order to avoid this confusion Briggs (2013) suggest the concept of 'practice' as more suitable as it implies that local knowledge is a clearly integral part of the everyday practice of culturally-embedded knowledge with regard to alternative ways of working, thinking and making interventions.

Antweiler (1998) suggests that local knowledge should be aimed at servicing the community as opposed to its extraction from the community. The concept of practice makes it possible to re-think the nature of power relationships between practitioners and communities. However in

the midst of this process arise issues of re-ordering power relations, including the possibility of commercialisation of both knowledge and social relations (Laurie *et al.,* 2005).

From the above discussions, local knowledge can be found in a wide range of contexts, including agriculture, scientific knowledge, technical knowledge, ecological knowledge, medicinal knowledge (including related medicines, diagnosis, treatment and or remedies) and biodiversity related knowledge (Abbott, 2014).

### 2.1.1 Limitations of local knowledge and challenges of its utilisation

As much as indigenous and local knowledge and skills are not inherently insufficient, new, external technical approaches are also not automatically superior (Islam, 2007). However, it is important to avoid the notion that 'older ways are always better than the modern (Islam, 2007). Thus it is unrealistic to expect indigenous strategies to cope alone, particularly with extreme, unanticipated events and of which there is no prior experience, or for multiple shocks and stresses (Islam, 2007). Therefore, local knowledge, skills and adaptation strategies must be assessed wisely and systematically on the basis of their effectiveness. This should not be done in comparison of local to modern systems but for the purpose of finding the most appropriate approach for each situation (Twigg, 2004).

Usually, a blend of different knowledge sets and skills is likely to be more useful. However, identifying effective coping strategies is a major challenge as local knowledge and coping mechanisms are often invisible to outsiders (Twigg, 2004). Considerable effort may be needed to identify and understand them, particularly where people are changing or adapting coping strategies rapidly in response to external shocks, as it may be even harder for outsiders understand the dynamics. Similarly it is a tough task to grasp the local communities' views of risk as they are likely to observe and interpret it differently from the outsiders. Hence it is crucial to acknowledge the diversity in perceptions and decision-making processes with regard to risk and risk management, likely to be influenced by varying psychological and socio-cultural factors (Twigg, 2004)

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Indigenous knowledge is often handed down from one generation to the next through social processes. Unfortunately traditional social support networks and moral obligations also tend

break to down under the pressure of market forces, rapid social changes and resource scarcity. Younger generations' reluctance on traditional community roles and obligation to migrate to urban places for better life opportunities results in disintegration and loss of local knowledge. There has been advocacy for indigenous knowledge to be incorporated in school curricula in order to resist this trend (Manning, 2001).

Documentation should be within certain restrictions due to the possibility of exploitation for commercial interest. There have been instances where, publications on traditional medicinal plants led to over-harvesting of such plants by large external industries for profitable use.. Consequently, the locals are deprived of the benefits of their traditional systems as these plants, which are essential for treatments become unavailable to them (Chaudhuri, 2015).

Failure of the traditional/local approaches to address many diseases is deemed the common reason for the introduction of the modern system (and for the replacement of the traditional). This undeniable fact does not necessarily reflect the shortcomings of traditional systems. Despite the unavailability of many herbs, it must also be acknowledged that majority of these diseases were formerly unknown. Logically, availability or lack of remedy within traditional system should not be the primary reason for its condemnation. In fact, for the same reason that modern medicine also does not have remedies for many diseases (Chaudhuri, 2015).

## 2.2 Utilisation of Local Knowledge and Malaria Endemic regions

Communities living in malaria endemic areas have over the years developed appropriate concepts relating to malaria treatment and prevention. These concepts are based on traditional notions of health and disease and are derived from observations of the connection between environmental conditions, vectors and malaria (Kipsisey, 2008). These communities know through observation that malaria occurs throughout the year and intensifies during the rainy season. Their local knowledge of malaria has influenced the self- treatment at home without visiting health care facilities (Toé, 2009). Similarly due to the utilisation of local knowledge it is also common to prevent malaria through different local or a combination with scientific techniques in these communities, depending on what works best for them. Utilisation in the context of health refers to the ways in which individuals respond to ill health and disease. This response is subject to several factors, including individual's characteristics and ability to

access the necessary resources in order to deal with their ill health and disease (Mackian *et al.*, 2004).

Community inclusive vector control programs in Mexico for example, were found to be more effective, and outcomes are achieved quickly when compared to government-supported activities alone. People in the communities apply their own easily accessible preventive measures (smoke and mosquito coils) to avoid mosquito bites and the use of bed nets is widespread, which makes bed nets a viable alternative for malaria control (Rodríguez *et al.*, 2003). This is not very different from Batega (2004) study in Uganda, which concluded that while there is evidence of improved case management, there is still a high preference for home treatment of malaria; sometimes resulting in inadequate drug use. The tendency for consumers is to use traditional medicine concurrently with modern medicine and to visit health centres, private clinics and hospitals for malaria treatment only after home treatment has failed (Batega, 2004).

While in Tanzania Minja *et al* (2001) has shown that people in the study area have integrated ideas derived from biomedicine into their local knowledge and practice. After independence in 1961, Tanzanians have been exposed to many health education campaigns intended to improve the health of rural populations with a focus on widespread diseases like malaria (Minja *et al.,* 2001). Local people in different areas of the country have been actively involved in a malaria control research project to assist in identifying the type of trees whose leaves, barks or roots are used as medicine to cure malaria (Minja *et al.,* 2001). They also identified plant species that are repellent to mosquitoes. As Saifert (2005) suggests, since many indigenous groups appear to have excellent knowledge of cures and treatments for some of the most common diseases that afflict them, they should be involved in research studies regarding these diseases.

In western Kenya the prevention of malaria is taken seriously by communities, for instance, they have clear principles and practices relating to prevention (Kipsisey, 2008). The prevention of malaria includes a routine use of emetics and purgatives strictly followed in traditional rituals (Kipsisey, 2008). Self-medication was also found common in this area mostly due to inaccessibility of health services problems, which in turn compromise compliance with standard adherence to medications (Miguel, 1999). Studies indicate that most Kenyans have not adopted modern malaria control measures, most likely because

disease causation as promoted by Western-trained health workers seem to contradict their notions of malaria causation and control (Nyamwaya, 1982).

While the commonest reasons for utilisation of non-conventional health care (traditional healers and medicine) in the low to middle-income Asia-Pacific countries, was lack of accessibility to modern health facilities (due to long distances and lack of financial capital), confidence in traditional medication and undermining the severity of malaria symptoms (Suswardany, 2015).

## 2.3 Local knowledge and Adaptation to Malaria Endemicity

Malaria control is a multifaceted phenomenon that requires multidimensional intervention approaches. It is therefore essential to contextualize disease control strategies and pay attention ways in which prevailing local conditions influence disease transmission **(**Mouchet and Carnavale, 1998). The WHO, introduced country level strategic planning exercises to address local knowledge needs and to involve partners in health service delivery. The idea was to provide culturally specific interventions to address health problems, including malaria through utilisation of local knowledge (WHO, 2007). Communities and individuals are themselves assets that can significantly contribute to disease prevention through deployment of their local knowledge (Welsh Government, 2013). In Kenya, it was discovered that the combined usage of malaria control tools led to a gradual decrease in malaria cases in the district hospital and school children (Okech *et al.*, 2008). The simultaneous applications of both scientific and traditional methods to prevent malaria transmission, shorten the lifespan of the malaria vectors, and reduce the malaria vector population proved to be effective (Okech *et al.*, 2008). This can contribute to reduction in and elimination of malaria in the long run.

Botswana seems to have adopted an Integrated Health Services Plan (IHSP) which prioritises health services that are most needed and most efficient, and incorporates the views of both health professionals and the general public (Ministry of Health, 2009). This approach seemingly follows the health system, defined by the WHO, which includes all the actors and activities with the primary purpose as to promote, improve, or maintain the health of the citizens (Ministry of Health, 2009). However one of the important aspects of community involvement and participation, local knowledge particularly on malaria prevention and other diseases has been neglected.

The scale-up of interventions supported by the Roll Back Malaria Partnership, the President's Malaria Initiative and other partners, radically decreased malaria burden within the past several years in parts of sub-Saharan Africa (Mharakurwa *et al.*, 2012). However, it has also been observed that even though interventions have significantly reduced the burden of malaria in many countries, this reduction occurred even before the widespread intervention efforts (O'Meara *et al.*, 2008). This implies that there might have been others factors contributing to the reduction in malaria transmission to some degree (Mharakurwa *et al.*, 2012). An investigation into the reasons behind sustained malaria decline in some areas and the apparent failure of the same interventions in other epidemiological settings might reveal locally tailored malaria control efforts (Mharakurwa *et al.*, 2012). This may also help develop new or improve control strategies and achievement of malaria elimination in southern Africa (Mharakurwa *et al.*, 2012) as well as reveal adaptation strategies. Local knowledge help communities adapt to survive. To adapt as previously defined, is simply learning how to live with a situation and maintaining the changes made, over a long period of time. Without the understanding and consensus of the local actors, as many failures in the past have shown, the chances of successful policy implementation are minimal (Srinivas, 2015). It is not surprising therefore that the World Bank has also focused on developing a database that focuses of local knowledge of communities and cultures where health and development projects take place, including how local knowledge and practices can contribute to improving program management and evaluation (Brieger, 2007).

### 2.3.1 Types of Adaptation

Adaptation within the human system can be classified as reactive or anticipatory (proactive), de-pending on the timing, goal and motive of its implementation. It can also be autonomous (spontaneous) or planned, based on intent on the scale and manner of occurrence (Klein, 2003).

Reactive Adaptation takes place after the initial impacts of external shock have been experienced (Klein, 2003). Reactive adaptation is the immediate response to a shock, usually for the purpose of regaining stability. It is therefore, immediately effective and it can be put in place when the damage effectively materializes. However, it is not the optimal response sometimes when our past understanding doesn't correspond to current environmental and socio-economic conditions (Natural Resources Canada, 2016). It is therefore necessary to

constantly adjust the actions undertaken every period in response to the damages caused by shocks/climate change. Adjusting accommodates the damages which cannot be or were not accommodated by anticipatory adaptation (Bosello *et al.,* 2009).

Anticipatory (or proactive) adaptation takes place before impacts of a shock are observed (Klein, 2003) based on foresight and predictions. It is, represented by all those actions taken in anticipation to the manifestation of the expected damage, aiming at reducing its severity once materialised (Bosello *et al.,* 2009). Anticipatory adaptation implies building a stock of defensive capital that must be ready when the damage materializes. It is subject to economic inertia: thus investment in defensive capital translates into protection capital after some years. Hence, it needs to be undertaken before the damage occurs (Bosello *et al.,* 2009).

Investing in Research and development (R&D) and knowledge can be seen as a form of anticipatory adaptation. R&D activities and investments make adaptation responses more effective as they produce knowledge for capacity building and innovation. These are especially important in sectors such as agriculture and health, where the discovery of new crops and vaccines is crucial to reduce vulnerability to climate change (Barrett, 2008).

Autonomous or spontaneous adaptation: an unconscious response to climatic stimuli or shock triggered by the changes that natural and most human systems will undergo irrespective of any policy plan or decision (Ravindranath and Sathaye, 2002). These changes can be ecological in natural systems and market or welfare related in human systems. This implies that individuals or communities can undertake adaptation to environmental risks and scarcity independently of outside intervention.

Autonomous adaptation is often unheeded in management of climate change impacts by international and national efforts (Christoplos *et al.,* 2009). It has been observed that, the poor adapt in various ways that are usually overlooked, uncoordinated, and independent of national governments, development, as well as international agencies aid. In view of that, autonomous adaptation is perceived as inefficient (Eisenack, 2009). Accordingly other scholars argue that autonomous adaptation can significantly supplement planned adaptation (Forsyth and Evans, 2013). Autonomous adaptation in human systems is mainly based on the actor's rational self-interest, whilst the focus of planned adaptation is on collective needs (Leary, 1999). Nevertheless, these two cannot be undertaken separately, as they are inherently connected.

Planned adaptation: is based on and results from deliberate interventions with awareness that conditions have changed or are about to change (anticipated) and that it is necessary to act in order to return to, maintain or achieve a desired state. It requires deliberate policy decisions with regulations, standards and investment schemes with a top-down approach (Parry *et al.,* 2007). Hence, planned adaptation is commonly viewed as explicitly dedicated to the development process and mostly linked to policy making at national level policy making (Adaptation Knowledge Platform, 2013).

However a focus on planned adaptation at the national level is inadequate in guaranteeing that actors at community level also follow-suit. In formalisation of adaptation policy, top-down approaches usually fail to sufficiently incorporate corresponding local procedures for risk management and development, which can hamper local adaptation processes. Therefore a community focus can aid establish a direct link between addressing development needs and enhancing adaptive capacity. Thus, the local level is perceived to be a crucial entry point for adaptation (Adaptation Knowledge Platform, 2013).

### 2.4 Malaria prevention, elimination and residual transmission

Malaria is said to be entirely preventable and treatable, if the recommended interventions (malaria vector control measures) are applied appropriately (Ministry of Health, 2009). Prevention is defined as population and individual based interventions for primary (actions aimed at avoiding manifestation of disease) and secondary (early detection) to improve the chances for positive health outcomes (WHO, 2007). Therefore primary malaria prevention refers to avoiding malaria transmission through the use of several interventions such as indoor residual spraying, getting rid of potential breeding sites and wearing long sleeved attire. Secondary malaria prevention refers to evidence based malaria screening to administration of proven drug therapies to avoid development of malaria in the host body system.

The World Health Organisation's intervention goals are: to protect individuals against infective malaria mosquito bites, to reduce the intensity of local malaria transmission at community level by reducing the longevity, density and human vector contact of the local vector mosquito population (WHO, 2007). There are two strategic approaches to malaria, namely prevention and case management. The two most broadly applied preventive interventions world-wide are insecticide treated nets (ITNs) and indoor residual spraying (IRS). Chemoprevention is another malaria prevention strategy targeting the vulnerable

groups (pregnant women and young children) (WHO, 2015) despite the fact that other 'at risk populations" under similar conditions particularly in malaria endemic areas are also likely to suffer from malaria. Other such vulnerable populations due to the nature of their occupation include fishers, grass harvesters and *molapo* farmers are also likely to be vulnerable to malaria. In situations where preventive intervention fails, improved access to diagnostic testing and treatment and community case management through the public / private institutions is essential for effective treatment of confirmed malaria cases (WHO, 2011).

Malaria elimination refers to a reduction to zero of the incidence of infection caused by human malaria parasites in a defined geographical area as a result of deliberate efforts (WHO, 2015). This calls for continuous use of prevention measures to avoid transmission re-occurrence (WHO, 2007). In 2009, the goal for elimination of malaria by 2015/16 was set in southern Africa (WHO, 2015). However, the national new goal for elimination has since been moved to 2018, and the regional (southern Africa) to 2020.Botswana was also committed to the Millennium Development Goals particularly goal 6; target 8, which were to halt the problem and to reverse the incidence of malaria and other diseases by 2015 (Ministry of Health, 2009). The revised plan under sustainable development goals has set a target to end the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases and other communicable diseases by 2030 (United Nations, 2015). The Ministry of Health has a malaria strategic plan to guide the country towards elimination of this disease.

However, even with a hypothesis of full coverage of ITNs and IRS, malaria transmission may still continue. This persistence is most likely because IRS only targets indoor resting mosquitoes and ITNs only target night biting mosquitoes (Killeen, 2014). The transmission occurring even after full universal coverage with effective ITNs and IRS containing active ingredients to which local vector populations are fully susceptible to is known as residual transmission (Killeen, 2014). Residual transmission occurs in many parts of Africa regardless of effective implementation of vector control interventions (Killeen, 2014). In Tanzania and Uganda, for instance, malaria transmission continues despite high coverage of ITNs and IRS due to residual transmission (Killeen, 2014). Controlling residual transmission requires different approaches in addition to current ITNs and IRS intervention measures. In Botswana, this implies finding ways to capture local knowledge about 'observed' mosquito behaviours in

in malaria prone communities. Also, local knowledge specific livelihood activities would broaden the scope of at risk populations and or households. This kind of data would help tackle residual transmission problems in malaria prone communities and thus add value to current vector control tools.

## 2.5 Local knowledge and the Importance of Social capital

Local knowledge is developed, adapted and enhanced, through absorption and assimilation of ideas from various sources (Food and Agriculture Organisation, 2005). It is a social process. It is equally important to understand existing local knowledge on malaria, how the knowledge system -evolved (ways of knowing), is shared/communicated and or applied in everyday life of individuals in communities in the Okavango Delta as a malaria endemic region. Social capital is likely to mediate this ways of knowing.

Social capital here is used to refer to the relationship structures, obtained through interactions between individuals and their networks of interrelations that facilitate learning within a community (Moran, 2005). These relationships provide direct help and or information, as well as access to institutional agents, hence they are integral to knowledge utilisation (DFID, 1999). It has been observed for instance, that if an individual's family has knowledge of an effective home remedy; the person will often attempt that treatment before utilising professional health care services (Kleinman, 1980). Thus the knowledge and social support available to the individual in question is likely to affect utilisation of specific health care services (Rebhan, 2008).

Therefore a lack of social capital may also limit cooperation and interactions among the health service users and local health service providers (Rebhan, 2008). Therefore attention to social capital in general can also improve not only health intervention outcomes but also as a process for either incorporating local knowledge on health issues, or generating creative intervention alternatives, and or enriching the overall malaria policy formulation discussion (Williamson and Feldstein, 2007). Furthermore, as Gould (2001) rightfully suggest, it is important to know how things work in interactions, and relationships and partnerships are enhanced in institutions (often referred to as cultural capital) in community gatherings (celebrations, rituals and other intercultural dialogue platforms). An understanding of this process has a major influence on people's choice to seek health care and or their assessment

of which health care option to utilise for prevention and or treatment of an illness (Lee *et al.*, 2004).

The environment influences people's way of life, that is, their cultural sensibilities (Kolawole, 2012). Cultural processes therefore guide actions and preferences of individuals (Bourdieu, 1986 cited by Jeannote, 2003). Among such actions is adherence to malaria prevention and treatment modalities (whether based on local or biomedicine knowledge) is likely to be moderated by cultural sensitivity (Lukoschek, 2003; Rose *et al.*, 2000). Successful implementation of malaria control programme worldwide therefore need to pay considerable attention to the importance of socio- cultural determinants of local treatment and prevention practises (Deressa *et al.*, 2003; Launiala and Kulmala, 2006).

## 2.6 Multidimensional Factors influencing Malaria Transmission

### 2.6.1 Socio-economic factors

There is substantial scientific proof that ITNs are effective in reducing malaria-related morbidity and mortality (Lengeler, 2004). Therefore national and international malaria control programmes have focused more on 'scaling-up' ITNs coverage (Roll Back Malaria, 2005). However, socio-economic and cultural factors are also major contributors to malaria transmission (Ministry of Health, 2009). These include health-seeking behaviour and socio-economic status, which determine access to health services. More research attention has to been given to how malaria risk behaviours in relation to ITNs is influenced by socio-cultural beliefs and practices especially with regard sources of livelihood (Dunn *et al.*, 2011).

Livelihood activities overlap with malaria risk in terms of specific daily tasks, responsibilities and leisure time , particularly those undertaken outdoors at dawn and/or dusk (Dunn *et al.*, 2011). In São Tomé for example, many people watch communal television outdoors, posing them to risk for early-evening malaria transmission (Charlwood *et al.*, 2003). The practice of drinking alcohol in outdoor beer clubs in villages, a specific cultural norm that could not accommodate ITNs use, was reflected on in different ways by participants in relation to malaria risk. It is therefore vital to take into consideration human behaviour in the process of adapting vector control strategies (Dunn *et al.*, 2011).

### 2.6.2 Livelihood Sources and Poverty

Fishing is important for majority of livelihoods in African countries with river dwelling communities such as Tanzania, hence malaria is an occupational hazard for such communities (Njaya and Howard, 2006: Mboera *et al.*, 2013). Fishing has been reported to promote outdoor exposure of individuals to malaria vectors in India (Barai *et al.*, 1982) and Brazil (Sá *et al.*, 2005). Poverty as a socio economic status also makes people vulnerable as they practice livelihood activities that expose them to malaria. Poverty, usually measured by the amount of income a household/individual earns per day, is a multidimensional phenomenon, which generally refers to lack of multiple resources leading to failure to meet one's basic needs in many aspects including health (World Bank, 1999). Most households in the Okavango Delta's communities are poor and are becoming increasingly exposed to health risks such as HIV/AIDS, a compromised immune system hence makes the community susceptible to malaria related morbidity and mortality and malaria (Njaya and Howard, 2006). Such households are likely to be more vulnerable, as they may find it more beneficial to continue engaging in livelihood activities that increases exposure to malaria transmission. Using housing structure as proxy indicator of poverty, in Senegal for example, exposure to malaria infections have been attributed to housing structure (traditional homes: simple mud dwellings with grass thatching), the mortality rate among 1-4 years children was 50% higher compared to those residing in modern homes (Goldberg and M'bodji, 1988).

From the discussion above, there is a possibility of dual causation with poverty nourishing the conditions in which malaria thrives and malaria hindering economic growth and keeping communities in poverty (Sachs and Malaney, 2002).With the likelihood of dual causation between poverty and malaria, poor households experiencing high malaria incidence that in turn keeps them in poverty, may be trapped in reinforcing cycles (Somi *et al.*, 2007). Poverty remains extremely high in some districts, and Ngamiland West (44.6%) was notably the highest in 2009/10 and the fifth poorest (33.4%) in 2015/16 (Statistics Botswana, 2016). This implies that poor households in relation to structure and composition (age, gender and household headship), are likely to be prone to malaria infection in Botswana. The opportunity cost of a healthy behaviour may be high, hence it may not be easier to attain and maintain prevention of diseases such as malaria. High opportunity cost has implications for the uptake of prevention interventions as it determines what members of the household are willing to

give up (opportunity) now and in the future to implement the prevention strategy (Cropper *et al.*, 2000).

### 2.6.3 Climatic Variability

Climate variability is likely to aggravate morbidity and mortality of climate sensitive diseases such as malaria. The survival and reproduction of mosquitoes, as well as development of parasites within their bodies, are both heavily dependent upon temperature, humidity and rainfall (Killeen, 2014). Time series malaria and climate data analysed over the last century worldwide has shown that a change in rainfall amount (excess rainfall or occasional drought) is correlated with the variability of malaria incidences (Thomson *et al.*, 2005). Since the 1980s malaria epidemics have become more frequent and severe due to a combination of factors including changes in environmental conditions in Southern Africa (Mabaso *et al.*, 2004). Countries of high transmission in this region include Mozambique where the transmission of malaria is highest during the wet season (Abellana *et al.*, 2008). However, even in low transmission countries like Botswana, there are areas of high transmission due to climatic suitability. The perennial transmission in the Delta may also be attributed to the perennial surface water found in these districts (WHO, 2013). The transmission intensity of malaria is also strongly influenced by environmental temperature (Craig *et al.*, 1999). *Anopheles arabiensis* has been recorded to exhibit great production at extremely high water temperatures; hence this species dominates the months of maximum temperatures (Kirby and Lindsay, 2009).

## 2.7 Determinants of Local Knowledge Utilisation

The institutional, social, cultural, economic and environmental conditions, in which people are born, grow, live and work impact on their health and wellbeing (WHO, 2013). These factors can directly affect health service utilisation, and in turn have a direct influence on health (Mackian *et al.*, 2004). Utilisation of health and medical services is defined as the ways in which individuals respond to ill health and disease (Mackian *et al.*, 2004). Many factors may influence this response, including characteristics and knowledge of the individual and their ability to access the health resources. The socio-economic and cultural factors (Hetzel *et al.*, 2007; Ricci, 2012; WHO, 2013) including accessibility to health care sources shape household responses to illness (Mboera *et al.*, 2006, 2008). Cultural beliefs about causes and effective cure of illness as well as behaviour and practices, are known to interfere with the

control measures and health care seeking patterns (Nyamongo, 2002; Shayo *et al.,* 2003). Such behaviours occur within some institutional structure including family, community or the health care facilities (Shaikh and Hatcher, 2007). The success of any malaria control program, therefore, depends heavily on local community knowledge of ecological and socio-economic determinants and the strategies available and utilised to prevent it (Imbahale *et al.,* 2010; Mboera *et al.,* 2010).

2.7.1 Cultural factors*:*

Culture is defined as a pattern of ideas, customs and behaviours shared by a particular people or society. Culture is also known to be dynamic and adaptable to prevailing conditions (Malecki, 1998). Cultural factors such, as religion and ethnicity are significant determinants of health care service utilisation. They play a major role in the construction of perceptions of illness, knowledge and understanding of illness and hence the actions taken with regard to treatment (Tanner and Vlassoff, 1998) and prevention. The cultural beliefs of a community therefore shape healthcare practices and local ideas about illness, perceived severity and effectiveness of traditional healers have important implications on health-seeking patterns including prevention (Maslove, 2009). They have a direct bearing on acceptance of preventive measures (e.g., vaccines, prenatal care, screening tests, etc.), perceptions of individuals' ability to prevent and control disease. Therefore people who strongly believe and adhere to their cultural beliefs are likely to uphold and value local knowledge, as well as utilise it to deal with and adapt to endemic diseases such as malaria (see Figure 1).

