CHAPTER ONE

1.0 Background

Malaria, a protozoa infection of the genus Plasmodium remains a threat to human population across continents, especially Africa and in particular sub Saharan Africa. "There are four species of parasites that cause infections in humans namely, *Plasmodium Malariae, Plasmodium Ovale, Plasmodium Vivax and Plasmodium Falciparum* . Each species has a different biological pattern in which it affects man. The most common species that is clinically significant causing the most lethal form of malaria is *Plasmodium Falciparum*. In Zambia, *Plasmodium Falciparum* accounts for more than 95% of malaria cases, with *Plasmodium malariae* comprising 3% and *Plasmodium Ovale* 2%. *Plasmodium Vivax* is very rare in Zambia" (Diagnosis and Treatment of Malaria in Zambia, 2010). There were an estimated 219 million cases of malaria (range 154–289 million) and 660 000 deaths (range 610 000–971000) in 2010 globally. Country-level malaria estimates available for 2010 show that 80% of estimated malaria deaths occur in just 14 countries and approximately 80% of estimated cases occur in 17 countries. Together, the Democratic Republic of the Congo and Nigeria account for over 40% of the estimated total of malaria deaths globally. The Democratic Republic of the Congo, India and Nigeria accounted for 40% of estimated malaria cases.

In Zambia, about 4.3 million cases both confirmed and clinical were reported and of these 6,149 resulted in deaths in 2007. The malaria incidence was estimated at 358 cases per 1,000 population in 2007, 412 cases per 1,000 population in 2006 (ZDHS, 2007). In 2009, the national malaria incidence was at 251 cases per 1,000 population (NMCAP). The National Health Statistical Bulletin also recorded a trend of malaria prevalence from 2008 to 2010. Malaria prevalence was 246 cases per 1,000 population in 2008, 251 cases per 1,000 population in 2009 and 330 per 1,000 population in 2010; this indicated an increasing malaria incidence with a significant difference between the years 2009 and 2010. The majority of these cases were recorded among the under-five (5) population, prevalence rates of 641 in 2008, 620 in 2009 and 897 per 1000 in 2010. In Lufwanyama, malaria prevalence was reported at 90.3 in the year 2009, 224.7 in 2010 and 380.9 per 1000 in 2011 (Lufwanyama DHIS, 2012).

Malaria accounts for 6.8 million disability-adjusted life years lost in Zambia (Roll Back Malaria, 2011). Its effects in the general adult population have been that of high medical expenses and low productivity. This can cause serious problems to economic development, either directly through the costs of health care and hospitalization or indirectly, through work-days lost to personal illness or to caring for a sick child hence affecting productivity. In Zambia, efforts began after recognizing that reducing malaria burden was good for mining productivity in the Copperbelt Province. Early efforts by the mines initiated the use of IRS (Roll Back Malaria, 2011).

1.1 Statement of the Problem

One of the objectives of Zambia's national strategic plan for malaria control include IRS coverage of above 85% of eligible households in 15 target districts, (Roll Back Malaria, 2011). This is as well a core objective in the prevention of malaria in Lufwanyama (Action Plan Report, 2012). Lufwanyama between the period of 2009 and 2011 had 18 health facilities these being St. Joseph's, St. Mary's, Shimukunami, Nkana, Bulaya, Mukumbo, Lumpuma, Mukutuma, Chikabuke, Mushingashi, Fungulwe, Chinemu and Mibenge health centres and 4 health posts, that is, Kapilamikwa and Mibila (became independently functional in 2010). While Kansoka and Chantete became functional in 2011.

Records show that out of a total of 11,719 households in St. Joseph, St. Mary's, Shimukunami, Nkana, Chinemu and Mibenge catchment areas that were designated for IRS 11,703 households were sprayed giving coverage of 99.8%. In the preceding years of 2009 and 2010 in the same catchment areas, about 10,340 out of 10,880 and 10,243 out of 11,201 households were sprayed giving coverage of 95% and 91% respectively (Lufwanyama Indoor Residual Spraying Database, 2011).