2.7.2 Demographic/Socio-economic factors:

Demographic/Socio-economic factors of the community have direct bearing on the problem of malaria, and may be some of the reasons for seeking care outside the formal health care system (see Figure 1). Therefore extent of knowledge and utilisation of health care vary with the prevailing socio-economic conditions of health care service users (Collins *et al.,* 1995; Yadav *et al.,* 1999). For instance education pattern among the people has major influence in the prevention of malaria disease. It is widely known that formally educated people are more likely to abide to the biomedical health care practices, whereas the less educated will be misinformed and less compliant. Education is also tied to other health seeking determinants such as, culture, social status, occupation and income, which also determines ability to adapt (Maslove *et al.,* 2009). However this is not always the case as, no significant correlation was

observed between educational background and the use of traditional medicine for malaria treatment in a study conducted in the Philippines (Bell *et al.*, 2005).

Income determines health care seeking behaviour, risk factors associated with health outcomes (Mackenbach and Howden-Chapman, 2003), barriers to seeking health care (Taffa and Chepngeno, 2005), types of treatment and prevention (Nyamongo, 2002) and delays in service use (Johansson, *et al.,* 2000). For example lack of money to seek health care could be a reason for self-treatment. The cost of health care is not limited to treatment bills only but also time taken to travel back and forth (Atkinson *et al.,* 1999), transportation costs hence loss of income. In such cases applying local knowledge on readily available resources to prevent and treat illness may be seen as a better alternative, than seeking formal health care and for the poor households this may become an adaptation strategy.

2.7. 3 Gender, age and psychosocial factors

Gender differentiates roles and expectations, behaviours and constraints that are placed upon an individual by culture and society, by virtue of their sex, is reported to affect the utilisation of health and medical services in some developing countries (Pillai *et al.,* 2003). It has been found that women are more likely to delay health-seeking and treatment (Yamasaki-Nakagawa *et al.,* 2001; Fonck, *et al.,* 2001; Bashour and Mamaree, 2003). In India, Das and Ravindran (2010) found the use of traditional herbs more common among women, while the males resorted to conventional medication. On the contrary, Chaturvedi *et al* (2009) observed no association in gender and choice of health care providers (Traditional healers, governmental and private health services, and self-medication), for malaria in a study in northeast India.

Age as a determinant of health can be in coincidence with other factors. Usually the elderly find it difficult to access adequate health care (Waweru *et al.,* 2003), hence they may be more likely to resort to informal health care, home and folk remedies, traditional healers and medicine and even spiritual healers (Aikins, 2005) not solely due to economic reasons but as likely out of habit tradition (Sandhu and Heinrich, 2005), or personal beliefs and attitudes (Astin, 1998).

The psychosocial factors are usually influenced by other health determinants, such as, institutional, ecological, cultural and demographic. For example proximity to health services

for people in rural areas is limited and transportation is more costly (Buor, 2003). Psychosocial factors: of health describes how national and community level social processes lead to perceptions at the individual level (Egan *et al.*, 2008). They include stress, mental health status, coping behaviours, social support, and personality. These factors could influence utilisation hence the process that leads to help seeking (Buor, 2003). Individuals' experience of symptoms, assessment of own health status and health related concerns and behaviours, at a single point, are predictive of health care service use over long periods (Buor, 2003). These subjective experiences and assessments may have considerable stability over time, which allows them to adapt to the prevailing conditions through the use of local knowledge. This affects access to facilities, availability, environmental exposures and may determine the perceptions and attitudes of individuals. Rural dwellers are also disadvantaged in terms of emergency care (Bulatao and Ross, 2002). It is therefore not surprising that many rural communities have been observed to have a "culture of self-reliance" as compared to their urban counterparts (Mayer *et al.,* 2005). This implies that people in rural areas are more likely to seek health care outside the formal health care, where local knowledge becomes a very essential component of health and wellbeing, including adaptation to endemic diseases such as malaria.

2.7. 4 Ecological/environmental issues:

The environment in which individuals and populations live has a dominant effect on their health. The people have over the years, gained an understanding of the diverse aspects of the environment through experience and knowledge, which has been passed from generation to generation, thus ensuring community survival (Mazzocchi, 2006). This is the basis for local knowledge, which enables them to make decisions in the fields of agriculture, health-care, natural resource management and other activities (Boven and Morohashi, 2002). This local knowledge is based on oral history, ecology and geographical knowledge. Local knowledge on the ecological and environmental dynamics such as floods, rainfall and temperatures which occur during the life times of people enables them to understand environmental related health problems such as malaria and how to prevent, treat and adapt to them. Thus ecology significantly impacts on the kind of knowledge and innovations that are developed in a given specific context (Kolawole, 2012). Local knowledge is utilised in identifying vulnerability to malaria with environmental changes as well facilitate adaptive responses (Vedwan, 2006). Therefore local community people uphold the principle of prevention through practices such

as using traditional medicines (herb or animal-based etc.) and avoiding certain environments (United Nations, 2010).

2.7. 5 Institutional factors:

Ellis (2000) defines institutions as regularized patterns of behaviour structured by rules that have widespread use in society'. From an organisational point of view, an institution is a structure in a social context for purposes of governing human action (Hodgson, 2006). In other words, organisation refers to how a health care system manages its resources, which will ultimately determine if an individual uses health services. Local institutions play a significant role in households coping and adaptation alternatives (McCarthy *et al.*, 2001). Institutions influence adaptation especially at household community and household level. This is very relevant in this study because organizations are important for making community groups aware of available resources and their effective utilization (McCarthy *et al.*, 2001). Malaria control calls for synchronisation among the actors involved in policy making, within the various agencies and organisations across governance scales (Kramer *et al.*, 2009).

Government and non-governmental organisations play an essential role in the utilisation of local knowledge in health and other sectors. Therefore the organizational set of health service delivery systems (in or outside formal health facilities) largely determines people's health seeking behaviour (Shaikh and Hatcher, 2005). In most cases the primary options are self-care and use of local knowledge based traditional health care systems. However, health practitioners usually discourage utilisation of local knowledge based interventions and prefer recommending conventional biomedical options administered by formally trained medical staff. As Ahmed (2000) argues, formal health institutions do have the potential to promote and protect traditional knowledge systems and medicines. However, practitioners' intellectual property rights need to be recognized by creating enabling platforms for community participation in planning, programming implementation and monitoring of health services delivery (United Nations, 2010). Consideration could also be given on how to monitor utilization of local knowledge by communicating national successes regarding the use of traditional knowledge in enhancing community health (United Nations, 2010). Promoting a stakeholder driven decision tool framework could improve current policies as well as the effectiveness of malaria related institutions (Paul *et al.*, 2015).

Social institutions play a key role in determining adaptive capacity. Therefore inadequate institutional collaboration and support works against adaptation. Nations with ineffective institutional arrangements, commonly have a lower capacity to adapt than countries with well-established and effective institutions (McCarthy *et al.,* 2001). The success of any malaria control program therefore, depends heavily on local community knowledge of ecological and socio-economic determinants and the strategies available and utilised to prevent it (Imbahale *et al.,* 2010; Mboera *et al.,* 2010). There is need for both nations and international organisations such as WHO to work closely together in monitoring and response activities for in order to eliminate disease threats such as malaria.

## 2.8 A Conceptual framework for local knowledge, health service utilisation and adaptation to malaria endemicity:

Andersen and Newman's model of health care utilisation was first developed in the 1960s, and has since gone through four phases. The fourth phase of the framework was developed in the 1990s. This framework has been mainly used for explaining health care utilisation patterns by the general population (Evashwick *et al.,* 1984: Padgett and Brodsky, 1992). Multiple studies have evaluated these patterns, describing both prior health care service utilisation as a strong predictor of subsequent health care service use and items such as low-income status and a lack of motivation regarding prevention to health care procrastination (Murimi and Harpel, 2010). It has also been used to show that, differences in health care utilisation exist amongst various social classes in both developed and developing countries (Brenes-Camacho and, Rosero-Bixby, 2009). Elsewhere, the Andersen and Newman's framework has been used to identify areas in which policies should focus on improving utilization of preventive services, where Argentina has been a typical example of such efforts (Jahangir *et al.,* 2012). The healthcare utilization framework reveals factors that either facilitate or hinder utilisation of health service. It assumes that an individual's access to and use of health services is a function of three elements: a) predisposing factors, b) enabling factors and c): need factors.

### **2.8.1** Predisposing Factors

Predisposing factors are the characteristics of individuals that exist before illness and those that may influence the probability of an individual requiring a health service. They include: a) social structure which may shape how an individual handles health problems, such as education, occupation, ethnicity, social networks, social interactions, and culture, b) health

beliefs which may mould an individual's perceptions of their health care service need: Attitudes, values, and knowledge that people have concerning and towards the health care system and c) demographic characteristics such as age, gender, marital status and level of education. Predisposing factors might be exogenous, for example health care support.

### **2.8.2** Enabling Factors

Enabling factors are conditions that make health service available to an individual. They enable an individual to seek health care. They are the logistical aspects of obtaining care. They constitute empowerment factors such a) affordability of health services, b) possession of a health insurance policy, c) adequate income, d) personal and family factors and e) community factors.

### **2.8.3** Need Factors

Need factors reflect the needs of a health service user; they are the most immediate cause of health service use. Need factors are of two types; perceived and evaluated factors. Perceived need is the way people view their own general health and functional state, as well as how they experience symptoms of illness, pain, and worries about their health and whether it's serious enough to seek health care service (Andersen, 1995). This helps understand care seeking and adherence to a medical regimen. Perceived health may include different dimensions such as overall quality of life, perceived health, daily activities, and psychosocial variables as predictors of health service utilisation (de Boer *et al.,* 1997). For example a perceived belief that antenatal care was not adequate has been reported to be associated with not receiving this preventive care (De Allegri *et al.,* 2011). Perceived need will better help to understand care-seeking and adherence to a medical regimen.

Evaluated need represents professional judgment about people's health status and their medical care need. It depends on the kind of and amount of treatment that will be provided after a patient has presented their case to a medical provider. Evaluated need is more closely related to the kind and amount of treatment that will be provided after a patient has presented to a medical care provider (Andersen, 1995).

### 2.8.4 Other components of the Andersen and Newman's model

The model also comprises three components with a linear relationship: 1) primary determinants; 2) health behaviours; and 3) health outcomes. Primary determinants are the direct cause of health behaviours; they include characteristics of the population (demographics), the external environment (physical, and economic influences of utilisation), and the health care system (resources and organisation). The health policy, resources, and organisation, as well as the changes in these over time, constitute a health care system. Health care resources include the amount and distribution of human capital as well as education of health care personnel and available equipment.

In addition, the model explains that people's health behaviours determine health outcomes. Health behaviours include personal health practices (diet and exercise) and the use of health services. Health behaviours are the direct cause of health outcomes (perceived health status, evaluated health status, and consumer satisfaction) (Andersen, 1995). Furthermore, the model clarifies that there are several health services available and their purpose (preventive or curative) will determine utilisation. Thus, the utilisation of a specific health care service delivery system very much depends on characteristics of the population and the health services (Andersen, 1995; Andersen and Newman, 2005).

However the model does not pay sufficient attention to culture and social interaction (Guendelman, 1991: Portes *et al.,* 1992). Andersen (1995) argues that social structure is included in the predisposing characteristics component. Another limitation of the model is on the enabling resources is that organisational factors are not given enough attention (Gilbert *et al.,* 1993; Kelley *et al.,* 1992). However, Andersen (1995) argues that more detailed organisational measures can be included as additional enabling factors without too much damage to either the measures of the model. Going beyond the availability of regular medical care and organisation in the community should also reveal the potential importance of personal enabling factors in health service utilisation. The Andersen and Newman's framework is also silent on the role played by knowledge systems individuals may possess and how these influence choice of health care. Therefore individual's approach to health problems as well as the preferred solution or service will be predicated on forms of knowledge preference.

The usage preference theory (Kolawole, 2012; 2015) of local knowledge utilisation argues that local people, in spite of the bourgeoning modernity would continue to use certain aspects of different knowledge systems belonging to them in time and space as long as they consider them useful or relevant to their context-specific needs. Kolawole (2001) and Quardre (2010) have argued that there is a positive and significant relationship between preference for local knowledge and its utilisation in problem solving within particular local settings. Kolawole (2012) further argues that everyday life socio-cultural, environmental, economic and institutional pressures have been observed to play a significant role in the desire to adhere to one's own knowledge system. Therefore adherence to health service demands will also depend on the individual's preference for local or modern (formal) knowledge utilisation. Similarly, individuals and households in given socio-cultural, environmental, economic and institutional settings draw upon diverse knowledge system, including locally acquired ones, to make health preference decisions.

From the Andersen and Newman's framework the determinants of health care utilisation, which ultimately influence utilisation of local knowledge in health care have been assembled under predisposing, enabling and need factors, health care system and external environment. To be more contexts specific, it seems appropriate to zoom into the factors themselves. Hence the framework below (Figure 1) has been developed based on literature review and the above mentioned framework and theory. The utilisation of local knowledge is the targeted health behaviour under this framework, which will result in adaptation to malaria endemicity as the outcome.

In conclusion, literature has made a distinction between local knowledge and demonstrated other inter-related non-main stream concepts. Empirical studies have also revealed the importance of local knowledge in adaptation to malaria endemicity. The challenges and limitations in regard to adoption of local knowledge have also been identified. Adaptation has also been shown to be a broad concept defined accordingly. Background information on malaria prevention, elimination and residual transmission revealed the loopholes in the current interventions which require different approaches in addition in order to achieve eradicate this disease. The importance of social capital in production and progression of local knowledge has also been emphasised. The section also demonstrates the influence of socio-economic factors, climatic variability, livelihood sources and poverty in malaria transmission, wellbeing and consequently local knowledge utilisation. Some studies revealed that socio

demographic factors influence utilisation of local knowledge in health care, while others observed no association. The Andersen and Newman's model of health care utilisation categorised the reviewed determinants of local knowledge utilisation accordingly as predisposing, enabling and need factors. The model was also criticised for its shortcomings which were compensated for by the Usage preference theory. Lastly a conceptual framework specific to local knowledge utilisation in adaptation to malaria endemicity, was derived from a review of theoretical and conceptual frameworks, in relation to local knowledge and utilisation of health services.

## 2.9 Utilisation of local knowledge in adaptation to malaria endemicity framework

Figure 1 shows the factors influencing the utilisation of local knowledge in the adaptation to malaria endemicity. The likelihood of applying local knowledge to malaria depends on: the interaction among socio-cultural, demographic/socio-economic, ecological and institutional factors and their interplay with psychosocial factors. These factors also aid the ability to adapt to malaria endemicity. The successful and effective utilisation of local knowledge, over time results in adaptation to malaria endemicity. The back and forth double pointed arrows indicate that factors themselves influence each other. The dotted arrow shows the end product of local knowledge utilisation, which is adaptation to malaria endemicity. The dotted box indicates the potential confounding factors.

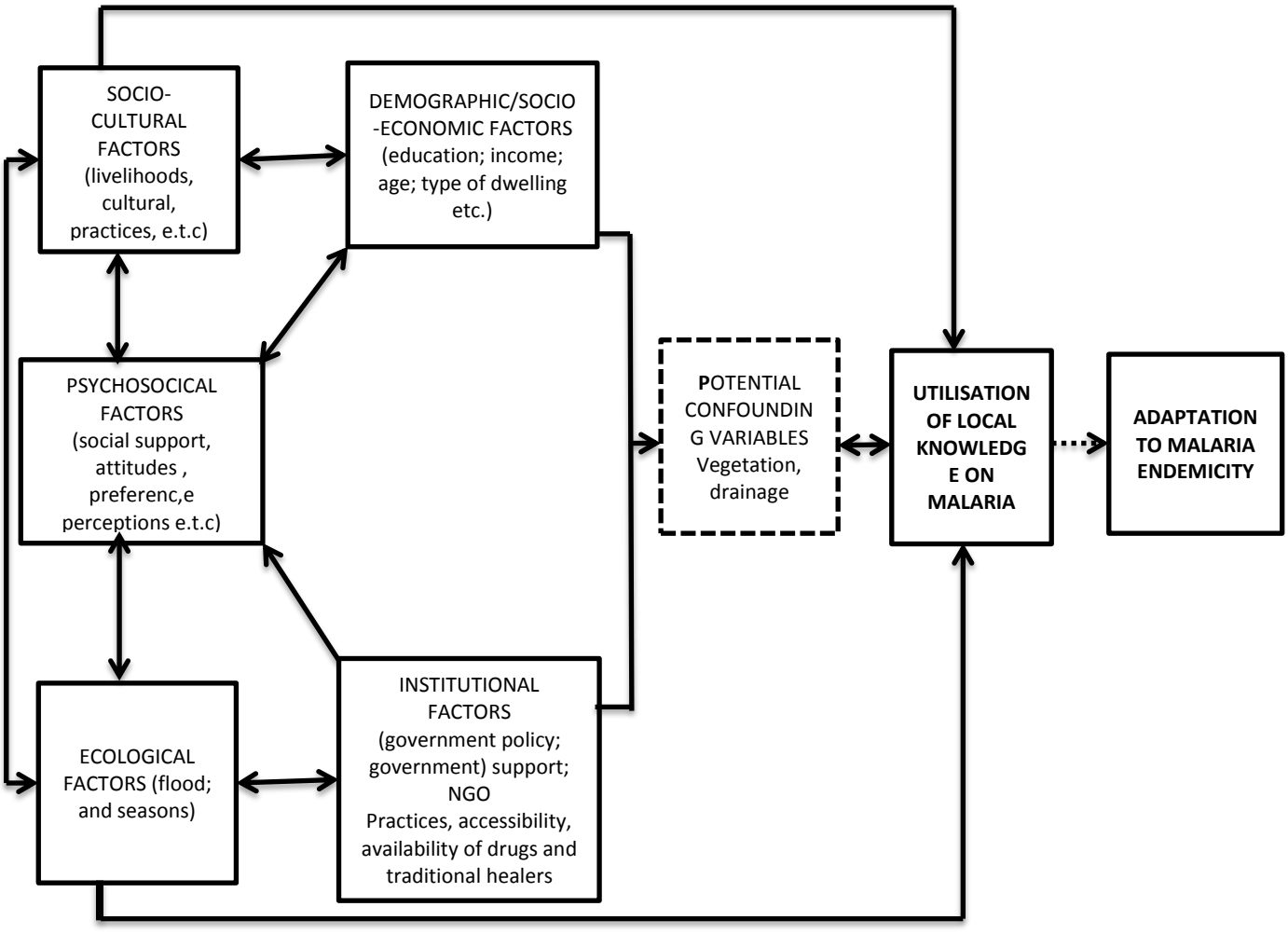


**Figure 1:Conceptual framework by author, showing the interplay among the factors that determine local knowledge utilsaton in adaptation to malaria endemicity**

# CHAPTER 3

## 3 METHODOLOGY

This chapter elaborates the methodology that was employed for collecting and analysing the study data. The research questions were cuts-across descriptive and analytical approaches. The chapter focuses on the a) study area, b) study design, where sampling procedure, data collection, data processing and analysis techniques are explained in detail and c) ethical considerations.

### 3.1 Study area

The Okavango Delta, in the north-western Botswana, is a perennial wetland in a semi-arid environment. The Delta is a habitat for many aquatic and terrestrial flora and fauna species and a vital source of livelihoods for the human population in the entire Ngamiland District (Kgathi, *et al.,* 2005). Consequently, the population is clustered in a band of settlements around the Delta. The area experiences very high temperatures ($32^{o}$ C average daily maximum) and receives rainfall averaging 500mm per annum (Department of Meteorological services, 2015). However, annual floods provides opportunities for water related activities such as flood recession farming (*molapo* farming) thus, farmers exposed to surface water that are conducive habitats for the malaria vector.

This Okavango Delta is known to be a freshwater inland Delta with seasonal and permanent flood *plains. Anopheles arabiensis* mosquito species for over 98% of malaria cases in Botswana is known to breed in temporary and sunlit freshwater, thus making this Delta a suitable breeding site. Hence the Okavango sub-District is a malaria endemic area with high malaria cases (usually accounting for more than 50% of the national malaria cases). This sub-district was reported as one of the significant malaria hotspots nation-wide, in 2008-2010 and 2011 (Simon *et al.,* 2013). From the year 2009 to 2012, the region accounted for 22% of total cases of malaria reported in Botswana (Simon *et al.,* 2013). However, in January to March 2014, about 63% of the total reported cases of malaria nation-wide were from the Okavango Delta region indicating a highly significant increase (Ministry of Health, 2014). Chimbari and Magole (2009) reported that even though the malaria control programme in the Okavango District is functional, accessibility to healthy facilities is limited during the rainy season and in times of high floods. In the absence of rain, the malaria vector (*Anopheles* mosquito) makes use of the hoof prints left by animals on the edges of water channels as breeding sites.

This creates good breeding sites for mosquitoes which can also be primarily attributed to permanent swamps within the Delta (Chimbari and Magole, 2009).

Two study sites were selected in the delta, namely Shakawe and Ngarange villages. These were selected based on i) the number of malaria cases recorded in by the Ministry of Health in 2014. ii) proximity to the perennial surface water and iii) access to health facilities. Communities in this area are vulnerable to malaria during periods of flooding. Shakawe and Ngarange villages **(**Figure 2**)** are located in the area designated as malaria endemic. Shakawe is the largest fishing village in Botswana (Mmopelwa *et al.*, 2005), this activity has been documented to promote exposure to malaria vectors (Barai *et al.*, 1982). Shakawe village is located in the upper northwest corner of Botswana on the northern banks of the Panhandle of the Delta (Figure 2). The population of Shakawe was 6693 (CSO, 2011) and the village is growing steadily, has a shopping centre, government offices, NGOs and several private safari lodges. This village accounted for more than 50% of the malaria cases from the district in 2014 (129 cases out of 891).

Ngarange village is on the eastern part of the panhandle along the Okavango River (Figure 2). It has a population of 988 people (CSO, 2011). Livelihood activities in both villages include but not limited to fishing, gathering of wild and aquatic fruits, pastoral and arable *molapo* farming. The main ethnic groups found in these villages are the HamBukushu, Baherero, Bayei, Basarwa and Batawana. The livelihoods of these ethnic groups particularly the HamBukushu and Bayei are traditionally dependent on water resources (such as fish). Hence they are likely to be exposed to malaria transmission. Bayei are also traditionally dependent on *molapo* farming. Ngarange village accounted for 53 malaria cases in 2014 (Ministry of Health, 2014).

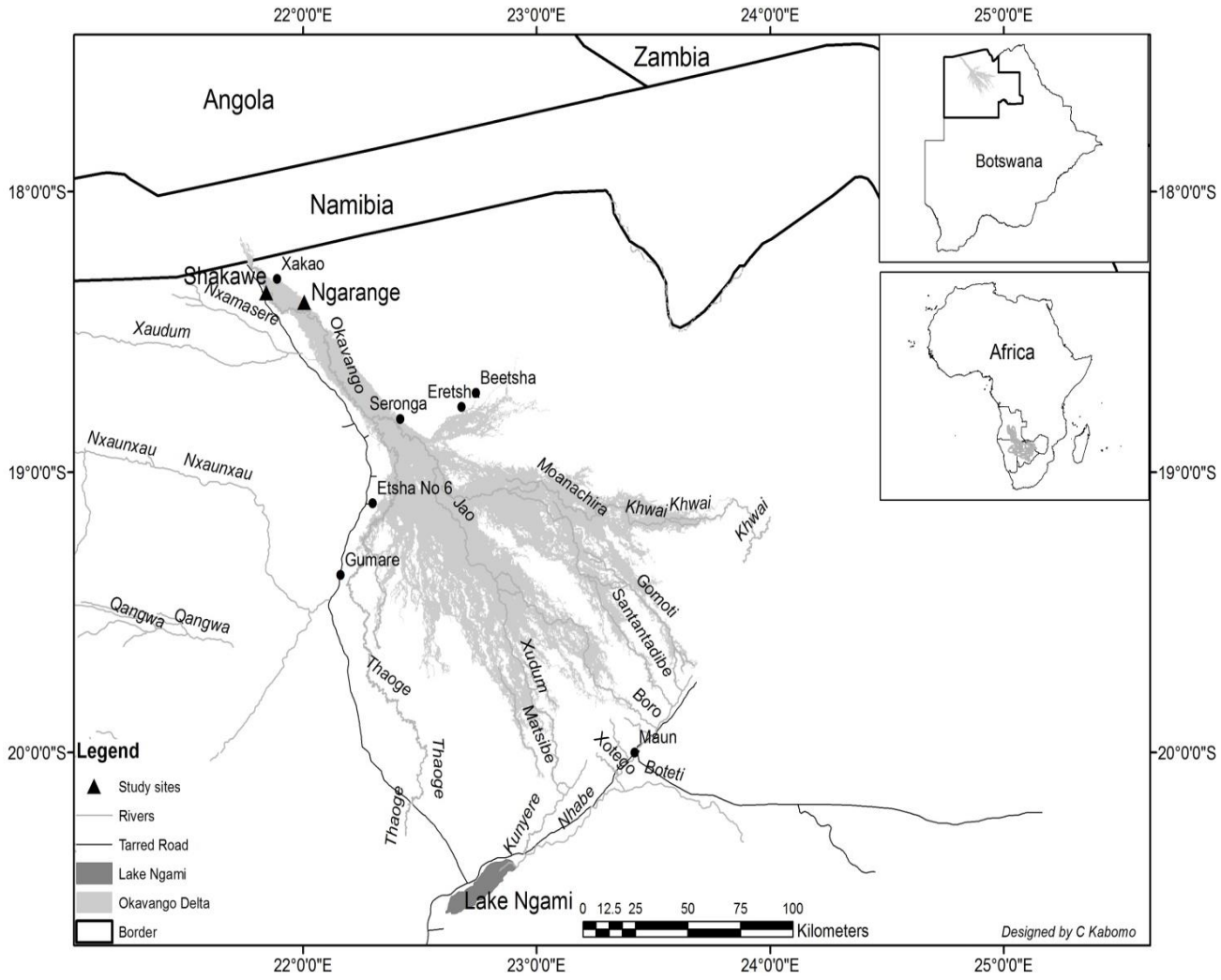


**Figure 2: Map of the study area showing the study sites (Shakawe and Ngarange)**

## 3.2 Study design

The study adopted a mixed approach (both quantitative and qualitative). The mixed approach is usually used when one type of research (qualitative or quantitative) is not adequate to address the research problem or to answer the research questions (Creswell, 2012). It is used for complementarity, expansion and explanation purposes (Bryman, 2006). The quantitative aspect of this study is designed to address the household survey, which seeks to determine the relationships between variables. It involves collection of data through close-ended checklist, on which the researcher checks the behaviours under observation (Creswell and Clark, 2006).

In contrast, the qualitative aspect (such as focus group discussions) explores the experiences, attitudes and perceptions of discussants and elucidate on the development and operation of knowledge and ideas at the local level (Kitzinger, 1995). It consists of open-ended information gathered through interviews with participants. This will allow the participants to phrase responses in their own words. In addition data will be collected through observation and images (Creswell and Clark, 2006).

This is a non-interventional analytical and exploratory study, which was carried out through a cross-sectional survey. Non-intervention studies are observational in nature and objects/subjects can only be observed and analysed, with no action taken afterwards. The analytical part of the study addresses in-depth analysis of data collected. In cross-sectional surveys, data on independent and dependent variables, individual characteristics, risk factors, together with data on the outcome are collected at the same time and over a short period (Levin, 2006). In this way cross-sectional studies offer a 'snapshot' of the outcome and the characteristics linked with it at a definite point in time (Levin, 2006). Thus cross sectional approach is suitable due to time limitation and is more appropriate because the aim is to describe the current level of local knowledge and implement the guidelines. The time limitation (short duration) and the fact that little is known about the problem makes this study exploratory.

### 3.2.1 Sample design and selection

This study used both probability and non-probability sampling methods. Probability sampling includes the use of stratified random sampling technique, where the population was first divided into strata (wards). Stratified random sampling is a technique which attempts to restrict the possible samples to those which are ``less extreme'' by ensuring that all parts of the population are represented in the sample. This reduces bias in sample selection. Stratified sampling was found suitable due to the heterogeneous (high, middle, low or no malaria incidences) sub-groups in the population that were likely to differ considerably. Then a simple random sample was selected from each stratum so that each subject had an equal chance of selection. This approach was employed in household survey sample selection. The random sampling was done without replacement because it was not necessary for this study to investigate a unit more than once.

### 3.2.1.1 Sampling procedure

**Initial sampling [from a household survey]**

This study used data from a cohort followed up retrospectively from a socio-economic survey that was conducted from 27th October to 6th November 2015 in the two study villages. The socio-economic survey sample was determined through stratified sampling procedure. First, the wards were stratified based on spatial size (that is, small, medium, large) in both villages. Malaria case classification (low, medium, high) was also used to determine ward selection in Shakawe. The levels (high, middle, low or none) were determined based on the data collected from the local clinic records on malaria incidences in each ward. The classification of the number of malaria cases by ward was as follows: 0-1 cases being 'Low', 2-10 being 'Medium' and above 10 being 'High'. This was done in order to ensure that all parts of the population are represented in the sample and to reduce bias (Fitzpatrick and Wallace, 2006). A household listing was then done in the selected wards in the two villages in order to establish a sampling frame. Simple random selection of households proportional to size of the ward (in terms of household number) was then carried out. The sample size was determined from the total number of listed households in each village. This was calculated using Cochran (2007) sample size formula for categorical data. Shakawe had 877 households, Ngarange had 300. The confidence level was fixed at 95% with a margin error of plus/minus five ($^{+}_{-}$5). Thus a total of 274 households from Shakawe and 81 from Ngarange were interviewed, both totalling 355 households. Essentially, the overall sample in both villages summed up, made up 31% of the total number of listed households in both study village. In social research, this is considered appropriate for small populations (Moser and Kalton, 1971; Balnaves and Caputi, 2001).

**Cohort study sampling**

A retrospective cohort study type uses data already collected for other purposes, but carried out at a later stage (Mann, 2011) and also previously collected data on exposure status for both cases and non-cases (LaMorte, 2016). The purpose for carrying out a cohort study was to further investigate the exposure and practices of malaria affected households. Cohort retrospective studies tend to be prone to selection bias due to maturation of study subjects and or failure to follow up some. Losses of study subjects however do not necessarily nullify the study. For this study, the sample (355 households) for the socio-economic study was used as a sampling frame, to follow up respondents who had experienced malaria. From the 2015 socio-

economic survey, a total of 129 households with malaria cases were initially identified. However, the retrospective cohort study household interviews were conducted with 79 households (or 61% of 129). Of the 79 households interviewed, 54 were from Shakawe and 25 from Ngarange. The initial cohort attrition factors included absence of targeted households from home, subject loss due to relocation, death and or unwillingness to participate in the follow-up study. But more importantly, the flood level had receded at the time of data collection, therefore making most community members to be available during day time because it was the season of reed and grass harvesting as well as fruits gathering.

Non-probability sampling employed purposive sampling technique to select key informants, and focus group discussants. Purposive sampling is suitable for selecting "information rich" individuals, groups or organizations that have the greatest insight into the research question (Devers and Frankel, 2000). This strategy selects leading persons with a more familiar and relevant view with the subject matter than other participants. Views from a sample of this group are more reliable than a random sample, although the findings are still not generalizable to the overall population (Bhattacherjee, 2012).

A total of 16 key informants were interviewed (10 were from Shakawe and 6 from Ngarange). Criterion-based purposive sampling was used and the criteria for selection included personal skills, leadership position in the community, and occupation/profession. Criterion-based sampling is used to identify and select all cases that satisfy a pre-set criterion of importance (Palinkas *et al.,* 2013). These key informants were viewed as either custodian of local knowledge and opinion leaders able to make inferences (Marshall, 1996) about utilization of local knowledge on malaria epidemic in their area. These key informants are also relevant because, of their personal skills, position in the society, they are able to provide more information and a deeper insight into the dynamics and events around them. They are interested in the behaviour of those around them, they observe the development of their culture and often speculate, or make inferences about, both (Marshall, 1996). A key informant interview guide was used to conduct the interviews. This was helpful in gathering in-depth information on attitudes, beliefs, and anecdotal data from individual witnesses. Personal contact with participants stimulated rich and more detailed responses. It also provided an excellent opportunity to probe and explore questions.

One focus group discussions (FGDs) was conducted in each study site. Criterion-based purposive sampling was also used to select the FGDs. The selection criteria for FGDs were age, gender, length of residency, and household livelihood activities. Some of the participants were identified during the household interviews prior to the FGDs. FGDs served to explore the meanings of survey findings that cannot be explained statistically, the range of opinions/views on a topic of interest and to collect a wide variety of local terms (Overseas Development Institute, 2009). In-depth information on knowledge, attitudes and practises, experiences, norms and beliefs as well as data on recommendations for malaria prevention was collected. As this technique relies heavily on oral communication, therefore data was collected using mainly a voice recorder.

Data were also collected through a Participatory Rural appraisal (PRA) workshop. One of the strengths of PRA is that the analysis and interpretation of findings is carried out during the appraisal providing opportunities for cross-checking (Townsley, 1996). The overall objective of the PRA was to gather and package knowledge from the community about their livelihoods in general and how these relate to the social, environmental and climate variability impacts of malaria and/or bilharzia.

The PRA was held in Shakawe village from 25th – 27th June 2014. This period was selected to optimize participation since it is a low activity period in terms of community livelihood activities and in the hydrological cycle of the Okavango River flood pulse. A total of 34 participants from Shakawe and Ngarange villages were selected purposively based on diversity of socio-economic backgrounds in terms of profession, knowledge and influence of health issues. The participants comprised of 10 females and 7 males from Ngarange village, and 7 females and 10 males from Shakawe village, thus 17 participants from each village. The participants included village elders, youths, women and men from diverse occupational backgrounds including farmers, social workers, chiefs, teachers, nurses, traditional and spiritual healers. Their position in society gives them access to information sought by our research (Marshall, 1996). The PRA participants were divided into three gender-mixed focus groups of 11-12 individuals through random numbering. Each group was assigned specific tasks with instructions, and was led by a scribe and a facilitator.

### 3.2.2 Data collection

#### 3.2.2.1 Household interviews

A week before the commencement of the actual data collection exercise, the instruments were pre-tested in Mohembo, which is 10 kilometres away from Shakawe, having similar characteristics with the two communities being studied). This pre-test exercise was done to ensure that the instruments were consistent in their pattern of measurement.

During the actual data collection, face-to-face interviews were conducted using a structured interview schedule, with the help of a trained and experienced research assistant. On the average, an interview lasted between 35 and 40 minutes. Data were collected on household socio-economic background, sources of livelihood, local knowledge utilization on malaria prevention, local adaptive strategies against malaria and perceptions on health institutions.

In assessing the local knowledge used in malaria prevention, respondents were required to answer "yes" or "no" to a list of 13 question regarding knowledge utilisation in malaria prevention, compiled based on literature review, and from previous socio economic survey results. The respondents were also asked to rate how often they utilise the knowledge and its effectiveness, two separate 5-point Likert type scales. The scale options for frequency of use were 1 "always", 2 "usually", 3 "Sometimes", 4 "Seldom" and 5 "Never". On the effectiveness scale: 1 "very high", 2 "high", 3 "moderate", 4 "low" and 5 "very low''.

In analysing relationship between livelihood activities and exposure to malaria transmission, a list of 13 livelihood activities, compiled based on the previous conducted socio-economic survey was used. Respondents were required to state the season (specify months) at which the livelihood activates they take part in take place. Exposure to malaria transmission was also measured by: a "time of day" (6am-8am, 8am-12pm, 12pm-4pm, 4pm-6pm, 6pm-8pm, 8pm-12am, 12am-4am and 4am-6am) b "duration of activity" ( 1-2 hours, 3-4 hours, 5-6 hours, 7-8 hours and more than 8 hours), c "suitable attire" (short sleeve, long sleeve, any and non) and d "chances of mosquito bites" (very high, high, moderate, low and very low), which were all measured on Likert scales.

In assessing the adaptive strategies against malaria transmission, respondents were required to answer yes or no to a list of 11 adaptive strategies, compiled based on literature review, and

previous socio-economic survey results. The respondents were also asked to rate how often they use the strategies and their effectiveness on two separate 5-point Likert type scales. The scale options for frequency of use were 1 “always”, 2 “usually”, 3 “sometimes”, 4 “seldom” and 5 “never”. On the effectiveness scale, options were categorized into: 1 “very high”, 2 “high”, 3 “moderate”, 4 “low”, and 5 “very low”.

In assessing the perceptions towards health institutions, the respondents were asked to respond to a set of statements on a 5-point Likert type scale in relation to how they perceived health care institutions and delivery. The scale options ranged from “strongly agree” (1 point) to “strongly disagree” (score: 5), with a “neutral” opinion in between (score: 3). Thus, disagreement with a statement about health institutions practices receives higher scores (either 4 or 5 points). Eight Likert items/ statements which reflected health institutions’ practices regarding malaria were used to show households’ perceptions. Therefore the possible maximum score, a respondent could obtain, was 40 points and the minimum was 8 points from which the average was computed based on the 8 Likert items measured on the scale.

#### 3.2.2.2 Key informant interviews

The 16 key informants (10 from Shakawe and 6 from Ngarange), were interviewed using a semi-structured interview guide with both semi-closed and open-ended questions. The informants included chief/headman; health officers, village health and or village development committee chairpersons, malaria focal person, community health nurses, medical doctors, district health management team members, elderly community members and traditional healers. A key informant guide was used to collect data on a) adaptive strategies against malaria, b) utilisation and adherence to interventions and c) awareness of mosquito and malaria patterns. On average an interview had duration of between 40 and 45 minutes.

#### 3.2.2.3 Focus group discussions

In Shakawe village, the FGD participant’s age ranged from 32-63 years and 24-56 years in Ngarange. Regarding gender composition, two females and six males participated in the FGD session in Shakawe while six females and three males participated in the session in Ngarange. Usually 8 to 12 participants are the ideal number, but 10 is considered better since a few may decide to cancel at the last minute (Morgan, 1998). A focus group discussion guide was used to conduct the FGD. Although focus group discussants were relatively homogenous based on

external threat of malaria transmission, other characteristics (such as age, gender, occupation) and livelihood activities (such as fishing, livestock herding, reed harvesting, farming, informal and formal employment) constituted internal diversity. The purpose of conducting FGDs was to gather in-depth analysis to compliment household survey with data on a) household perceptions on health care institutions' service delivery, b) utilization of local knowledge, c) patient health seeking behaviour, d) utilization of local knowledge on malaria prevention and or treatment in the study area. This technique was also used to supplement the household survey method and make use of participants' interactions. FGDs data were voice-recorded on tape and notepad, and were transcribed and coded by the researcher. In addition, a trained field assistant helped with translation where necessary and took additional notes during the discussions while the researcher focused on facilitation. The focus group discussions lasted between 30 and 40 minutes.

#### *3.2.2.4* Participatory Rural Appraisal

PRA tools were also used to analyse relationship between livelihood activities and exposure to malaria transmission. They included, livelihood analysis (free listing and ranking) and disease calendar, as well as impact of climate/seasonal variability on disease and vector dynamics. These tools provided data on malaria exposure in relation to livelihood activities and climate variability.

In order to compensate for the limitations in numerical descriptions, in addition secondary data sources, field observations and informal interviews were used for expansion and explanation purposes (Bryman, 2006). Secondary data sources were also consulted to supplement and strengthen the validity of primary data. This included desk review from unpublished reports on: malaria trends, malaria control programme policy obtained from the Ministry of Health; rainfall, floods and temperature trends from the Department of Meteorological Services; and village population statistics in government publications derived from Statistics Botswana. These sources provided information that capture past changes and developments in malaria infection, including the trends over the years. Published journal articles formed the bulk of literature review, and also used to guide construction of data collection instruments and in the discussions to support and critique findings from the field or primary data.

The survey instruments, focus group script, and interview guides are available upon request to the author.

### 3.2.3 Data processing and analysis

Quality assurance of quantitative data from the cohort household survey was done by the principal investigator in the field to check and correct data capture errors and also through pre-data entry, sorting and coding. The data were coded, entered and cleaned in SPSS spread sheet. The coding process involved; categorisation and allocation of numerical codes to all close-ended responses. Data were analysed using descriptive statistics (such as frequency and percentages), measures of central tendency (i.e. mean, standard deviation). Non-parametric (Kruskal-Wallis and Mann Whitney) statistics were also used to explore the differences in perceptions and use of adaptive strategies with demographics of the population understudy.

Mann-Whitney test assesses whether the medians/means of two groups are statistically different from each other (Hart, 2001; Laerd-statistics, 2016). While Kruskal-Wallis test determines if there are statistically significant differences between two or more groups. Thus these tests analyse dependency or causal relationship between an independent variable and dependent variables in question (Field, 2013; Laerd-statistics, 2016). They are suitable and therefore advantageous for data that does not meet assumptions of parametric techniques (t-test and anova) because they are robust to assumptions required under parametric tests, particularly a) large samples size and b) normally distributed data. The test assumes a) random samples and b) independent observations, where; a) the dependent variable should be measured at the ordinal or continuous level (i.e., interval or ratio), b) independent variable should consist of two or more categorical, independent groups (Pallant, 2005; Laerd-statistics, 2016).

However they are omnibus test statistics, thus they do not indicate where the differences are. Post-hoc tests rectify this shortcoming. Non-parametric tests, are unlikely to catch a small effect that does exist, thus they are less powerful (Siegel and Castellan, 1988). They are convenient for dealing with unanticipated, outlying observations that might be problematic with a parametric approach (Whitley and Ball, 2002)

Qualitative data from key informants' interviews and, focus group discussions were analysed using content analysis procedure described by Mayring (2000). The process entails 'structuring' data with the intention to filter the relevant content and pre-determined

categories (themes). All of the categories were reviewed and others merged to form sub-categories. Content analysis process requires reading and re-reading data sources (key informants and FGD transcripts (Mayring, 2000).

Livelihood analysis was carried out by listing and ranking of the livelihoods activities from the PRA data. This was followed by perceived malaria exposure in relation to livelihood source. Livelihood sources were then ranked relative to the exposure to malaria, to establish the extent to which they are perceived as likely to expose people to malaria. From this ranking a seasonal analysis of livelihood sources was done to demonstrate perceived linkages between climate/seasonal variability and malaria exposure. For meaningful analysis, livelihood sources, vector abundance and disease patterns were then mapped against the climate variables of flood and rainfall to produce a 'livelihood-malaria seasonal calendar' (Mukherjee, 1997).

### 3.2.4 Validity and Reliability

Validity refers to the degree to which results obtained from the results of any data actually provide relevant facts about the phenomenon being explored (Creswell and Miller 2000). To ensure validity in this study, the choice of research variables were guided by the research objectives and the data collection tools were reviewed by a team of experts. Reliability is the measure of the degree to which a research instrument yields consistent results or data after repeated trials. It is the extent to which data are truthful and the extent to which results are replicable *(*Leedy, 2001). The purpose of carrying out a pre-test exercise before data collection was to ensure that the instruments were consistent in their pattern of measurement. Furthermore, responses were captured in an audio recorder and note taking. Moreover, respondents were comfortable providing the information requested from them without hesitation. Under PRA, after group activities one participant from each group made a presentation to all participants for the purpose of validation of the information by other villagers and researchers.

### 3.2.5 Ethical considerations

#### 3.2.5.1 Voluntary participation

Participation in this study was absolutely voluntary, and was not induced in any way. Participants were informed that they had the right to discontinue at any time. There was no punishment or threats for refusal to answer any questions, thus decision to participate was without force, undue influence or intimidation.

#### 3.2.5.2 Informed consent

Individuals were made aware of the implications of participating before taking part. Participants in this study decided voluntarily whether to participate or not, after receiving and adequately understanding necessary information about the proposed research. Benefits and potential risks, expected responsibility, confidentiality, objective of the study, procedure and study duration, was explained to the participant.

#### 3.2.5.3 Confidentiality

Participants' confidentiality was ensured, no information which could give away the participant was required and only authorized people had access to the information collected. The information collected is also be stored appropriately to ensure confidentiality.

#### 3.2.5.4 Justice

This study used recognized and unbiased methodology to minimize unfair selection of subjects. The study also used a mixed methods approach for triangulation purpose, where more than one source of data was used to understand the phenomenon being studied from various points of view (Ary *et al.*, 2013). This strengthens conclusions about findings and reduces the risk of false interpretations (Hales, 2010). This will reduce bias of the whole study.

### 3.2.6 Data dissemination plan

Data will be disseminated through conferences and seminar presentations (See plan of data dissemination in chapter five**)**, page). Results will be shared with the affected communities as

a form of feedback in *Kgotla* meetings and clinics. The annual national malaria conference will also serve as a good platform for data dissemination.

# CHAPTER 4

## 4 RESULTS AND DISCUSSIONS

This chapter presents the study findings. The chapter is divided into five sections. The first section is a general discussion of the socio-economic and demographic background of the respondents. The remaining four sections present the main findings of the study, focusing on the results, discussions and conclusion. The sections are structured based on the study objectives, which include: a) local knowledge utilisation in malaria prevention by households; b) rural livelihoods and household exposure to malaria transmission; c) household adaptive strategies against malaria endemicity; and d) household perceptions on health institutions' utilization of local knowledge on malaria prevention.

### 4.1 Socio-demographic background

Based on the findings of the cohort study, 32.9% of the households were represented by males, while 67.1% were represented by female respondents. The ages ranged from 18 to 90 years old and the mean age was 38 years. Majority (43%) of the respondents were in the age group (bracket) of 29-39 years; these are people who may have witnessed previous and current practices in relation to malaria prevention. The household types were male-headed (55.7%), (which were also the major participants across all livelihood activities), *de facto* female-headed (38%), and *de jure* female-headed (6.3%). While the highest level of education attained in most households was the Senior Secondary (43.2%), the lowest was primary school education (1.3%). The types of dwelling were mainly traditional mud/reed with thatch roof (45.6 %), mainly traditional mud/reed with corrugated iron roof (12.7%), mud plastered with cement (2.5%), modern brick house (constituting 1-3 rooms, iron roof and concrete walls) (36.7%) and modern brick house (multifunctional rooms, iron/tile roof, concrete walls) (2.5%). Majority (88.6%) of the households prepared their meals out-doors and 11.4% prepared the meals indoors.

In comparison to the cohort sample, there were more males (50.4%) and less females (49.6%) representing the households in the socio-economic survey. The male headed households constituted 36.7% of the population, which was less than the result obtained in the cohort study. *De facto*-female headed household on the other hand constituted 15.5% of the

households, which also smaller than the percentage obtained in the cohort. However, there were more *de jure* female headed households (50.7%). In terms of house structure, the mud/reed house structure (55.8%) also dominated like in the cohort. The households' level of education was mainly junior secondary school (30.4%) in the survey as against the cohort study in which most households had senior secondary school education.

## 4.2 LOCAL KNOWLEDGE UTILISATION IN MALARIA PREVENTION BY HOUSEHOLDS

This section focuses on the first objective of the study, which assesses the local knowledge used by households in the prevention of malaria in Shakawe and Ngarange villages. The analysis addresses the awareness of malaria season, utilisation of malaria prevention knowledge and effectiveness, knowledge use across sex, age and education level, and lastly discussions of the results and conclusions.

### 4.2.1 Households' awareness of malaria season

As shown in Figure 3, majority (94.9%) of the respondents were aware of malaria disease; indicating that they were already aware of it through various information sources including the radio, television, Kgotla meetings, and newspapers. They were also aware of seasons during which malaria transmission becomes effective. This awareness of malaria can be attributed to the endemicity of malaria in the area as well as the availability of information, education and communication, which had long existed in the communities.

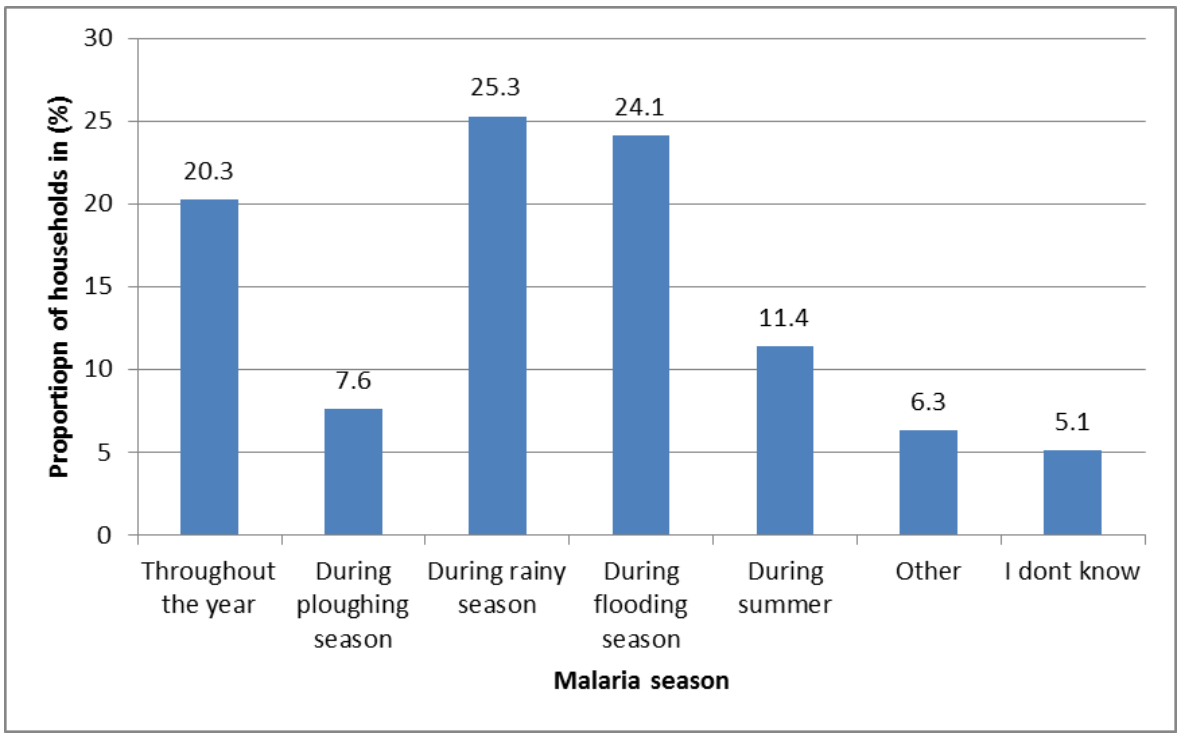


**Figure 3: Households' awareness of malaria season**

Majority (25.3%) of households observed that malaria occurs during rainy season. Some respondents (24.1%) indicated that it occurred during flooding season, whereas others stated

that it occurs throughout the year (20.3%). A few of the households ranging from 7.6 % to 11.4 % indicated that malaria prevails during summer, and in the ploughing season. Those categorised as 'other' comprising 6.3% of the households indicated that malaria infection occurs: a) when the vegetation cover is thick; b) during the harvesting period; and c) when IRS is not administered. The remaining 5.1% did not know when this disease is most likely to be prevalent.

Key informant interviews also confirmed the perceptions of most households that, *"malaria increases with floods and thick grass cover in the surrounding*" as one informant emphasized. The informants also observed that mosquitoes enter houses *'at all times: morning, during the day, evening and at night,* including *"when doors and windows are open."* The key informants also mentioned that once indoors mosquitoes hide in dark places "*especially under beds and furniture*." These observations seem to speak to changes in mosquito behaviour, not just seasonally, but also their perennial presence "*even during winter*" including continued biting throughout the year. Malaria cases were also observed to be escalated by floods, presence of surface water and untidy environment. The key informants also linked malaria to poorly constructed houses and poverty, apparently *"people fish with nets, not because malaria is not dangerous but because they are faced with two different disasters: hunger and malaria, therefore they find it more beneficial to get something to eat, even if it means putting their health at risk."*

The claim that malaria cases are escalated by floods was also attested to by the focus group discussants, who stated that *"the abundant water flowing from Namibia"* led to an increase in malaria cases in their area. They indicated that floods provide favourable breeding conditions for the mosquito population. According to the focus group discussants the malaria problem is also worsened by the fact that, communities are not allowed to burn the vegetation in the river. They elaborated that *"the previous practice of burning in the river really helped, we used to stay for almost a year without mosquitoes, it really reduced mosquito numbers, but now we are no longer allowed to burn."* According to them, the vegetation in the river should be set on fire in early September, this practice helped in getting rid of mosquito eggs and larvae.

They further stated that the malaria problem in their area is exacerbated by the presence of papyrus and reed in the river, which provides favourable breeding environment for mosquitoes. Furthermore, the focus group discussants linked malaria transmission to "*lack of knowledge in general, even when given mosquito nets you cannot use it, because of lack of knowledge."* Abandoned homesteads were also considered to be favourable breeding grounds for mosquitoes as *"that's where mosquitoes hide."* On mosquitoes' behaviour it was also mentioned that there has been a range of new species observed, furthermore the vector has been observed to bite more painfully and increase in number and *"mosquitoes are more prevalent in homesteads, unlike in the past."* They explained that *"in the past mosquitoes were more common in the jungle than in human dwellings."*

### 4.2.2 Utilisation of local knowledge in malaria prevention

Data in Figure 4 reveal that most (46.8%) respondents had the knowledge about the use of elephant and insecticide treated net and cow dung as mosquito repellents. This is probably because elephant and cow dung are the most abundant resources in the area. Both strategies were utilised by 46.8% of the households, where both were mostly used sometimes by 36.7% of the households.

Majority of the key informants also mentioned the use of dry cow and elephant dung to repel mosquitoes. According to the focus group discussants these are widely known and still used by everyone, especially *"from August to April, when mosquitoes bite a lot.*" The smoke is said to be *"highly effective, as much as mosquito coil, it lasts for 24 hours."* The elephant and cow dung *"are mostly used by people at cattle post."*

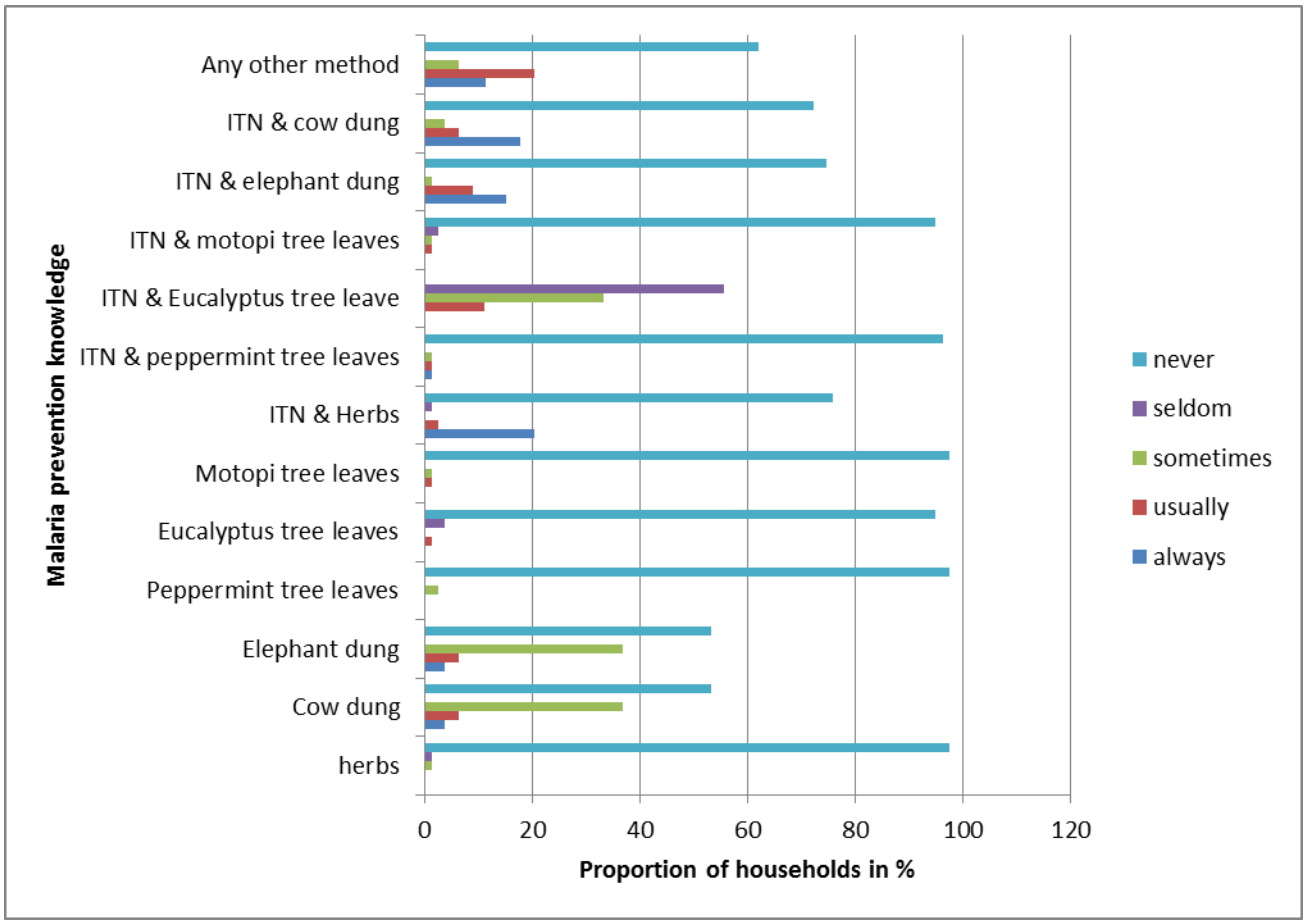


**Figure 4: Malaria prevention knowledge use frequency by households**

The forms of prevention moderately used by households include a combination of ITN and cow dung (27.8%), ITN and elephant dung (25.3%), and ITN and herbs (24.1%). These were also more frequently used as indicated on the always level of use; ITN and herbs (20.3%), ITN and cow dung (17.7%), ITN and elephant dung (15.2%). Eucalyptus tree leaves (5.1%) and peppermint (*schinus molle*) tree leaves (2.5%) were the least used. Both the key informants and focus group discussants justified the low usage to the fact that these plants (particularly peppermint tree) are not abundant in their area.

The use of ITN, clearing the surrounding by cutting grass and wearing long sleeved clothes were other methods used. Another prevention method mentioned by one traditional healer is the use of *Mohetshola* green leaves. Another informant mentioned "*mongoo tumwe"* in Hambukushu language *"which means mokwata wa monang in Setswana"* and *mosquito back* in English as one of the plants that repel mosquito with their odour. *Mongoo tumwe*, is usually available during the rainy season by the river banks. *"The leaves are placed under the pillow at bed time, to provide protection against mosquito bites at night."* One of the focus group

discussants mentioned another herb, *called "nxwii pimboro in Sesarwa language, which means maoto a monang in Setswana"* and *mosquito legs* in English. *"It has yellow flowers, the scent repels mosquitoes, and it is usually available during the rainy season".* The other mosquito repellent is a plant with white flowers, known as *"dimangwe in Hambukushu language, it gives off a minty (vicks vapour rub) odour."*

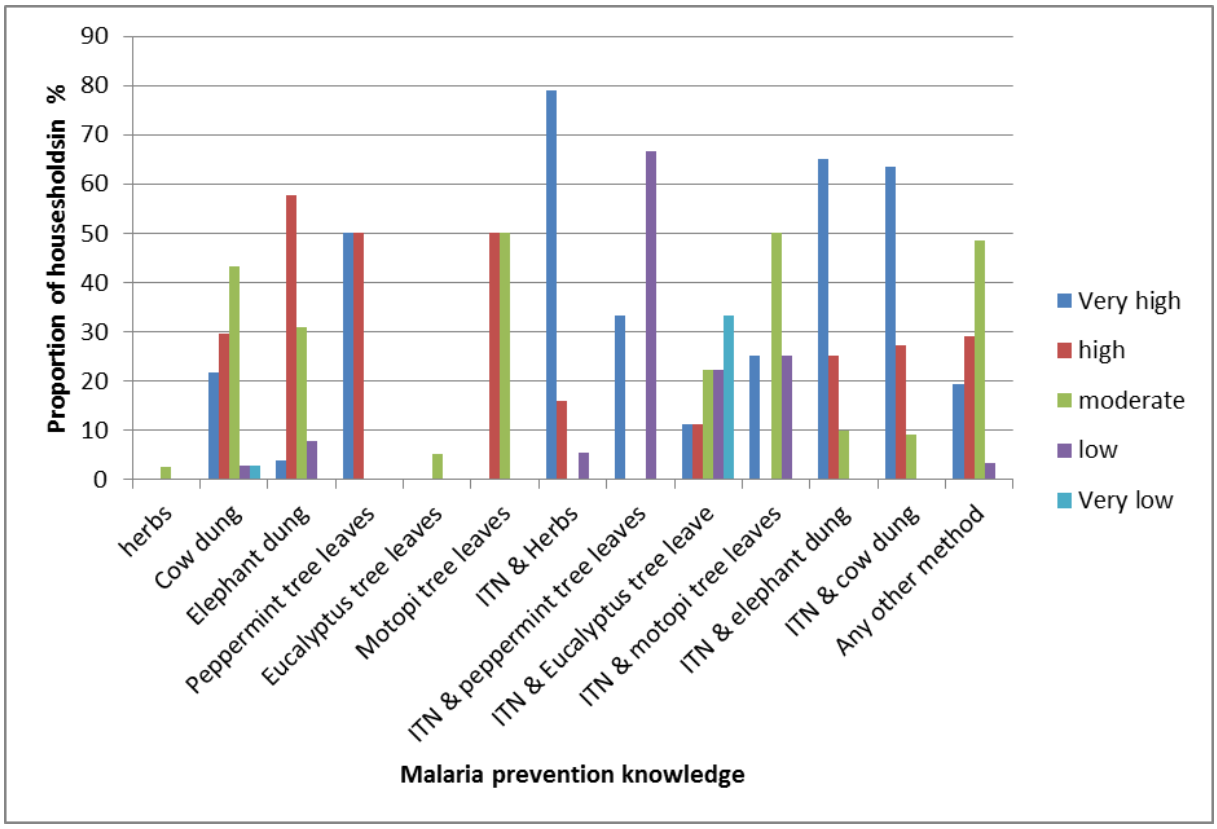


**Figure 5: Effectiveness of malaria prevention knowledge**

Data in Figure 5 show that the combination of ITN with herbs (78.9%), ITN with elephant dung (65%), ITN with cow dung (63.6%) and peppermint (*Schinus molle*) tree leaves (50%) had very high level of effectiveness. This is probably the reason, they are the most known. From the focus group discussions, cow dung and elephant dung were observed to be effective for 24 hours, and as much as mosquito coils, it is widely known, and therefore widely used, especially at the cattle posts. The discussants also mentioned that they usually combine malaria prevention measures, such as using cow dung along with ITN. A combination of ITN and eucalyptus tree leaves was found to be the least effective at 33.3% on the very low category of effectiveness.

### 4.2.3 Knowledge use by sex

Data in Figure 6 show that females tend to use all the mentioned malaria prevention knowledge except for shepherd's/*motopi* tree (*boscia albitrunca*) leaves, while males use all except for peppermint (*schinus molle*) tree leaves. Thus, peppermint tree leaves utilisation was only common among the females, while *motopi* tree leaves was commonly utilised among the males only.

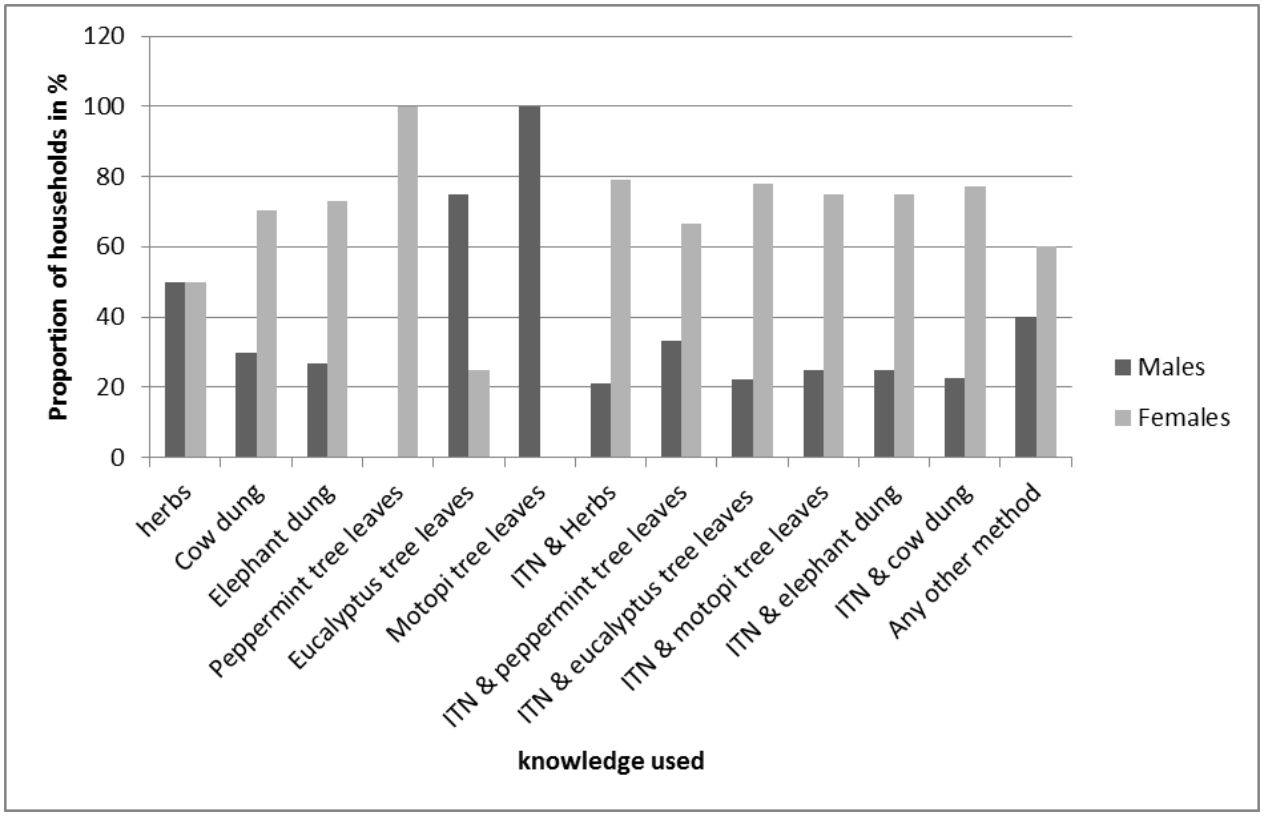


**Figure 6: Malaria prevention knowledge by gender**

Data also show that males (75%) mostly utilise eucalyptus tree leaves while females mostly and equally utilise a combination of ITN and cow dung and a combination of ITN and eucalyptus tree leaves (77.3%). Herbs were used equally by both sex groups to prevent malaria.

### 4.2.4 Knowledge use by age group

Figure 7 shows that herbs (50%) and peppermint tree leaves (50%) were mostly utilised by individuals who belonged to 18-28 years age group. Elephant (53.8%) and cow (37.8%) dung, ITN and herbs (42.1%), eucalyptus tree leaves (50%), ITN combined separately with

eucalyptus tree leaves (55.6%), *motopi* tree leaves (50%), cow dung (59.1%) and elephant dung (55%) were mostly utilised by those in 29-39 years age bracket.

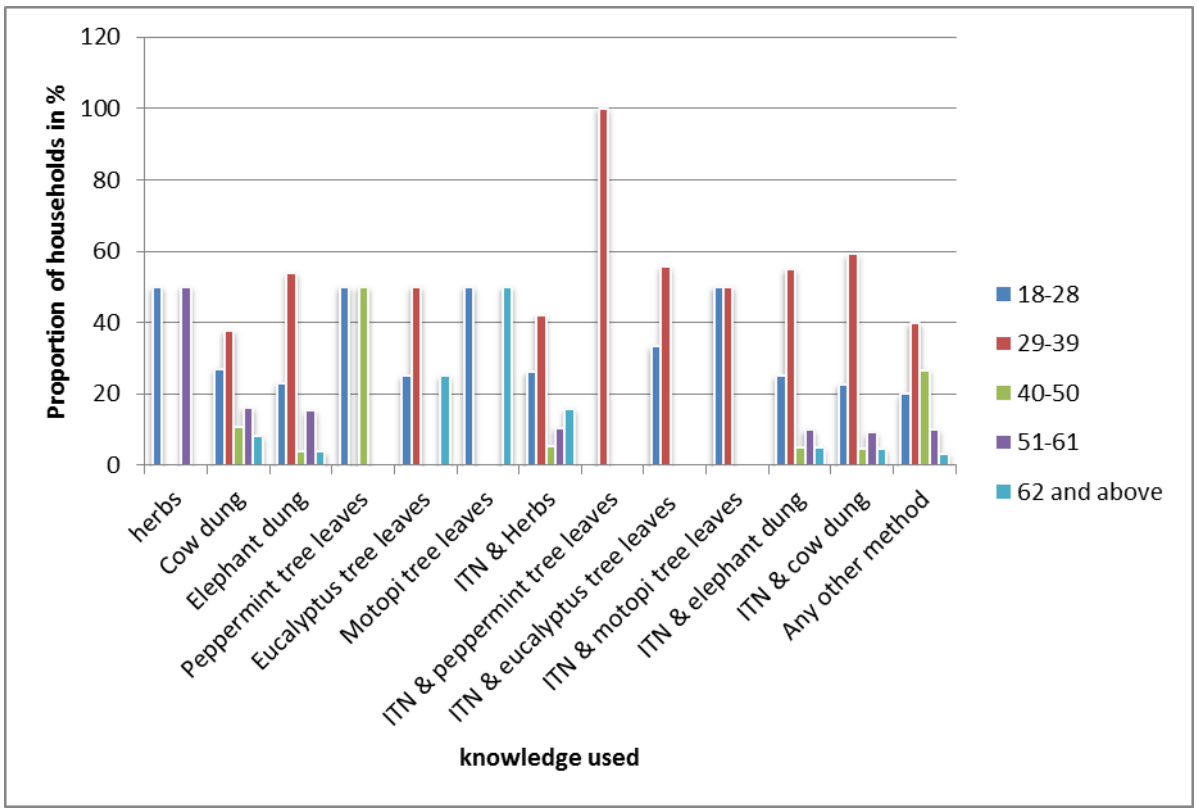


**Figure 7: Malaria prevention knowledge use by different age groups**

Respondents that belonged to the 40-50 years age group mostly preferred peppermint tree leaves (50%) and cow dung (10.8%). Half (50%) of the respondents who were in the age bracket of 51-61 years utilised herbs while 16.4% of those belong to that age category utilised cow dung to wade off mosquitos. While eucalyptus tree leaves was utilised by 25% of the respondents who aged 62 years and above, 15.8% of the same age group utilised ITN herbs.

### 4.2.5 Knowledge use and level of education

Generally knowledge in malaria prevention was mostly utilised by the junior secondary school education level respondents (Figure 8 below). This is probably because most of the respondents had acquired the junior secondary school level of education.

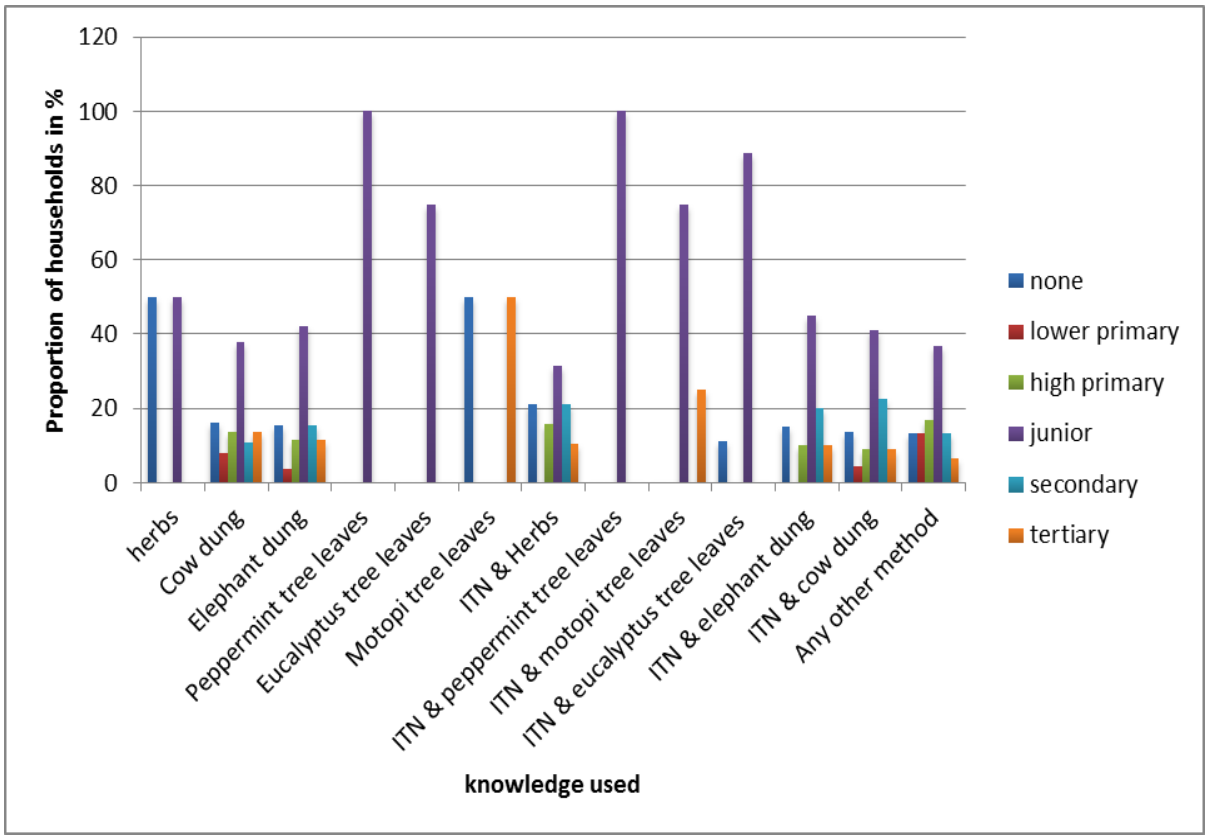


**Figure 8: Malaria prevention knowledge use across education levels**

Figure 8 above also indicates that cow (37.8%) and elephant dung (42.3%) utilisation was common in the junior secondary school education group. In the lower primary education level group cow dung was the most preferred at 8.1%, whereas for the senior secondary level ITN and cow dung was the most utilised at 22.7%. For the tertiary education level *motopi* tree leaves utilisation was at 50% followed by its combination with ITN at 25%.

Chi-square analysis was conducted to determine independence of malaria prevention knowledge use on sex, age and education of respondents. Table 1 below shows that there are no statistically significant associations between the use of knowledge and sex, age and education.

**Table 1: Malaria prevention knowledge use, across sex, age and education level**

| **N=79** | **P-values** | | |
|---|---|---|---|
| **Knowledge used** | **Sex** | **Age group** | **education** |
| Herbs | 0.553 | 0.975 | 0.743 |
| Cow dung | 0.373 | 0.604 | 0.877 |
| Elephant dung | 0.298 | 0.373 | 0.893 |
| Peppermint tree leaves | 0.447 | 0.592 | 0.618 |
| Eucalyptus tree leaves | 0.102 | 0.901 | 0.435 |
| *Motopi* tree leaves | 0.105 | 0.934 | 0.27 |
| ITN and Herbs | 0.163 | 0.879 | 0.609 |
| ITN and peppermint tree leaves | 0.704 | 0.769 | 0.372 |
| ITN and eucalyptus tree leaves | 0.377 | 0.1 | 0.028 |
| ITN and *motopi* tree leaves | 0.06 | 0.123 | 0.435 |
| ITN and elephant dung | 0.28 | 0.223 | 0.636 |
| ITN and cow dung | 0.177 | 0.21 | 0.786 |
| Any other method | 0.211 | 0.852 | 0.839 |

Notes: Significance level: p= 0.05

***Source: compiled by author from the household interviews findings***

However, there was a statistically significant association between the utilisation of the ITN and eucalyptus tree leaves and education where [$\chi 2$ (5) =.12.531, p=.028]. This association can also be observed in Figure 8, where utilisation of the ITN and eucalyptus tree was at 88.9% in the junior secondary school education level and the remaining 11.1% was among the none education category. This is contrary to the key informants' views, where majority (66.6%) attested that use of health services and knowledge varies with age, sex and education level.

### 4.2.6 Discussion

The households in the Okavango Delta indicated that malaria incidence occurred most likely during the rainy season and flooding season. It was further clarified that in times of rain and floods, the malaria vectors, mosquitoes thrive in terms of breeding, hence malaria prevalence during these seasons. This has also been verified as previously stated in this study malaria transmission is common in times of rain particularly between the months of November and May (Ministry of Health, 2007). Moreover the Okavango Delta areas have been observed to experience perennial transmission (WHO, 2007). The likelihood of malaria was also linked to the perennial presence of surface water, which also contributes and partially explains the endemicity of malaria in the area. As previously stated, malaria vector habitats are said to increase in times of floods and therefore the presence of water enhances the potential for exposure to the disease (WHO, 2007).

As it is the case in the malaria endemic Okavango Delta households, the communities living in malaria endemic areas are usually aware of the link between environmental conditions, vectors and malaria (Kipsisey, 2008). Ecological factors are among the factors interplaying to influence local knowledge utilisation in adaptation to malaria endemicity in the framework of this study. Knowledge on the malaria vector breeding patterns with variations in ecological factors such as flood, rainfall and seasons catalyses the adaptation process. These observations enable the communities to utilise their local knowledge to prevent malaria through different local or a combination with scientific techniques in these communities, depending on what works best for them (Toé, 2009).

Local knowledge utilisation in malaria prevention in the Okavango Delta is still a common practice. Locally available resources that have been observed over the years to repel mosquitoes are used to prevent malaria. This affirms the basis for this study, which argues that local knowledge utilisation among other factors, also depends on an understanding of ecological/environmental aspects gained over the years throughout generations. This knowledge is viewed as a predisposing enabling factor under Andersen and Newman's framework of health care utilisation. Thus through this knowledge the households in the Okavango Delta are enabled to and empowered against malaria transmission.

The practice of burning dry elephant and cow dung to keep away mosquitoes is the most common means of avoiding malaria vector contact in the study area. This practice and

knowledge is not unique to the Okavango Delta, as Mathews and Thadathil (2011) in India, reported high demand for elephant dung as a mosquito repellent, the smoke produced from burning the dung, has been observed to kill mosquitoes instantly. It was found to be the most affordable and effective mosquito repellent, compared to other products in the market. Furthermore it has no side effects. Similarly, for many years cow dung has been used for many purposes including repelling mosquitoes (Mathews and Thadathil, 2011). The combined use of cow dung with neem leaves (excellent antiviral agent when burnt) or and other plants' parts (particularly that produce pleasant smell) to repel mosquitoes was found to be the most traditional and common practice (Mandavgane *et al.,* 2005; Mathews and Thadathil, 2011). The fact that it was observed to be the common traditional practice, despite availability of alternative modern repellents which is also of no exception in the Okavango Delta, can be clarified by another theory (The usage preference theory) adapted by this study. The usage preference theory (Kolawole, 2012) postulates that people stick to their traditional ways of resolving problems despite the changes brought about by modernisation, as is the case in the Okavango Delta.

The combination of mosquito repellents was observed in the present study, where household had the knowledge of using ITNs concurrently with herbs, cow and/or elephant dung and tree leaves (e.g. peppermint tree leaves). Peppermint has been previously linked to malaria prevention (Ansari *et al.,* 2000), who claimed that applying peppermint oil (*Mentha piperita*) on the skin strongly repelled adult mosquitoes. The oil has also been observed to be non-toxic to humans (Ansari *et al.,* 2000). Therefore essential oils have received attention as potentially controlling vectors of mosquito borne disease due to their repellent properties (Traboulsi *et al.,* 2002).

Combining repellents was also observed to be very highly effective compared to using just one prevention method, by the households in the study area. Similarly in Mexico the communities apply their own preventive measures (smoke and mosquito coils) to avoid mosquito bites and the use of bed nets is widespread, which makes bed nets a viable alternative for malaria control (Rodríguez *et al.,* 2003). Community inclusive vector control programs were found to be more effective, as outcomes were achieved quickly from community-based programs compared with government-supported activities alone. In Tanzania Minja *et al* (2001) has shown that people in the study area have integrated ideas derived from biomedicine into their local knowledge and practice. This is not surprising in

view of the fact that, Tanzanians have been exposed to many health education campaigns especially after independence in 1961. The government intended to improve the health of rural populations with a focus on widespread diseases like malaria (Minja *et al.,* 2001). Despite the respondents not being allowed to burn the vegetation in the river, which they claimed to be worsening malaria problem in their community, there is evidence elsewhere that this practice could potentially reduce malaria transmission risk**.** Whittle *et al* (1993) noticed effective decline in mosquito emergence after controlled burning of flood water mosquito. Wallace *et al* (1990) also linked a notable reduction in mosquito presence to the burning of rice fields in South Carolina.

However, burning of vegetation in water bodies is not only effective for mosquito control, it is also said to be detrimental to the essential wetland functions and services such as wildlife habitat provision and water quality improvement (Berg *et al.,* 2010). Several wetland functions are directly based on the diversity and primary productivity of the plant community. Therefore creating a balance between maintenance of wetland functions and avoiding increased mosquito population requires a compromise from both the former and latter aims (Berg *et al.*, 2010).

### 4.2.7 Conclusion

Being aware of the disease itself and the time it is mostly prevalent, is in itself a step towards prevention and a pre-requisite to the actual application of local knowledge in malaria prevention. As previously stated in the framework of this study, local knowledge on the ecological and environmental dynamics such as floods, rainfall and temperatures which occur during the life times of people enables them to understand environmental related health problems such as malaria and how to prevent, treat and adapt to them. Over time people gain an understanding of the diverse aspects of their environment (properties of plants and animals, the functioning of ecosystems) through experience and knowledge. Therefore the environment in which individuals and populations live has a dominant effect on their health. This predisposes and enables households to utilise this knowledge to adapt to malaria endemicity. The most abundant resources are usually the most used against malaria transmission, in this study cow dung and elephant dung were the most common. These are considered to be even more effective when used along with herbs that repel mosquitoes and or produce fresh or bearable odour, as well as with ITNs.

The households in the Okavango Delta could benefit more from their local knowledge of malaria prevention, provided the Ministry of Health embarks on investigating and improving upon what actually repels mosquitoes. Provided with evidence that other methods (such as peppermint tree leaves and other local herbs) which are currently not largely used, with potential to repel malaria vector; encouraging households to use them more often could be really beneficial in the fight against malaria. This could also help come up with locally manufactured products against malaria, which the community at large would be more accepting and compatible with. Scrutinising practices which may compromise the ecosystem, such as burning the aquatic vegetation to get rid of mosquitoes, could also help reveal safer large scale methods of decreasing mosquito survival. Generally the households in the study area have relevant malaria prevention knowledge, which is also utilised regardless of age, sex and literacy level. This may be attributed to the process of local knowledge derivation, which is based on shared experiences, customs, values, traditions, and lifestyles. Hence it is acquired and validated slowly over a long period of time, from generation to generation and therefore becomes embedded in lifestyle and practices through ought generations. Thus it is therefore utilised by all household members regardless of age, sex and literacy level.

## 4.3 RURAL LIVELIHOODS AND HOUSEHOLD EXPOSURE TO MALARIA TRANSMISSION

The objective of this section was to analyse local knowledge in relation to livelihood activities and exposure to malaria transmission in the study area. The section starts with a presentation of livelihoods activities and participation by gender, livelihood activities and malaria cases from the main socio-economic survey. (These are self-report cases, but the households did mention that it was confirmed at the clinic that indeed, it was malaria they were suffering from at the time of illness). Furthermore, the section presents more details on households' exposure to malaria transmission in livelihood activities with the cohort study results. The discussion and conclusion of results then follow to complete this section.

### 4.3.1 Livelihoods and malaria cases

Majority (58.9%) of the households gathered grass and reed in the river. They also practiced rain-fed arable farming (493%) as shown in Table 2 below. These are also the most practiced livelihood activities across both gender categories including livestock farming, basket and commercial fishing. It is also evident that females participate in higher numbers in many activities compared to the males, particularly in *molapo* arable farming, subsistence and hook and line fishing.

**Table 2: Participation in livelihood activities by gender (Socio-economic survey)**

| Livelihood activity | Proportion of households in % N= 355 | | |
|---|---|---|---|
| | All households | Male-headed | Female-headed |
| Gathering grass/reeds in the river | 58.9 | 48 | 52 |
| Rain fed farming | 49.3 | 47.4 | 52.6 |
| Livestock farming | 35.2 | 49.6 | 50 |
| Harvesting water lily | 29.7 | 33.3 | 66.7 |
| Basket fishing | 14.7 | 55.8 | 44.2 |
| Gathering fruits by the river | 14.2 | 42 | 58 |
| Subsistence fishing (nets) | 11.3 | 57.5 | 42.5 |
| Harvesting grass in the wild | 11 | 43.6 | 56.4 |
| Fishing (hook and line) | 10.5 | 64.9 | 35.1 |
| *Molapo* pastoral farming | 8.2 | 41.4 | 58.6 |
| Irrigation farming (winter) | 7.6 | 55.6 | 44.4 |
| Commercial fishing | 4.8 | 47.1 | 52.9 |
| *Molapo* arable farming | 2.3 | 62.5 | 37.5 |

***Source: compiled by author from the household survey findings***

The least practiced activities are *molapo* farming (2.3%), pastoral farming (8.2%) and commercial fishing (4.8%). Other activities with smaller proportion of households include: gathering fruits by the river (14.2%), harvesting grass in the wild (11%), basket fishing (14.7%) and hook and line fishing (10.5%). Worthy to note is that all households participate in more than one livelihood activity.

In terms of malaria cases experienced by households, *molapo* arable farmers (75%) (the actual number of households practicing *molapo* farming is very small), wild grass harvesters (54.2%), and hook and line fishers (47.2%) had high proportions of households with malaria cases compared to other livelihood activities, as shown in Table 3 below.

**Table 3: Households' participation in livelihood activities and malaria cases**

| livelihood activity | Households proportion per livelihood activity | Proportion of households with malaria in % N=355 |
|---|---|---|
| Gathering grass/reeds in the river | 58.9 | 34.8 |
| Rain fed farming | 49.3 | 37.2 |
| Livestock farming | 35.2 | 32.3 |
| Harvesting water lily | 29.7 | 36.9 |
| Irrigation farming (winter) | 29.6 | 29.6 |
| Basket fishing | 14.7 | 37.3 |
| Gathering fruits by the river | 14.2 | 32 |
| Subsistence fishing (nets) | 11.3 | 25 |
| Harvesting grass in the wild | 11 | 54.2 |
| Fishing (hook and line) | 10.5 | 47.2 |
| *Molapo* pastoral farming | 8.2 | 34.5 |
| Commercial fishing | 4.8 | 41.2 |
| *Molapo* arable farming | 2.3 | 75 |

***Source: compiled by author from the household survey findings***

It is noteworthy that these are also some of the least practiced activities as only 2.3% of the households took part in *molapo* farming. While wild grass harvesting was practiced by 11% of the households. Hook and line fishing was a common activity among only 10.5% of the households. From the proportion of households with malaria under every activity, it is clear that fishing activities expose people to malaria transmission.

### 4.3.2 Household's exposure to malaria transmission in livelihood activities

From the follow up made through the cohort study, the top six most practiced livelihood activities were summarised in terms of how they influence exposure to malaria transmission (see Figure 9-12).Chances of mosquito bites were reported to be very high (Figure 9) mostly during gathering grass and reeds in the river (40.7%), rain-fed farming (30.2%) and livestock farming (23.8%). High chances of mosquito bites were reported mostly under livestock

farming (33.3%) and harvesting water lily (33.3%). Majority of the basket fishing households (44.4%) rated it as a moderate exposure activity. Gathering fruits by the river was mostly rated as a 'low' (36.4%) and 'very low' (27.3%) exposure to malaria transmission activity.

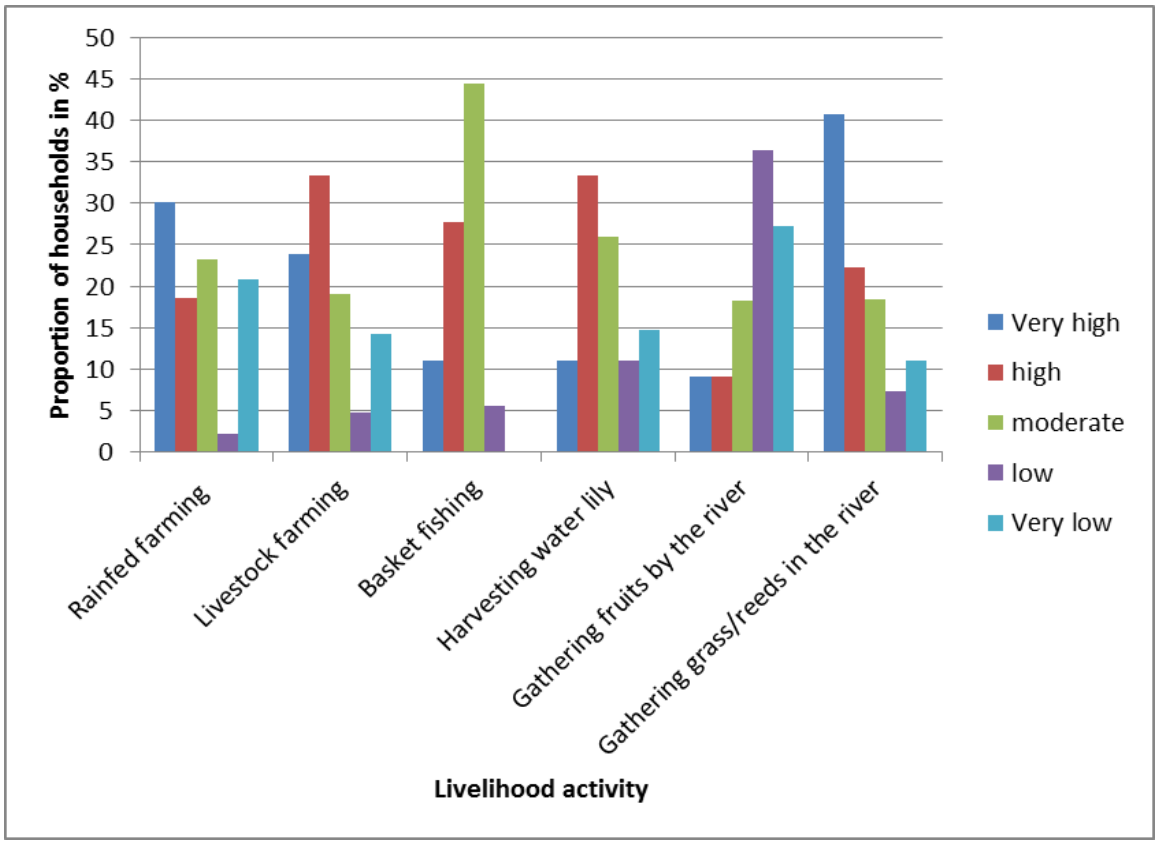


**Figure 9: Chances of mosquito bites in activity**

Most of the activities had duration of more than 8 hours (Figure 10 below), particularly rain fed farming (72.1%), harvesting grass/reeds in the river (70.4%) and gathering fruits by the river (63.6%). Livestock farming was mostly (66.7%) practiced for 1- 2 hours.

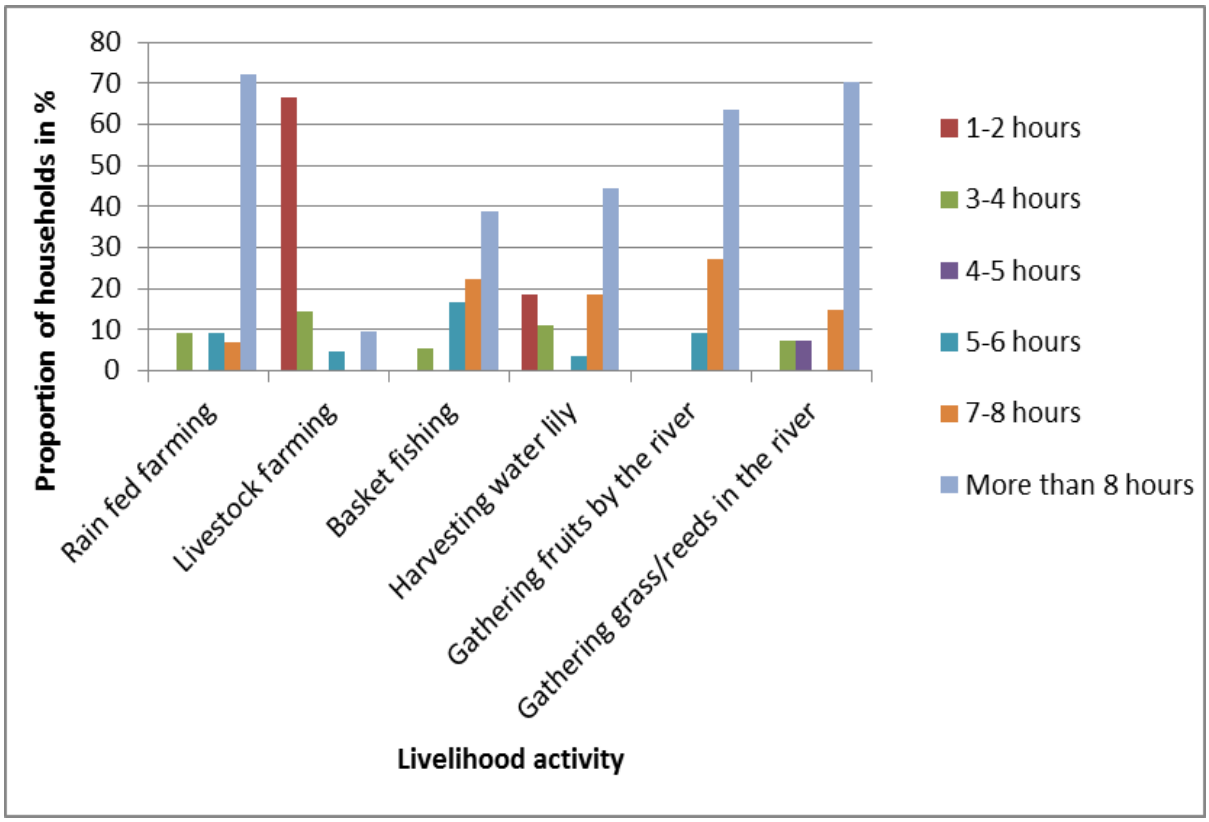


**Figure 10: Duration of activity**

It is clear that majority of the activities take place in the morning from 6-8am (Figure 11), particularly livestock farming (71.4%), rain fed farming (61.9%) and gathering grass/reeds in the river (46.3%). Majority of the activities were also carried out from 8am to 12 noon especially gathering fruits by the river (63.6%) basket fishing (55.6%) and harvesting water lily (48.1%).

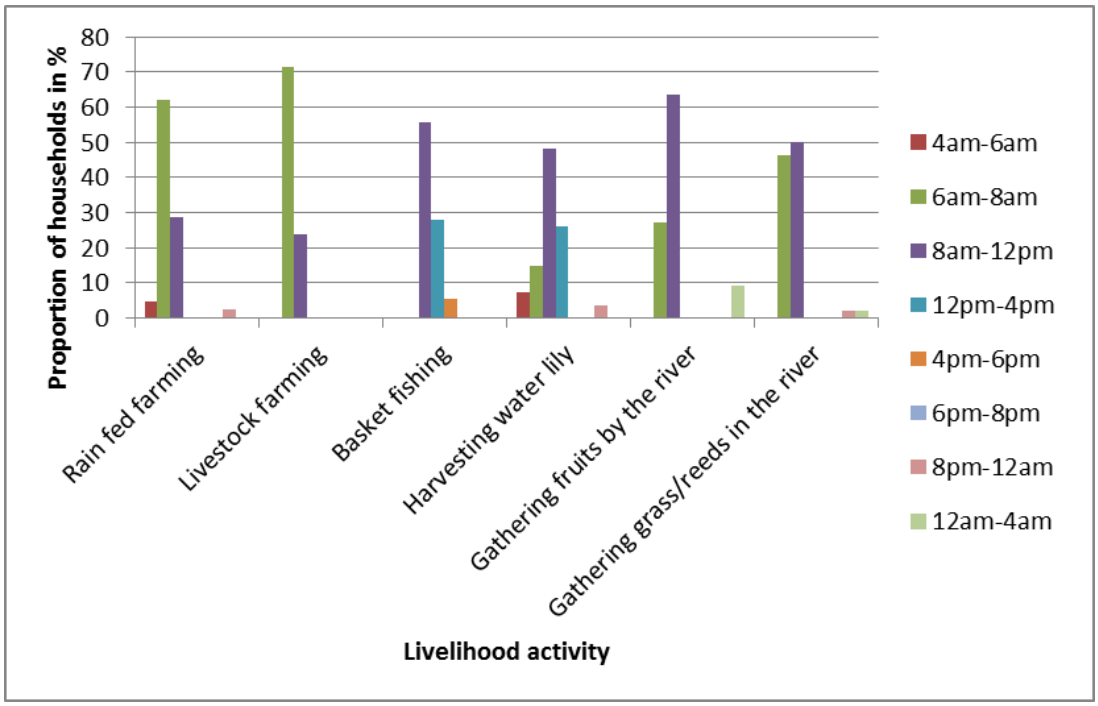


**Figure 11: Time of activity**

Any attire was popular in most of the activities (Figure 12) including basket fishing (77.8%), livestock farming (71.4%) and gathering fruits by the river (63.6%). Long sleeve clothing was mostly utilised by grass/reed harvesters (81.5%). Short sleeved clothing was the least common in all livelihood activities.

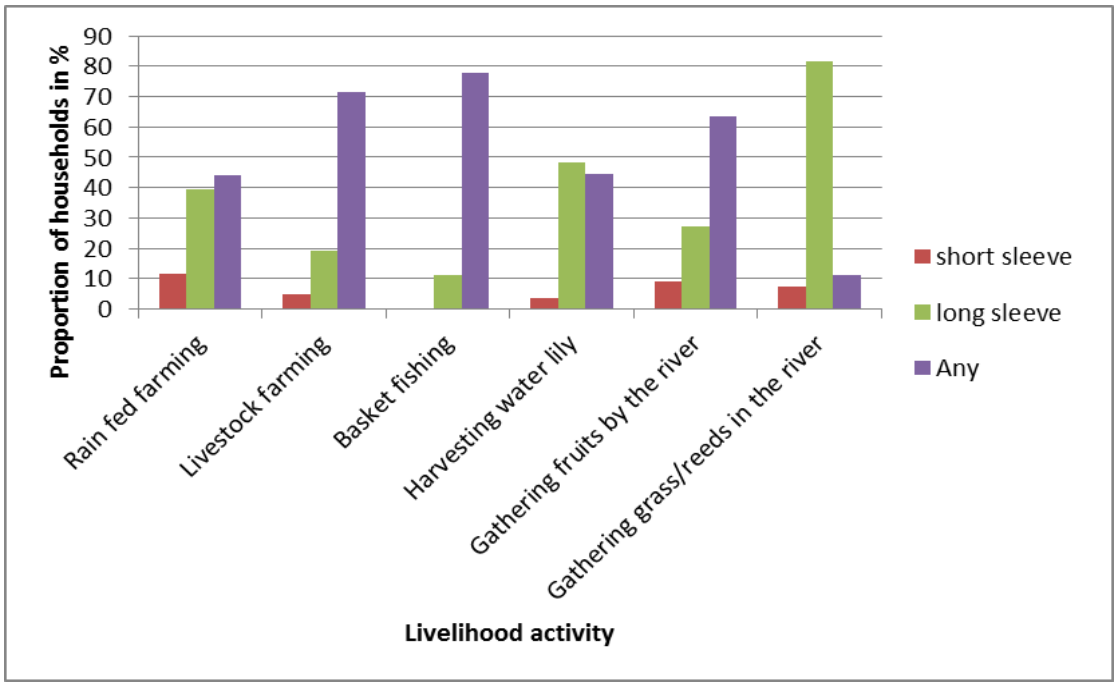


**Figure 12: Attire worn during activity**

The top six most practiced livelihood activities were summarised in terms of exposure to malaria transmission (Table 4 below). Majority of the activities were mostly categorised under the very high and high chances of mosquito bites. These include gathering grass/reeds in the river, rain-fed arable farming, livestock farming, fishing and other activities.

**Table 4: A summary of modal responses in terms of exposure to malaria transmission by livelihood activities**

| N=79 modal responses in % | | | | | |
|---|---|---|---|---|---|
| **Livelihood source** | **Time of the day** | **Duration** | **Suitable attire** | **Chances of mosquito bites** | **Season** |
| Gathering grass/reeds in the river | 8am-12pm (50)<br>6am-8am (46.3) | >8 hours. (70.4) | Long sleeve (81.5) | Very high (40.7)<br>High (22.2) | August (48.1<br>August-December (39) |
| Rain-fed farming | 6am-8am (61.9) | >8 hours. (72.1) | Any (44,2)<br>Long sleeve-39.5 | Very high (30.2) | October to May(76.8) |
| Livestock farming | 6am-8am (71.4) | 1-2 hours. (66.7) | Any (71.4) | Very high (23.8)High (33.3) | All year (95.2) |
| Harvesting water lily | 8am-12pm (48.1) | 8 hours. (44.4) | Long sleeve (48.1)<br>Any (44.4) | High (33.3)<br>Moderate (25.9) | August-Dec (55.5)Sep-Dec (37) |
| Basket fishing | 8am-12pm (55.6) | >8hours. (38.9)<br>7-8hours (22.2) | Any (77.8) | Moderate (44.4)<br>High (27.8) | Aug-Dec (27.9)<br>Sep-Dec (72.4) |
| Gathering fruits by the river | 8am-12pm (63.6) | >8 hours. (63.6) | Any (81.8) | Low (36.4) | July-October (27.3<br>September - December (73.1 |

***Source: compiled by author from the household interviews findings.***

These activities also coincided with the hot and rainy months of the year, particularly November, December and March. Therefore, they were also mostly carried out on just any attire due to the hot weather; participants did not ensure or insist on long sleeved clothing for protection against the bites of mosquitoes. Long working hours (5-6 hours and > 8 hours) was also common among these activities. Activities with low and moderate (basket fishing, and gathering fruits by the river) chances of mosquito bites were mostly carried out in any attire.

### 4.3.3 Livelihood activities and exposure to malaria transmission

A summary of exposure to malaria transmission in livelihood activities with season is provided below (Table 5) as analysed by the PRA participants. The darker the colour coding the more intense the activity or disease exposure situation.

**Table 5: Livelihoods and disease calendar; livelihood activities and exposure to malaria transmission**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Malaria cases | | | | end | | | | | | start | | |
| Floods | low | low | 2nd inflow start | end | | | | | | 1st inflow start | | end |
| Rainfall | | | | end | | | | | start | | | |
| Mosquito abundance | | | end | | | | | start | | | | |
| Fishing | Pre-2008 | Pre-2008 | | | | | | | | | | end |
| Water reed & grass harvesting in the river | | | | | | | start | | | | end | |
| Gathering of water lily and other plants | | start | | | | | | | | | | end |

***Source: Participatory Rural Appraisal Report 2014***

Livelihood activities such as reed and thatching grass harvesting between July and November (5 months) are relatively low malaria risk. Although gathering of water lily (*N. nouchali*) and other aquatic plants appear to run throughout the year (February to December), Table 5 suggests that these were considered to be moderate to low risk because harvesters may practice these during low risk season (May-August) when it is either cold (winter – June-July) or hot (August/September) and thus avoid or minimise risk of malaria transmission.

### 4.3.4 Discussion

From the results of the study, exposure to malaria transmission has been shown to differ with livelihood activities, depending on a) chances of mosquito bites, b) the time of activity during the day, c) duration spent doing activity, d) the time of the year (season/months) of activity and e) the attire/clothing worn during activity. The study also mainly focused on natural resource dependent livelihood activities as most livelihood sources in the Okavango Delta have been observed to be dependent on natural resources and more specifically water-based resources (Murray, 2005). These activities were also shown to be the most practiced compared to non natural resource based livelihood activities from the socio-economic survey results. The relationship between livelihood activities and exposure to malaria transmission as observed is discussed below.

All households partake in more than one livelihood activities, with majority active in rain fed farming and grass and reed gathering at the river. All the different type of fishing activities were perceived to expose households to chances of mosquito bites, followed by grass/reed harvesting. These are also some of the livelihood activities observed elsewhere to expose people more to malaria than others, particularly fishing and irrigation farming (Mboera *et al.,* 2013). The study findings consent with the reviewed framework, which classifies livelihood activities under socio-cultural prcatices as a predisposing factors. These factors may influence the probability of requiring a health service, as well as the utilisation of local knowledge in adaptation to malaria endemicity. The present study also shows that chances of mosquito bites hence exposure to malaria transmission is very high for majority of activities that take place in the morning, thus 6am-8am. Thus early at morning twilight. This time of the day has also been observed to be the high mosquito biting rate time. This is similar to observations elsewhere where most people were

found to be more at risk of infectious bites before and after bed time, with a variation in human activity at twilight periods (Kabbale *et al.,* 2016). The same study also revealed that the Anopheles mosquito is notorious for outdoor feeding compared to indoor feeding, as high chances of exposure were commonly observed under outdoor activities. Moreover *Anopheles Arabiensis*, displays a varying and potentially opportunistic behaviour (Animut *et al.,* 2013) in feeding and resting habits, including host preference (Taye *et al.,* 2006; Tirados *et al.,* 2006). Hence it makes sense that, even though almost all the activities that take place at the river, thus fishing, gathering grass/reeds at the river began after sunrise thus from 8am-12pm (when mosquitoes are less likely to bite), most of them were still considered to present very high chances of mosquito bites**.** Still in the same study area, Maphane *et al* (2017) reports that fishing activities also contribute to malaria transmission since they also take place at early morning and night hours. From the findings of this study and Maphane *et al* (2017), exposure to malaria transmission in activities that take place at the river, particularly fishing, may be assumed to be present and/or even high at both twighlight and day light times.

From the results, the chances of mosquito bites hence exposure to malaria transmission is very high for majority of activities that take place in the morning, thus during 6am-8am. This is early at morning twilight, when most of the farming activities take place. This time of the day has also been observed to be the high mosquito biting rate. Mboera *et al* (2013) in Tanzania reports that a fraction of farming activities coincide with peak biting times of the local malaria vectors. The occurrence of vector mosquito bites outside the established peak sleeping times could be attributed to behavioural adaptation in response to the upscaling of insecticide treated nets, which also sabotages the role of ITN in malaria prevention (Killeen *et al.,* 2006). Besides the fact that the activities occur at the breeding sites of mosquitoes, the high chances may also be attributed to that, most of them had the longest duration ranging from 5-6 hours to more than 8 hours. In Cambodia exposure to malaria transmission has been observed to be subject to the intensity, duration and frequency of the interaction with the forest environment, depending on the nature of mobility patterns and activities at and nearby forested area (Guyant *et al.,* 2015). In this case both the ecological and socio-culutral factors interplay as predisposing factors of malaria transmission. Thus people are exposed as they are bitten while working, as they are more exposed due to the conducive breeding environment for the malaria vector. Hence people

involved in forestry activities, or other activities that necessitate lengthy stays in the forest environment have been observed to form most of malaria victims during the outbreak (Markwardt *et al.,* 2008). However, there exists a risk of being bitten at any time from dusk to dawn.

Activities with high chances of mosquito bites also coincided with the hot and rainy months of the year, particularly November, December and March. Hence activities were also mostly carried out on just any attire due to the hot weather; participants did not ensure or insist on long sleeved clothing for protection against the bites of mosquitoes. Failure to do so in Tanzania, exposed fishermen to mosquito bites, as they were at risk spending time nearby water without protection (Le Mare *et al.,* 2014). Whereas wearing clothing that covers arms and legs significantly reduced the malaria risk among European tourists who visited Africa (Schoepke *et al.,* 1998). These are the months when mosquitoes are likely to thrive in breeding as the environmental conditions are mostly conducive, compared to other months of the year. Therefore activities such as rain fed farming, *molapo* arable farming and fishing activities can be linked to high exposure to malaria transmission as they usually take place during the hot months of the year. As pointed out before, in Botswana the rainy season between November and May is the main malaria transmission period, with a peak from mid-February to April (Ministry of Health, 2007). More than half of the malaria incidences from January to May in Botswana is likey due to rainfall variability between December and February (Thomson *et al.,* 2005). Furthermore as previously stated, it has been observed that although some parts of the country experience sporadic transmission, the northern districts particularly Chobe and Okavango experience perennial transmission (WHO 2007). This maybe attributed to the perennial surface water found in these districts. Therefore fishers, grass and reed harvesters and participants in other water based livelihood activities are likely to be exposed due to the perennial transmission of malaria in this district.

### 4.3.5 Conclusion

Exposure to malaria transmission was very high for livelihood activities which took by place by or at the river compared to others. The intensity of exposure per livelihood activities varied and depended on duration of activity, time of the day, seasonality and protection from mosquito bites, through protective clothing. Exposure to mosquito bites and hence malaria transmission

therefore varies with activity, water-dependent activities present higher exposure to malaria as compared to other activities. However, due to the fact that all people participate in several livelihood activities, exposure cannot be limited to a certain group of individual; hence everyone is likely to be vulnerable to malaria transmission. This contradicts the tenets of the framework of this study, which views socio-economic activities as predisposing factor/ determinants of exposure to malaria transmission. However in agreement with the framework participants in certain activities such as fishing activities, *molapo* and rain-fed arable farming, grass and reed harvesting are more likely to be exposed, especially due to the lack of attention paid to the attire worn in these activities and the dawn times they take place at. From this study it can also be concluded that indeed the malaria vector is opportunistic and flexible in behaviour, depending on host availability as chances of mosquito bites were observed to be high in some activities at daylight such as grass/reed harvesting at the river. In light of this, measures against the residual transmission occuring in these circumstances, should be considered in the malaria control policy, vigorously as the country aims to eliminate malaria by 2018 and Africa at large aims for the year 2030. The study has further illustrated that the community possess useful local knowledge of behaviours, environmental conditions, including seasonal variations, which enhance and/or inhibit mosquito breeding resulting in various levels of malaria transmission.

## 4.4 HOUSEHOLD ADAPTIVE STRATEGIES AGAINST MALARIA ENDEMICITY

This section focuses on the third objective of the thesis, which determines households' adaptive strategies against malaria transmission. It starts with analysis of respondent's demographic profile analysis in relation to adaptive strategies; it then zooms into the adaptive strategies utilisation and effectiveness by households and lastly discussion and conclusion.

A Kruskal-Wallis test was conducted to explore the influence of sex on the level/frequency of use of adaptive strategies with the demographic attributes of respondents. Kruskal-Wallis test revealed no statistical significant difference in the use of adaptive strategies between the sex groups [$\chi^2$ (1) =3.126, p=.07] with a mean rank use of adaptive strategies 46.50 for males and 36.81 for females. The Kruskal-Wallis test also revealed no statistical significant difference in the frequency of use of adaptive strategies among the different age groups, education level, type of household and type of dwelling. This shows that frequency of use of adaptive strategies did not differ with sex, age, education level, type of household and type of dwelling. However, descriptive statistics revealed that the female sex group and senior secondary certificate holders were the most dominant across all the strategies. The traditional mud/reed with thatched roof house type was the commonest among the adaptive strategies used. The modern brick house type (multifunctional rooms, iron/tile roof, concrete) mainly used the 1) avoiding cooking outside in the evening, 2) construction of modern houses and 3) cooking indoors adaptive strategies. The households which made out-door preparation of meals used all the adaptive strategies more than those that prepared their meals indoors.

### 4.4.1 Household adaptive strategies

Below is the description of each strategy in terms of its pattern and frequency of utilisation as well as its perceived effectiveness.

#### 4.4.1.1 Structural strategies

Structural strategy entailed any modification or change in accommodation facility to guard against mosquito invasion. Figure 13 below shows that altering house structures was the most embraced adaptive strategy. Some 48% of the respondents altered their house structures. While

most of them sometimes alter their houses (29%), 9% of them seldom do so. Also, while 7.6% of them would usually alter their house structures, only 2.5% of the population always do so. The second most adopted strategy was construction of modern houses, utilised by 36.7% of the households. This construction of modern houses as an adaptation strategy is not shown in Figure 13 because the frequency of use (as measured on the Likert scale responses) was not appropriate for measuring this strategy.

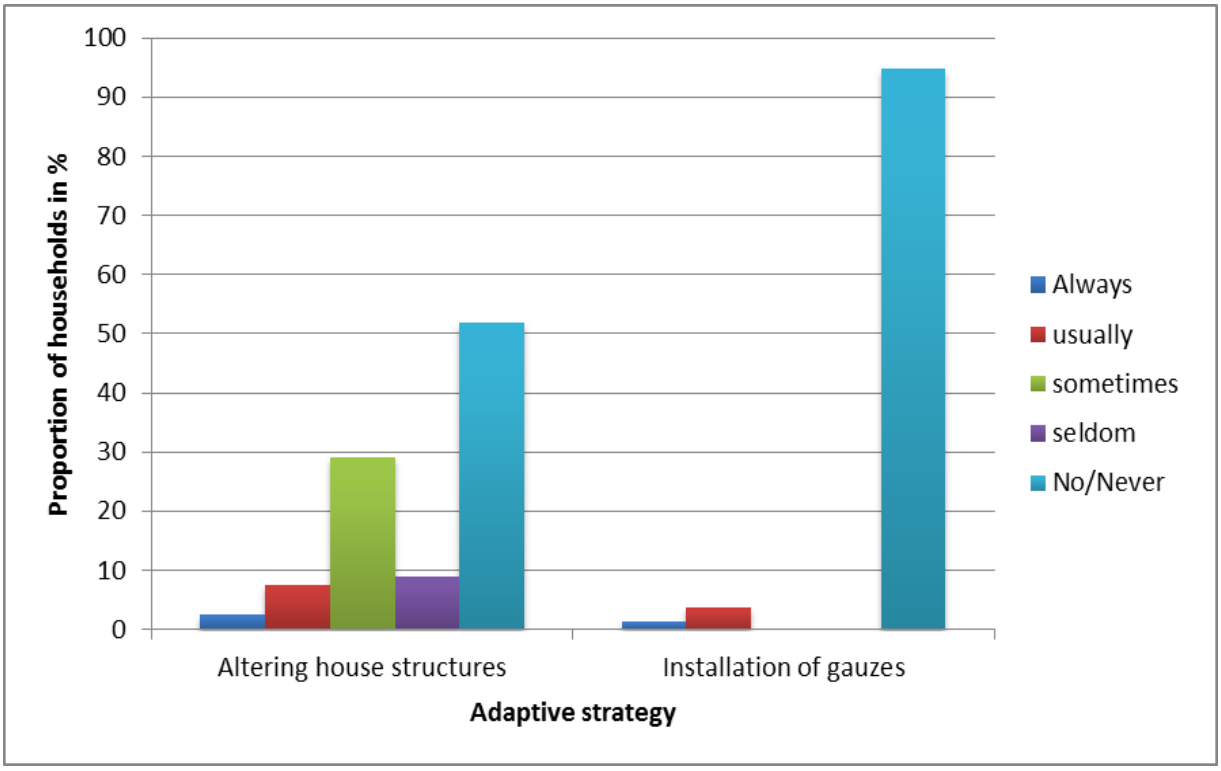


**Figure 13: Utilisation of structural adaptive strategies by households**

Field observations and informal discussions suggest that, even though architecture structural change strategies were not very evident throughout the villages; there were modern houses (with brick walls, corrugated iron roof and windows) in almost every interviewed and non-interviewed household. However, it was also evident that newly constructed reed houses and some mud houses had eaves that could allow mosquitos in and out at dusk and dawn (Figure 14a and 14b). Observational evidence (as shown in Figure 14c below) indicates that one of the informants used house screening (that is, construction plastic to wrap the walls of the reed hut) in order to wade

off mosquitoes from entering and exiting the hut through the spaces between the reeds and grass-roof (Figure 14c) as would be the case in an unsealed structure (Figure 14d).

**Figure 14a** and **14b** reed and mud hut showing eaves in Shakawe (Photo: Courtesy of Barbara Ngwenya

**Figure 14c:** house screened with plastic material, structural adaptive strategy in Shakawe (Photo: Courtesy of Dirontsho Maphane)

**Figure 14d:** Eaves in the reeds (Photo: Courtesy of Barbara Ngwenya)

**Figure 14: Structural adaptive strategies**

#### 4.3.1.2 Timing of activities

This adaptive strategy involved carrying out activities at some particular time of the day or season when the chances of mosquito bites are low as compared to any other time of the day or year. This also implies avoiding doing activities at the peak of mosquito biting times/periods, at dawn and dusk. Figure 15 below shows that majority (43%) of the households resorted to adhering to taboos that restrict movement at certain times of the day. While approximately 9% of them always adhered to taboos restricting movement, about 17.7% of them usually did so. Nonetheless, while about 14% of the respondents sometimes adhered to taboos, 2.5% of them seldom adhered. Seasonal migration to the field and cattle post, and back to the village was the second most embraced strategy (30.4%) in the timing of activities. While 16.5% of the households usually engage in this back and forth migration, 7.6% of them migrated sometimes, 5.1% seldom and 1.3% always migrated. Tending to crops after dawn and before dusk (27.8%) and avoiding out-door cooking in the evening (26.6%) were the least adopted strategies.

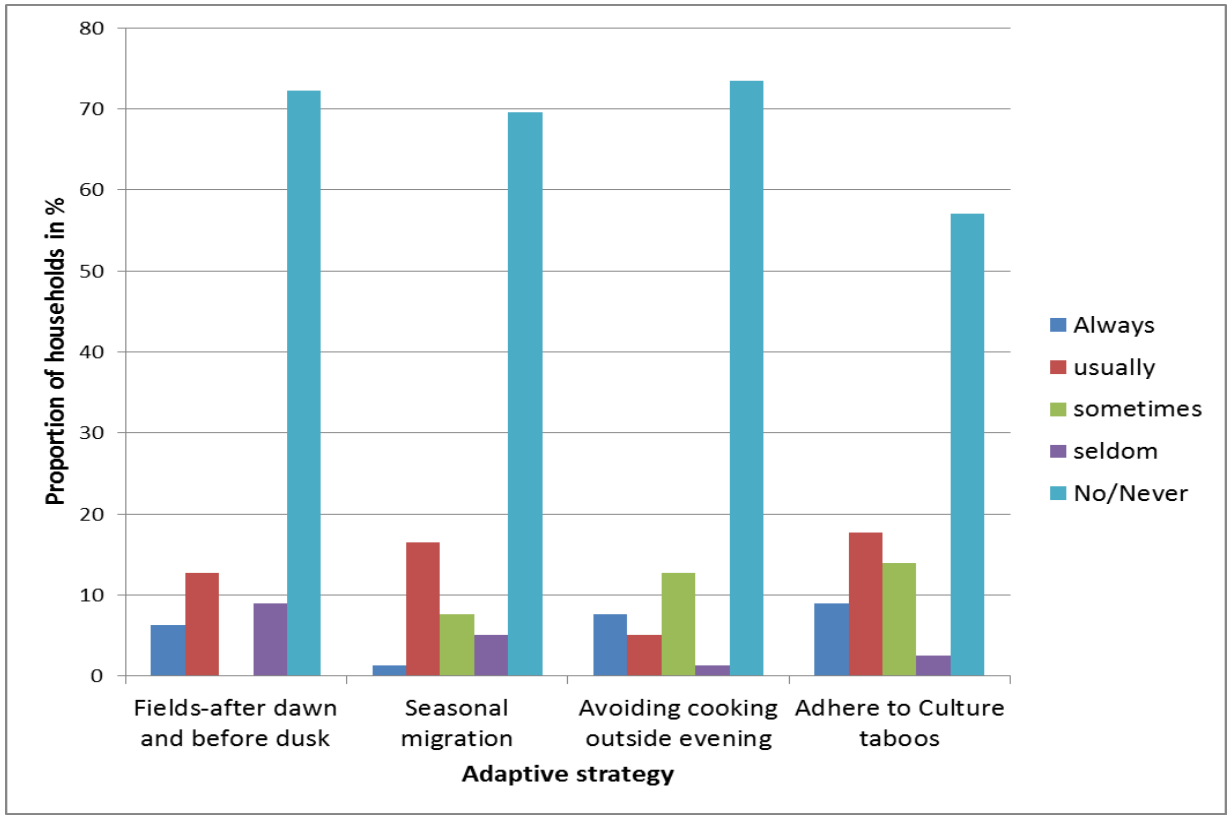


**Figure 15: Utilisation of timing of activities adaptive strategy by households**

#### 4.3.1.3 Other strategies

The other adaptive strategies included diverting mosquitoes away from the human host by constructing livestock kraals close to homesteads; engaging in household capacity building through health information dissemination workshops; and diversifying livelihood activities away from high risk malaria transmission areas to low risk activities such as formal employment. Figure 16 below shows that attending health information dissemination workshops is the most frequently used by households to adapt to disease transmission (69.6%), followed by cooking indoors (43%), and livelihood diversification (35.4%). However, construction of livestock kraals in close proximity to homesteads is the least adopted strategy (17.7%). Informal interviews results showed that raising awareness strategy through health information dissemination workshops or through traditional institutions such as *Kgotla* (Customary Court) meetings enhances household adaptation capacity to malaria infection in the study area. Also, attending capacity building workshops enables household to adapt to malaria infection. These include weekly information education and communication (IEC) presentations and community awareness workshops organized by the health staff at the local clinics.

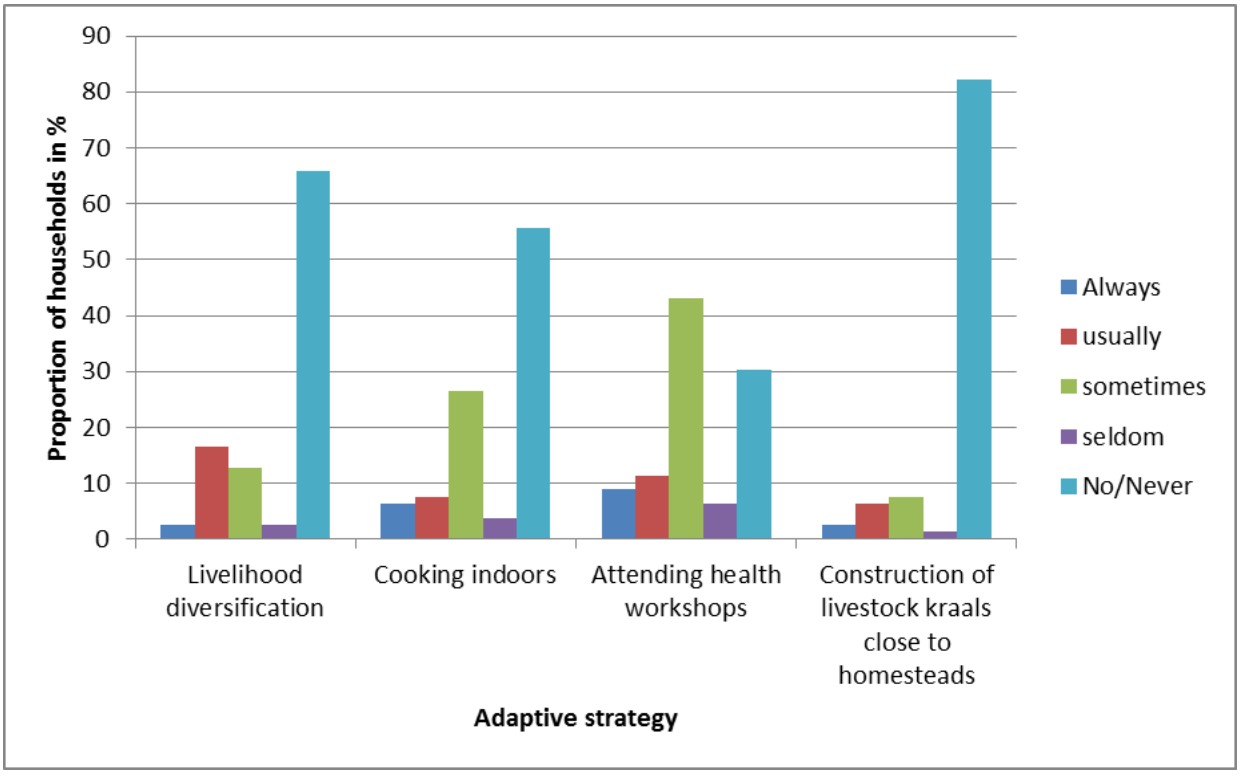


**Figure 16: Utilisation of other adaptive strategies by households**

### 4.3.2 Effectiveness of adaptive strategies

Households were asked to rate the effectiveness of each of the strategies they identified. Table 6 indicates that altering house structures was perceived as the most effective structural strategy and was rated very high by (15.8%) and high (131.6.2%) as compared to construction of modern houses, which was rated very high (17.2%) and high (34.5%) by the households. Also, installation of gauzes was rated very high (25%) and high (75%) by the households. In terms of timing of activities, tending to crops in the fields before dawn and after dusk was perceived to be the most effective strategy, rated (40.9%) highly effective and (31.8%) highly effective, followed by movement restriction (adherence to culture taboos) at certain times of the day with (28.6%) households rating it as very highly effective, (38.1%) at high level of effectiveness. Among the other strategies, attending health workshops was found to be the most effective, and was rated as having very high (32.7%) and high (41.8%) level of effectiveness.

**Table 6: Households' rating of adaptive strategies' effectiveness**

| | Effectiveness in % | | | | |
|---|---|---|---|---|---|
| **Strategy** | **Very high** | **high** | **moderate** | **low** | **Very low** |
| ***1. Structural*** | | | | | |
| Altering house structures | 15.8 | 31.6 | 34.2 | 7.9 | 10.5 |
| Installation of gauzes | 25 | 75 | 0 | 0 | 0 |
| Construction of modern houses | 17.2 | 34.5 | 31 | 10.3 | 6.9 |
| 2. ***Timing activities*** | | | | | |
| Fields before dawn and after dusk | 40.9 | 31.8 | 27.3 | 0 | 0 |
| Seasonal migration | 4.2 | 12.5 | 20.8 | 50 | 12.5 |
| Avoiding cooking outside evening | 19 | 38.1 | 33.3 | 9.5 | 0 |
| Adhere to Culture taboos | 28.6 | 34.3 | 22.9 | 5.7 | 8.6 |
| ***3. Others*** | | | | | |
| Attending health workshops | 32.7 | 41.8 | 21.8 | 3.6 | 0 |
| Livelihood diversification | 3.7 | 18.5 | 55.6 | 11.1 | 11.1 |
| Cooking indoors | 28.6 | 25.7 | 25.7 | 5.7 | 14.3 |
| Construction of livestock kraals close to homesteads | 21.4 | 14.3 | 14.3 | 21.4 | 28.6 |

***Source: compiled by author from household interviews findings***

The respondents opined that the community was aware of the symptoms and seasonal outbreak of the disease through the workshops and IEC (information, education and communication). They also were of the opinion that the response to and acceptance of government interventions against malaria also plays a major role in shielding people against the disease, and therefore must be considered as other adaptive strategies. Livelihood diversification and construction of kraals

close to homesteads were the least effective in this category as shown in Table 6 above. Most households rated livelihood diversification on the moderate level of effectiveness. Cooking indoors was the lowliest rated on the scale of effectiveness.

### 4.4.2 Discussion

The results indicated that the Okavango Delta communities have devised several adaptation strategies in a bid to protect themselves against malaria transmission. The strategies observed were categorised into (a) structural (which included modifications in houses to help limit and keep away mosquitoes from entering the houses and screening doors and windows/installation of gauzes to block vector entry); (b) timing of activities strategy (which includes partaking in activities at certain times of the year or day that present less exposure to mosquito bites, restriction of movements when mosquito biting chances are high); and (c) other strategies (which included having livestock in close proximity as alternative hosts to reduce biting rate on humans, livelihood diversification and attending health information [dissemination] workshops for capacity building against malaria).

In this study, altering house structures was found to be the most adopted and effective adaptive structural strategy against malaria transmission. This is probably because it is the most affordable, especially with traditional mud huts, where the building materials are readily available**.** Simply modifying a typical rural house design is a relatively low-cost technique for keeping away mosquito and lessening chances of malaria transmission. For households in the Okavango Delta, this indicates a major stride in malaria prevention given that in other parts of sub-Saharan Africa (SSA), this strategy was reported to be underexploited in malaria control (Tusting *et al.,* 2015). Improving house structures may be beneficial particularly in the SSA, where up to 80-100% of malaria transmission occurs indoors at night (Huho *et al.,* 2013).

In the Okavango Delta, the most common house structural change was closing the gap between the mud wall and the thatch roofing at construction stage. This, to a large extent, reduced the chances of mosquitoes entering the house. Generally in the SSA, traditional homes are considered to have mud walls, thatched roofs and earth floors, open eaves, no ceiling and no screening (Bradley *et al.,* 2013). Closed eaves have been associated with reduced chances of

malaria infection and clinical malaria in Uganda (Tusting *et al.,* 2015). This modification is likely to be protective, particularly in the SSA, since the primary African vector (*Anopheles gambiae*) has been observed to find its hosts by following odour trails close to the ground and flying upwards as soon as it encounters a vertical surface (Tusting *et al.,* 2015). This behaviour has also been observed in *Anopheles arabiensis* (the main malaria vector in Botswana). This vector enters houses through open eaves, after flying upwards due to its encounter with wall surfaces. Therefore, the populations in the study area can benefit from investing in housing improvement to block the entry routes of malaria vectors (Lindasy *et al.,* 2003).

Findings show that construction of modern houses was the second most used structural strategy against malaria transmission. Modern houses (brick wall and corrugated iron roof) were associated with lower mosquito biting rate compared to the traditional mud and reed huts. This is similar to a study by Tusting *et al* (2015) where modern wall materials were associated with a reduction in the chances of malaria infection, and modern roof materials were associated with up to a two thirds reduction in the incidence of clinical malaria. In Tanzania, houses built of bricks and with corrugated iron roofs are associated with lower levels of malaria-associated anaemia compared to poorly constructed mud-wall houses (Kahigwa *et al.,* 2002). Similar observations were made in malaria endemic community in Sri Lanka where the risk of getting malaria was greater for inhabitants of uncompleted houses, with thatched roofs and walls made of mud-woven coconut palm leaves, compared to better-constructed houses with complete brick and plastered walls and tiled roofs (Gamage-Mendis *et al.*, 1991; Atieli *et al.,* 2009).

All efforts made to reduce entry of malaria vectors through improved house construction has long been recommended as a way of reducing human exposure to mosquito bites and subsequent malaria infection (Lindsay e*t al.,* 2002). However, it seems the benefits of house screening/installation of gauzes for protection against mosquito bites have not yet been recognised by the Okavango Delta communities because it was found to be the least adopted strategy. House screening has contributed to the achievement of malaria elimination in many countries worldwide (Lindsay *et al.*, 2002). It was the first intervention first tried near Rome in Italy after the link between malaria and mosquitoes was established. It was then later shown to reduce malaria risk in India and South Africa (Anderson *et al.,* 2014). These observations only

cement the assumptions of the local knowledge utilisation framework, that demographics/socio-economic factors such as dwelling type play a role in adaptation to malaria endemicity.

Findings reveal that some of the households migrated seasonally mainly for agricultural purpose. This may possibly contribute to malaria cases, depending on the level of transmission risk at the cattle post/fields in the study area. Seasonal migration contributed to the malaria cases in the south of Azerbaijan in Asia where 40% of people migrate during the agricultural season (Grambsch and Menne, 2003). Seasonal migration in this scenario is a socio-cultural practice interplaying and impacting on adaptation to malaria endemicity. It is not clear how much seasonal migration contributes to reduction or increase in malaria cases. However, it is clear that, usually population movements seriously hamper vector control activities (Service, 1989**)**. The efforts to locate and spray temporary shelters of the seasonally migrating tribal groups in Bihar Province in India were said to be hampered by their settlements within dense forests, in brush wood huts and their inability to inform anyone about their movements (Service, 1989). In the Okavango Delta, the respondents complained that the IRS teams were not reaching their shelters in the arable fields and cattle-posts, although they (the respondents) pointed out that the structures in the fields are not suitable for IRS.

This study has also demonstrated that going to the fields after dawn and before dusk reduces chances of mosquito bites. Avoiding outdoor cooking in the evening was also said to lessen the chances of mosquito bites. These strategies are more likely to function in avoiding bites from the *endophagic* (outdoor feeding) and *exophilic* (outdoor resting) vector species, including the *Anopheles arabiensis* which is the commonest in Botswana. Some vector mosquitoes, particularly Anopheles are most active in twilight periods at dawn and dusk or in the evening, therefore making malaria transmission to happen mostly during these times (Mboera *et al.*, 2013). Given this scenario, it has, therefore, been observed that exposure to mosquito bites can be minimized by modifying patterns of activity or behaviour. Avoidance of outdoor activity especially during twilight periods can limit the exposure to malaria transmission (Grambsch and Menne 2003).

Certain cultural traits or social institutions function to limit malaria prevalence and mortality (Brown, 1981). This study has indicated that, cultural practices and taboos, such as avoiding movement around the village in the evening time, particularly by pregnant women, were not initially aimed at malaria prevention but which eventually became effective in reducing transmission. These traits do not exclusively function to limit malaria. Thus they had positive spill over effects over malaria prevention, or can be viewed as no regret adaptation strategies. Cultural practices as previously observed according to the framework guiding this study are adaptable to the prevailing conditions. Brown (1981) revealed that basic features of Sardinian culture had adaptive value against the malaria endemicity. The settlement pattern, pastoral transhumance, and restricted mobility for pregnant women played a role in malaria prevention for the Sardinian community. Restrictions on mobility were more rigorous during pregnancy and this is perceived as a seriously dangerous state in general, which also presents more risk of malaria transmission. It is, therefore, sensible to postulate that low malaria prevalence for women is due to cultural rules restricting their mobility. The overall argument is that these cultural traits reduce exposure to mosquitoes and consequently limit malaria rates among certain social groups (Brown, 1981).

Health workshops have been observed to also play a key role in adaptation to malaria endemicity in the Okavango Delta. The information disseminated in this platform provides the capacity to adapt. Workshops are carried out to raise community awareness among the locals through information sharing about climate change impacts on human health (Gonzales *et al.,* 2006). Health workshops build adaptive capacity to malaria endemicity in the study area, especially that most respondents attend the workshops. Capacity building is an essential step in adaptation process in all fields, including public health (Grambsch and Menne 2003). This allows collaboration with the local stakeholders, to restrain the propagation of diseases that are sensitive to climatic variability. It also forms a basis for human resources and knowledge as critical components for the public health community to help nations face the health challenges associated with climate change (Grambsch and Menne 2003). Thus education and awareness raising creates an environment that enables people to take well-informed, long-term, sustainable decisions (McMichael *et al.,* 2003). Education has also been observed to be among the socio-economic/demographic factors playing a role in the utilisation of health services as well as

knowledge in adaptation to malaria endemicity. Education also has a back and forth interaction with socio cultural practices including livelihoods as shown previously by the framework.

Certain livelihood activities expose communities to risks that can accelerate the exposure and transmission of infectious diseases. Hence they play an important role in occurrence of these diseases including malaria (Mphande, 2016). Diversifying livelihoods is one way of reducing the risk of malaria transmission. In the Okavango Delta, households recognised diversification as a way of reducing malaria transmission risk. They diversified into small-scale businesses such as selling airtime, fat cakes and cigarettes. Depending on more than one source of income and food implies spending less time on certain activities (such as night fishing and irrigation) that present more risk of malaria transmission. This was also observed in Rusinga Island in Kenya where most people engaged in different occupations, some of which yielded food and money. Thus, they also shifted from exclusive subsistence agriculture towards monetary or income-earning activities (Weckenbrock and Oldesloe, 2004). It has been observed that households tend to diversify livelihood strategies during challenging periods in order to adapt to change and reduce vulnerability (Ellis, 1999). Thus, having members of a household engaged in different livelihoods activities varies their level of exposure to risks (Mphande, 2016).

The potential use of alternative host species (such as livestock) to divert malaria vectors away from people has long been recognized as a potential environmental strategy for the reduction of malaria transmission (WHO, 1982). Almost all the households in the Okavango Delta did not have livestock kraals in close proximity to homesteads. This was also the least effective strategy in protecting people against mosquito bites. The cultural practice of kraaling near homesteads was not among the factors interplaying in utilisation of local knowledge to adapt to endemicity of malaria. Thus having livestock close to homesteads was not very well observed or recognised as a potential way of keeping the vector away from humans in the study area. A study conducted in Nigeria by Yakubu and Singh (2008) identified this strategy among other preventive measures. The study also observed higher mosquito population density inside cattle sheds than inside houses or outdoor resting boxes. However, it has also been revealed that increased availability of alternative hosts, such as goats could also enhance human malaria exposure, particularly to *Anopheles arabiensis*. This occurs when the heat and odour produced by animals

attract a high number of vectors to the households which are close to where the animals are kept (Iwashita *et al.,* 2014).

### 4.4.3 Conclusion

The study has demonstrated that effective adaptation requires individuals with the capacity to recognise and respond to health threats. Health workshops have also been found to be a means for capacity building against malaria endemicity because they inform people about the disease dynamics including prevention and vector behaviour. The framework of this study acknowledges education as one of the determinants of local knowledge utilisation in adaptation. Well-informed people are more likely to abide to the biomedical health care practices, whereas the less educated will be misinformed and less compliant. Therefore it only makes sense that health workshops important role in adaptation to malaria endemicity as they serve as platforms for dissemination of information.

Findings in this study have shown that most households adhere to cultural practices (taboos) that restrict movement at certain times, particularly for pregnant women. Culture has also been observed to play a role in utilisation of local knowledge in adaptation by the framework adopted in this study. People who strongly believe and adhere to their cultural beliefs are likely to uphold and value and utilise local knowledge in different aspects of life including elimination of health threats such as malaria. Restricting activities to certain times of the day can help reduce the risk of malaria transmission. Therefore limiting outdoor activity especially during twilight periods can reduce exposure to malaria transmission. Alteration of house structures has also been identified as an effective strategy. Poor communities where people cannot afford modern structures such as those in the Okavango Delta can benefit from modifications such as screening/installation of gauzes on their traditional houses. This strategy has been shown to contribute towards reduction in malaria transmission cases in other parts of the world. However, the majority of households in the delta have not realised the potential benefits of house screening against malaria transmission, even though it has been shown to contribute towards reduction in malaria transmission cases in other parts of the world. Some practices and behaviours may not be intentionally meant for certain community problems such as malaria transmission, but they have an impact on disease prevention. However, with a focus on people's strengths and potential

contribution (rather than their vulnerabilities) against health problems such as malaria, more adaptation efforts and potential could be unveiled. Countries on the journey to malaria elimination, therefore, have the responsibility to maximise on these efforts to ensure sustainable progress in the fight against malaria.

## 4.5 HOUSEHOLD PERCEPTIONS ON HEALTH INSTITUTIONS' UTILIZATION OF LOCAL KNOWLEDGE ON MALARIA PREVENTION

This section of the results chapter addresses the fourth objective of the study, which assesses household perceptions on formal and informal health institutions practices regarding malaria. It presents an analysis of respondents' level of agreement to statements reflecting their perceptions of health institutions in relation to malaria.

### 4.5.1 Respondents' attributes and their perceptions on health institutions' practices regarding malaria

Mann Whitney test revealed no statistical significant difference in perceptions of males (M=44.40, n=26) and females (M=37.84, n=53, U=5754.5, z=1201, p= .230, and sex of respondent. Thus perceptions on practices by health institutions regarding malaria did not differ by sex.

Kruskal-Wallis test also showed no statistical significant difference in perceptions and age groups [$\chi 2$ (4) =.39, p=1] with a mean rank perceptions of 39.71 for (18-21), 39.68 for (29-39), 40.88 for (40-50), 40.72 (51-61) and 39.67 for (62 and above). The Kruskal-Wallis test also revealed no statistical significant difference in perceptions among the different education levels [$\chi 2$ (5) =4.63, p=.46] with a mean rank perceptions of 48.88 for none, 41 for high primary, 46.09 for junior secondary, 38.22 for senior secondary, 31.46 post-secondary, and 36.69 for other levels of educations. This shows that perceptions did not differ with age and education level.

### 4.5.2 Household perceptions on health institutions practices in malaria prevention

The sum of scores of the Likert-type items or responses was derived during data analysis. The perceptions index was composed through taking the average of the composite scores. The higher index demonstrated more negative perceptions towards health institutions and vice-versa. The results indicate that households held positive perceptions towards health institutions' practices towards malaria. The mean perceptions index was 2.06 with standard deviation of 0.52, a minimum value of 1.0 and maximum of 3.38.

Household's level of agreement varied from one statement to another based on household perceptions on institutional practices regarding malaria. In most statements, the majority of households agreed except for two ("current interventions are adequate" and "current interventions are effective"), which they strongly agreed with. The interventions discussed here, are the vector control interventions against malaria, indoor residual spraying (IRS) and insecticide treated nets (ITNs).

#### 4.5.2.1 Acceptance of interventions in malaria prevention

Data in Table 7 show that majority (50.6%) of the interviewees agreed that "The current modern malaria prevention measures provided by the government are acceptable in the community". While 30.4 % of the households strongly agreed with the statement. While 2.5 % of them disagreed with the statement, 5.1% strongly disagreed. From this observation, it is clear that the households held positive perceptions on acceptance of modern measures are positive.

This is in harmony with the key informants' observation that generally the interventions have been accepted. However there has also been an indication that the interventions may not be fully accepted due to unexplained symptoms/allergic reactions, experienced after Indoor Residual Spraying. Key informant interviews also revealed that despite pre-announcements on malaria activities, during IRS season most people are absent from their homes. Both the key informants and focus group discussants attributed the absence of people from homes during the IRS season to the fact that it coincides with the rainy season. During the rainy season people spend a lot of time at the fields preparing for ploughing, therefore most of them are absent at the time of IRS. Furthermore furniture is likely to be soaked with rainwater which might cause damage; therefore people may be reluctant to open their doors for IRS at this time of the year. The FGDs also revealed more concerns regarding IRS, including unexplained symptoms after IRS administration and allergies.

#### 4.5.2.2 Adherence to the interventions in malaria prevention

A total of 49.4 % of the respondents (Table 7) agreed to the statement that 'The current malaria interventions provided by the health workers are easy to adhere to'. Another 43.4% of the

respondents strongly agreed, and 6% were neutral about the statement. This indicates that the majority of households held positive perceptions on adherence to malaria prevention interventions.

The key informant interviewees indicated that they observed inconsistent (on and off) adherence to the health instructions regarding malaria prevention. They had list of concerns regarding insecticide treated nets usage. They revealed that using ITNs for fishing was the most common misuse, including use in shading garden/vegetable plots; this together with partial acceptance of nets probably contributes to the observed low usage rate of nets. Whereas the focus group discussants mentioned that they do prefer and adhere to health instructions regarding malaria prevention. However, they also find it beneficial to combine both the modern (IRS and ITNs) and old (cow dung etc.) malaria prevention strategies.

#### 4.5.2.3 Community involvement and participation in malaria prevention

'Health workers support and involve the community in the planning for malaria prevention' was affirmed by 44.3% of the households (Table 7). Strongly agree was selected by 32.9 % of the households, while 7.9 % were neutral, 13.9% disagreed and 1.3% strongly disagreed. This indicates positive perceptions about community involvement in the planning for malaria prevention by health workers. From the key informant interviews, community involvement through village health committee (VHC), village development committee (VDC), traditional healers (THs) and religious leaders was widely observed and attested to by most of the key informants.

However, very low and one-sided collaboration between traditional healers and the modern health system was observed particularly by traditional healers. (From the traditional healers' side, they refer people to the clinic when necessary, but the clinic rarely consults with them). The traditional healers also mentioned that they refer malaria patients to the clinic, because they do not know how to treat malaria, however, they know how to prevent it.

#### 4.5.2.4 Availability of malaria health care services

Data in Table 7 show that 39.2% of the respondents from household interviews agreed that, 'The health facilities and malaria prevention services are available to the community'. The other 31.6% strongly agreed, 13.9% neutral and 15.2% disagreed. This indicates positive perceptions about availability of prevention services and facilities. The shortage of ITNs was a common concern among the key informants, despite the aforementioned misuse.

**Table 7: Households' perceptions on health institutions' malaria prevention practices**

| N=79 Level of agreement in % | | | | | |
|---|---|---|---|---|---|
| **Perception statement** | **Strongly agree** | **agree** | **neutral** | **disagree** | **Strongly disagree** |
| The current modern malaria prevention measures provided by the government are acceptable in the community. | 34.2 | 50.6 | 7.6 | 2.5 | 5.1 |
| The current malaria interventions provided by the health workers are easy to adhere to. | 44.3 | 49.4 | 6.3 | 0 | 0 |
| Health workers support and involve the community in the planning for malaria prevention. | 32.9 | 44.3 | 7.6 | 13.9 | 1.3 |
| The health facilities and malaria prevention services are available to the community. | 31.6 | 39.2 | 13.9 | 15.2 | 0 |
| The health facilities and malaria prevention services are accessible to the community. | 31.6 | 45.6 | 12.7 | 7.6 | 2.5 |
| The current scientific malaria interventions are effective. | 44.3 | 36.7 | 12.7 | 6.3 | 0 |
| The current interventions are adequate. | 35.4 | 30.4 | 7.6 | 20.3 | 6.3 |
| Local knowledge is not taken into consideration as much as scientific knowledge when it comes to informing malaria control/prevention policy. | 24.1 | 38 | 7.6 | 15.2 | 15.2 |

***Source: compiled by author from the household interviews findings***

Staff shortage and shortage of medication and long waiting hours at clinic were also noted. Therefore is worth noting that people are reluctant to go to the clinic due to the slow service delivery and long waiting hours. From the FGDs, respondents mentioned that there is need for wider nets distribution coverage (currently nets are only distributed to pregnant women and children).

#### 4.5.2.5 Accessibility of health facilities and the interventions in malaria prevention

In Table 7 above, a total of 45.6% of the respondents agreed that: 'The health facilities and malaria prevention services are accessible to the community'. From the rest of the respondents 31.6% strongly agreed, 12.7% were neutral, 7.6% disagreed and 2.5% strongly disagreed. Therefore the households held positive perceptions about accessibility of services and facilities.
However key informants pointed out the, lack of transportation, staff shortage and long distance to health facilities, which limits accessibility to malaria health services. It was also observed that, most of the time people go to the clinic first then traditional healers, but still some go the traditional healers first then the clinic. It is therefore not surprising that people tend to delay seeking help at the clinic, even though it is not clear if this is an issue of accessibility or preference. Some of the focus group discussants, found the health services accessible, except for when they are away at the cattle posts and fields, where IRS is not administered.

#### 4.5.2.6 Effectiveness of the interventions in malaria prevention

Data in Table 7 reveal that 44.3% of the respondents strongly agreed that 'The current scientific malaria interventions are effective'. While 36.7% of them agreed with the statement, 6.3% disagreed. However, approximately 13% of the households were neutral. This indicates that households held positive perceptions about effectiveness of interventions.

From the FGD, some participants argued that IRS is not effective, it only increases mosquito biting rate, while others argued that IRS is effective in malaria prevention. Mosquito resistance to IRS has also been observed by the participants, however they also suggested that, IRS should also be administered in *malwapa* (reed yards) and trees. The respondents also pointed out that they need stronger nets; the current (white) nets are not durable. The blue/green nets that were distributed in the past were said to be stronger and more compatible with most house structures

(for hanging): as one of the discussants elaborated that they *"prefer green and round shaped nets over the white ones as they are short and easily get torn. The white ones are square shaped and therefore mosquitoes rest in the corners."* There have been allergic reactions / unexplained symptoms due to the use of ITNs and after IRS administration, experienced by some members of the community. Therefore there was a complaint that the nets are not very useful, hence alternatives such as peaceful sleep, would be more suitable.

#### 4.5.2.7 Adequacy of malaria interventions

Data in Table 7 show that 35.4% of the respondents strongly agreed with the statement: 'The current interventions are adequate'. While 30.4% of the households agreed with the statement, some of them either disagreed (20.3%) or strongly disagreed (6.3%). Hence the positive perceptions held by households, about adequacy of the interventions.

Lack of adequacy was expressed in terms of health service provision in general, without particular focus on malaria. These included long waiting hours at the clinic, language barrier, delay in seeking help, lack of knowledge and low health literacy. With reference to adequacy of malaria interventions, key informants and FGDs mentioned poverty and poor house structures (reed houses) as the main challenges. These makes the interventions somehow fall short on serving their purpose. Therefore, other local strategies, such as use of certain tree leaves, cow and elephant dung, come in handy to supplement IRS and IRs. It was also suggested that there is need for more additional alternatives against malaria prevention.

#### 4.5.2.8 Local knowledge utilisation in malaria prevention

Data in Table 7 reveal that 38% of the respondents agreed that 'Local knowledge is not taken into consideration as much as scientific knowledge when it comes to informing malaria control/prevention policy'. Nonetheless, 15.2% of them disagreed with the statement. While 24.1% of them strongly agreed with the statement, 15.2% strongly disagreed with it. The households' perceptions about local knowledge utilisation were, therefore, positive. Key informants mentioned that, the community is encouraged to use traditional (burning of dry cow/elephant dung etc.) methods by health practitioners. The use of traditional methods is a way

of involving the community and utilising local knowledge in the health system and fight against malaria transmission. Both the key informants and FGDs favoured the possibility of utilisation and preservation of local knowledge in the fight against malaria. It was suggested that the health sector, investigate and see what works from the locals, and improve on it if necessary and also advice on proper use based on scientific evidence, for health reasons.

### 4.5.3 Household responses to interventions and health institutions' practices regarding malaria

Generally, the households' perceptions towards practices by health institutions are positive and there is a reflection of efforts, compliance to and acceptance of the malaria interventions, by households. However, there has also been a list of concerns noted regarding malaria transmission and prevention. These include the most common: the use of ITN's for fishing by community members or households. Households also misused Insecticide nets in shading garden/vegetable plots; this together with partial acceptance of nets probably contributes to the observed low usage rate of nets. Indoor residual spraying was also said to be administered during the rainy season when furniture is likely to be soaked with rainwater and most people away preparing fields for ploughing. More concerns regarding IRS included unexplained symptoms after IRS administration and allergies. Other challenges observed include, language barrier, poverty, reed houses (these shelters provide limited/minimum protection against malaria vector), delay in seeking help, lack of knowledge and low health literacy. These challenges experienced by households in the area, hamper malaria prevention and elimination efforts.

### 4.5.4 Discussion

The findings indicate that generally households have positive perceptions about health institutions utilization of local knowledge prevention/treatment on malaria, as most of them agreed to statements in regard to acceptability, adherence, involvement of the community by health institutions, availability, acceptability, effectiveness, adequacy of interventions/ prevention services facilities and consideration of local knowledge by health institutions in informing malaria prevention policy. Despite this, some of the responses towards the interventions and health institutions practices are of concern, as they hamper and undermine malaria elimination efforts. These were attributed to the challenges faced by households in

malaria prevention, which in turn also becomes challenges to the health institutions. Overall this just points out the loopholes and areas to improve on in the malaria prevention policy.

According to most key informants' perceptions in the Okavango Delta, community involvement in malaria activities exists to a certain extent (through Information Education and Communication). This is contrary to a study carried out in Nigeria by WHO (2012) where participants alleged that community members are excluded from decision making by health systems on purpose. Ideally a common understanding of people's perceptions of health service is vital among all stakeholders, in order to accomplish universal health for the people and successful interventions. This is imperative for effective promotional messages and campaigns, aimed at creating demand for particular health interventions (Dowler *et al.*, 2006).

The utilisation of local knowledge against malaria (burning of cow/elephant dung to repel mosquito) is also well known by health workers in the Okavango Delta. However, there were mixed perceptions on this subject, as some key informants and FGD participants suggested the need to look further into these traditional methods, and improve where necessary, whereas a few felt they should be prohibited. Despite the mixed perceptions, it seems most people combine the traditional and modern prevention methods, such that people consult both traditional and modern health practitioners regarding malaria. Similarly, this was discovered in Tanzania by Comoro *et al* (2003) where some of the mothers from the urban areas used the hospital as first resort for malaria symptoms, while others combined the hospital with traditional treatment practices. This illustrates a case of coping behaviour (as psychosocial factor) influencing perceptions and malaria health seeking behaviour. However, some of the key informants in this study said the community members, go to the clinic straight away in case of malaria and other health problems; this was attested to by modern health practitioners. This may be an indication of evolution from old to modern practices (Comoro *et al.,* 2003). However, some felt there is a lack of truth in this; they indicate that people may fear to reveal that they do consult traditional healers before they go to the clinic, a practice that is widely criticised in the community. This was also evident elsewhere in Tanzania as it was concluded the fact that mothers who were aware of and with malaria associated symptoms still resorted to traditional healers is worrisome (Comoro *et al.,* 2003).

There is need for adequate information, education and communication (IEC) to ensure viable partnership with the community in the battle against malaria. Thus with ineffective social mobilisation; communities are likely to resist control interventions (WHO, 2014). This indicates that, health institutions practices and processes (influence psychosocial factors) determine the perceptions towards malaria health interventions. The Okavango Delta communities, may not be necessarily resistant to interventions, however absence in times of IRS has been observed. There have also been complaints that IRS takes place during the rainy season, it also causes allergic reactions, and that it only increases the mosquito biting rate.

To ensure compliance to health interventions, it is important that people are well informed and mobilised prior to implementation of the program (Carrington, 2001). From the findings of this study it seems the responsible persons (health educators) are on the right track, *kgotla* meetings and IEC where awareness, is bearing fruits as majority of respondents agreed that they adhere to health instructions. It is advised that local chiefs, community leaders, and relevant influential people be involved in education and mobilisation campaigns, to aid acceptance of the various malaria control strategies by the community (Carrington, 2001). Thus, perceived need for receiving malaria interventions is influenced by social support from the community, as a psychosocial factor. Majority of the respondents agreed that the Okavango Delta community has fully accepted the government interventions, active involvement of community leaders (local chiefs) and others can be partially credited for the general acceptance influenced by their input in health talks. Brown *et al* (2016) claims that in order to achieve sustainable and effective malaria control, it is crucial to secure public support for the control tools from the targeted populations.

IRS has been the primary vector control intervention in Botswana for decades, with target goal of 90 % average stated in the elimination strategic plan (Ministry of Health, 2009). However the coverage has remained at approximately 70 % in the high malaria transmission districts for several years. A decline in community's acceptance of IRS and inconsistency, in the quality of spraying over time has been observed (Global Health Sciences, 2015). This observation may be attributed to the perceptions that, there are allergies experienced and absence of people from homes during the spraying season. Even though it has been generally observed that people open

their doors for IRS, there has also been complains that, the fact that it happens from October to December is unsuitable for furniture to be taken outside, due to occurrence of rainfall at this time of the year. Moreover, the population is highly mobile and tends to migrate seasonally, especially during the rainy season when they relocate to the lands where the shelters are not favourable for spraying (Ministry of Health, 2015).

Botswana experiences seasonal malaria epidemics, and even more susceptible with the increase of importation from endemic countries, it is therefore essential that the populations at greatest risk have access to basic interventions (Global Health Sciences, 2015). The populations at risk which most of the time refers to pregnant women and children under five years of age, excludes other members of the community even in endemic areas such as the Okavango Delta. However, ITN distribution coverage has been below the Rollback Malaria Target of 80% for pregnant women and children (WHO, 2014). Because of this exclusion, there are complaints about the shortage of ITNs. Despite mass free distribution of ITNs high transmission districts, coverage averages only 60 %, furthermore lack of funding may result in insufficient distribution the future (Global Health Sciences, 2015). The participants also raised concerns regarding the quality of the current ITNs in distribution; they said that they prefer the previous green/ blue ITNs as they were durable and compatible with most house structures (for hanging). The perceived belief that the current interventions ITNs are not as effective as the previous ones may hamper malaria elimination goals.

Illiteracy and poverty are among the challenges hindering some of the strategies to prevent and control malaria. ITNs are used either for fishing or as greenhouses to protect plants from the scorching sun and birds (Ministry of Health, 2015). These are some of the predisposing factors which influence perceptions and utilisation of malaria interventions. The misuse of ITNs has also been reported elsewhere, including in Malawi, Zambia and Zimbabwe, this can happen anywhere if Fishery Departments or local leaders do not regulate fishing gear (Marshall and Maes, 1994).
The indifference in perceptions with sex, age and education level may be attributed to the fact that the population under study is relatively homogenous; in terms of geographical location, cultural practices and similar experiences with malaria health care service provided in their area. Furthermore the participants in this study were selected based on a common background of prior

exposure to malaria transmission. Therefore it is not surprising that the demographics of the population understudy did not influence perceptions. A study on the roles of demographics on the perceptions of electronic commerce adoption in Korea by Lee (2010) also revealed no sex differences and other demographics detected in terms of perceptions of electronic-commerce adoption. This was attributed to the sample being studied, having prior exposure to and experience with the internet and e-commerce, especially that they had been selected from online panel group in Korea (Lee, 2010).

The absence of statistically significant difference in perceptions with demographics (sex, age and education level) contrasts the null hypothesis and framework of this study. In the context of perceptions the framework states that, the likelihood of applying local knowledge to malaria depends on: the interaction among socio-cultural, demographic/socio-economic, ecological and institutional factors and their interplay with psychosocial factors. Thus the demographic characteristics of individuals are among other factors that determine perceptions. Andersen (1995) also mentions demographic characteristics as some of the predisposing factors of health utilization. However the results of this study do not necessarily invalidate the aforementioned assertions. It is advised not to rely too heavily on statistical significance because many other factors also need to be considered. Therefore, the results should be cautiously interpreted, taking into consideration all the available information (Pallant, 2005). For this study the similar socio-cultural, socio-economic and potential confounding factors such as geographical location of the respondents may partially explain the outcome from the statistical analysis.

### 4.5.5 Conclusion

The study has revealed that the households in the Okavango Delta hold positive perceptions towards health institutions practices. This is an advantage to, and an indication of good work from the health service providers, which is also a very essential milestone towards malaria elimination in Botswana. Health institutions to some extent involve the community in the fight against malaria, which is in line with the World Health Organisation (WHO) tenants of community participation. However, there is still room for more collaboration with non-government institutions such as traditional healers; this will improve the level of local knowledge utilisation in malaria prevention. It is imperative for the community to be actively

involved in planning and implementation of all malaria control activities (Ameyu, 2008). This calls for ample dedication and teamwork from, public and private health workers, traditional and religious associations, community-based organisations, non-government organisations, community leaders (Ameyu, 2008).

There were also concerns regarding the timing (rainy and also ploughing season) for Indoor Residual Spraying (IRS) administration, which reduces the households benefiting as well as the intended coverage of this intervention by the national malaria control program. This can also be mistakenly perceived as lack of acceptance of IRS by the community. It is clear that the Botswana strategic plan towards malaria elimination faces some challenges due to lack of community acceptance of vector control interventions to a certain extent, lack of active community participation and involvement, and communication barriers due to different languages (Ministry of Health, 2009). Key informant interviews from this study also revealed that there are communication barriers due to different languages in the study villages as well as lack of active community participation and involvement. These concerns from the community should be taken into consideration by the ministry of health as a step towards community involvement and good collaboration. In conclusion, the findings from this study highlight the loopholes in malaria control.

# CHAPTER 5

## 5 SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

This chapter presents the summary of findings of the study on rural households' prevention and adaptation strategies against malaria endemicity in the Okavango Delta, Botswana.

Specifically, the thesis assessed the local knowledge used by households in the prevention of malaria, it analysed local knowledge on the relationship between livelihood activities and exposure to malaria transmission. It also determined households' adaptive strategies against malaria transmission and finally assessed household perspectives on formal and informal health institutions practices regarding malaria. The conclusions below were drawn from this study are based on these objectives.

### 5.1.1 Local knowledge used by households in the prevention of malaria

- Malaria prevention begins with people's awareness of the disease as well as its season of prevalence. People become empowered when they have acquired the knowledge necessary to guard against the risk of malaria transmission. This further translates into observing what works against the malaria vector as the primary mode of malaria transmission. Therefore,

- Malaria-affected communities mostly utilise the readily available resources in their geographical areas/environment. In this case particularly cow dung and elephant dung which have been observed overtime to have effective repellent properties against mosquitoes, especially when used along with Insecticide treated nets. The combination of ITNs with herbs, ITNs with cow dung, ITNs with elephant dung and ITN with peppermint (*Schinus molle*) tree leaves were also observed to be the most effective, hence they are the most used and widely known (except for peppermint tree leaves). The National malaria control program should carry out further investigations and figure out how to improve these strategies, make them safer and encourage people to use them to compensate for shortage of ITNs and also to increase variety of prevention methods. It is

also important to look into, and investigate and cultivate local knowledge utilisation, while the few knowledge holders are alive, as currently very few people know the indigenous plants that repel mosquitoes.

- The perennial presence and biting of mosquito (even in winter) that has been observed, might possibly contribute to malaria cases, therefore both the public and NMCP should take precaution.

- Suggestions from this study as well as findings from other studies elsewhere infer that households in the Okavango Delta and similar communities elsewhere could benefit more from their local knowledge of malaria prevention, if encouraged to use other methods which are currently not largely used, with potential to repel malaria vector. This could also help come up with locally manufactured products against malaria, which the community at large would be more accepting and compatible with.

### 5.1.2 Relationship between livelihood activities and exposure to malaria transmission

- Exposure to malaria transmission was very high for livelihood activities, which take place by or at the river compared to others. Furthermore, the intensity of exposure per livelihood activities varied and depended on duration of activity, time of the day, seasonality and protection from mosquito bites, through protective clothing.

- Males were found to be the most exposed to malaria transmission in most of the livelihood activities. However, due to the fact that all people participate in several livelihood activities, exposure cannot be limited to a certain group of individuals; hence everyone is likely to be vulnerable to malaria transmission. However, participants in fishing activities, *molapo* and rain-fed arable farming, grass and reed harvesting are more likely to be exposed, especially due to the lack of attention paid to the attire worn in these activities and the dawn times they take place at. Therefore males and the public in general should take precaution (minimise exposure, cover up).

- From this study it can also be concluded that the indeed the malaria vector is opportunistic and flexible in behaviour, depending on host availability as chances of mosquito bites were observed to be high in some activities at daylight such as grass/reed harvesting at the river. However, activities that take place during twilight periods present higher exposure to malaria transmission. It is advisable to limit participation in these activities and also wear protective clothing.

### 5.1.3 Households' adaptive strategies against malaria transmission

- The study demonstrates that effective adaptation requires individuals with the capacity to recognise and respond to health threats. Health workshops have also been found to be a means for capacity building against malaria endemicity because they inform people about the disease dynamics including prevention and vector behaviour. Maximising on such educational platforms will build and strengthen adaptive capacity against malaria transmission.

- Findings in this thesis show that most households adhere to cultural practices (taboos) that restrict movement at certain times, particularly for pregnant women. Therefore, restricting activities to certain times of the day can help reduce the risk of malaria transmission, particularly limiting outdoor activity especially during twilight periods.

- Alteration of house structures has also been identified as an effective strategy. Poor communities where people cannot afford modern structures such as those in the Okavango Delta can benefit from modifications such as screening/installation of gauzes on their traditional houses. However, the majority of households in the Delta have not realised the potential benefits of house screening against malaria transmission, even though it has been shown to contribute towards reduction in malaria transmission cases in other parts of the world. It would be beneficial to extend the national presidential house appeal project to Okavango Delta and also encourage the public to use this strategy as it has been found to be helpful in the fight against malaria elsewhere.

- Some practices and behaviours may not be intentionally meant for certain community problems such as malaria transmission, but they have an impact on disease prevention. Such practices should be taken advantage of and encouraged.

### 5.1.4 Household perceptions on formal and informal health institutions practices

- The study has revealed that the households in the Okavango Delta hold positive perceptions towards health institutions practices. This could catalyse the malaria elimination progress in Botswana. Despite the positive perceptions, quite a few of the respondents disagreed that the current interventions are adequate. Therefore the malaria control programme should consider coming up with alternative and additional strategies against malaria.

- Community involvement in the fight against malaria in the study areas is limited to some extent. There is still room for more collaboration with non-government institutions (particularly traditional healers), this will improve the level of local knowledge utilisation in malaria prevention.

- The timing (rainy and also ploughing season) for Indoor Residual Spraying (IRS) administration is unsuitable, which limits the number of households benefiting as well as the intended coverage of this intervention by the national malaria control program. The ministry of health should consider co-ordinating malaria programme activities at the most suitable time and also improve service provision and delivery.

- Key informant interviews from this study also revealed that there are communication barriers due to different languages in the study villages as well as lack of active community participation and involvement. These barriers together with long waiting hours at the Shakawe clinic discourage and delay people from seeking health care on time. Having translators and improving service delivery in generally could curb these problems. In conclusion, the findings from this study highlight the loopholes in malaria control.

## 5.2 Recommendations

The recommendations made in this study aim to capture the attention of all stakeholders, community leaders, all sectors with connection to livelihoods, e.g. fisheries department, Non-governmental organisations, private health institutions and charitable organisations), policy makers specifically Ministry of Health (National Malaria Control Programme). Based on the results of this study**:**

- The Ministry of Health should embark on investigations to verify and improve upon (where necessary) what (local products; herbs and dungs) actually repels mosquitoes. Following this, the malaria control programme should incorporate local knowledge to come up with alternative and additional strategies against malaria.

- There is need for integrative re-thinking to improve malaria prevention and control policy and strategies, and to pay more attention to the potential contribution of certain livelihood activities and practices to malaria transmission.

- Households should restrict activities to certain times of the day and limit participation in twilight and outdoor activities especially during this (twilight) period, and also wear protective clothing. Furthermore, males and the public in general should take precaution (minimise exposure, cover up) by wearing protective clothing, particularly when participating in livelihood activities of high exposure.

- The NMCP should maximise on educational platforms such as health workshops, to build and strengthen adaptive capacity against malaria transmission.

- The concerns from the community should be taken into consideration by the Ministry of Health as a step towards community involvement and good collaboration, as this has implications on acceptability of interventions. This involves considering coordinating malaria programme activities at the most suitable time and also improve service provision and delivery.

- The national presidential house appeal project should be extended to the Okavango Delta and the public must be encouraged to adopt house screening strategy as it has been found to be helpful in the fight against malaria elsewhere.

- There is also need to scrutinise practices which may compromise the ecosystem, such as burning the aquatic vegetation to get rid of mosquitoes in order to also help reveal safer large scale methods of decreasing mosquito survival.

- The public and private health workers, traditional and religious associations, community-based organisations, non-government organisations, community leaders should be engaged and more dedicated to the fight against malaria in collaboration with health institutions.

- In light of this, measures against the residual transmission occurring in these circumstances, should be considered in the malaria control policy, vigorously as the country aims to eliminate malaria by 2018 and Africa at large aims for the year 2030.

- Countries on the journey to malaria elimination, therefore, should maximise people's strengths and potential contribution against health problems such as malaria. This should unveil more adaptation efforts and potential to ensure sustainable progress in the fight against malaria.

- This thesis has captured local knowledge about observed' mosquito behaviours in communities' relation to specific livelihood activities as well as of households interaction with their surrounding environment. This insight into local communities' knowledge of malaria prevention and adaptation will hopefully add value to current vector control to tools to target residual transmission, if considered in the malaria control policy.

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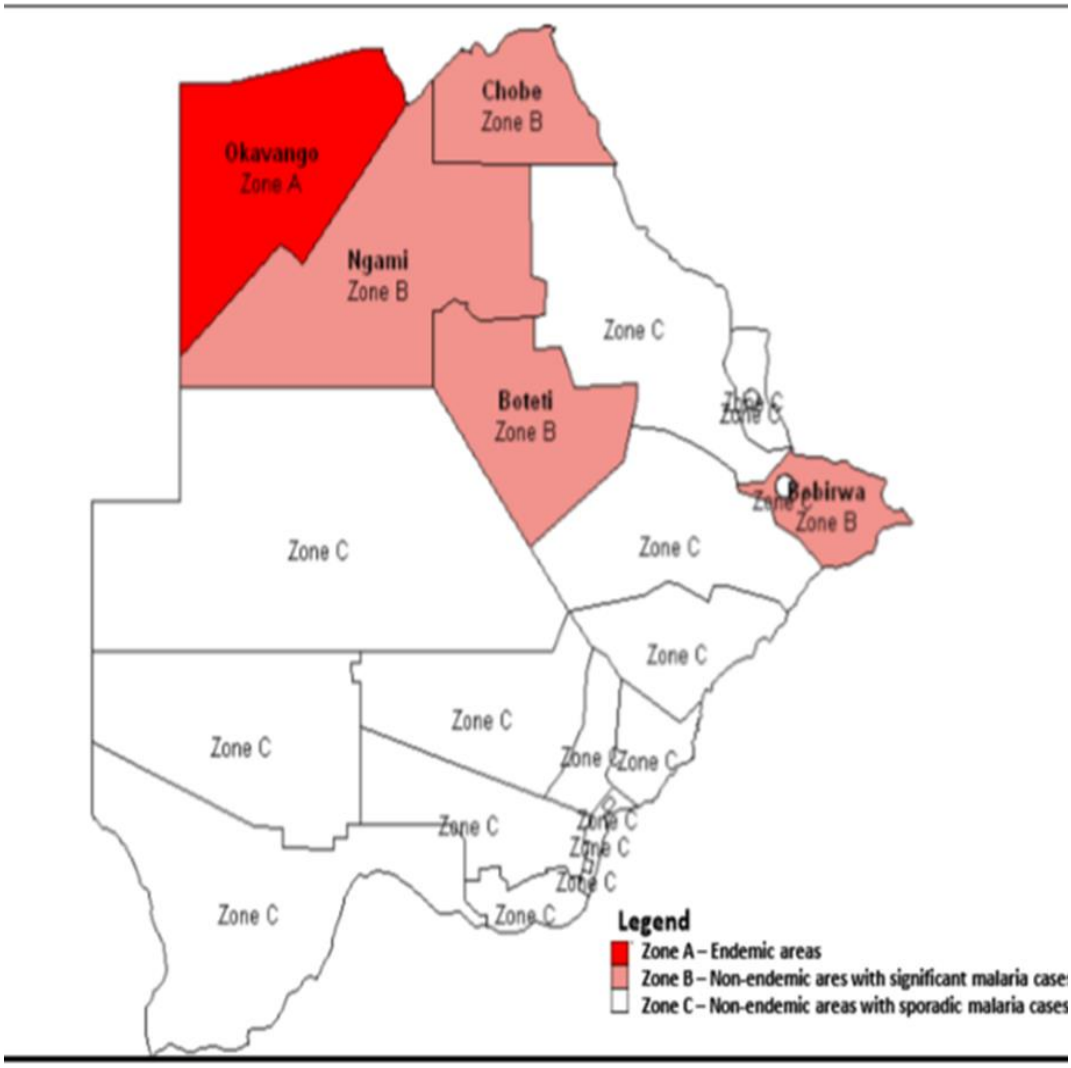
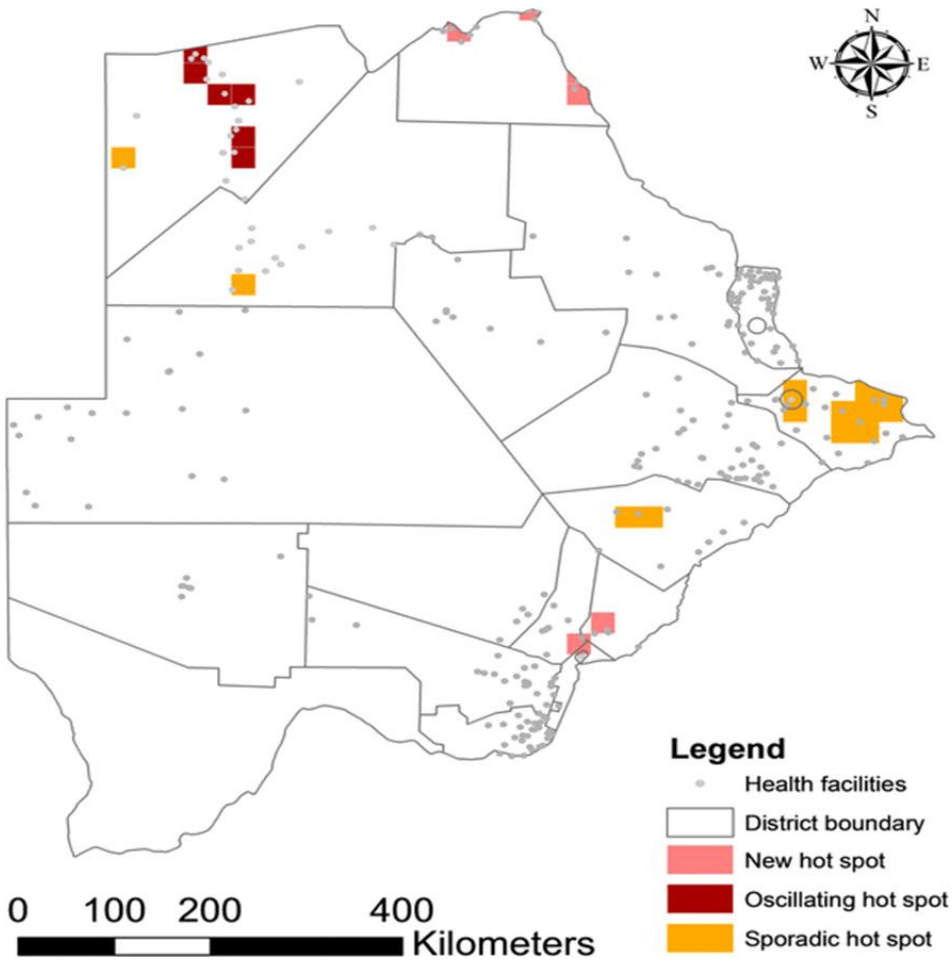
# 6 APPENDICES

## 6.1 APPENDIX A




Source: Ministry of Health Botswana (2008)

## 6.2 APPENDIX B




Source: Ministry of Health Botswana (2015)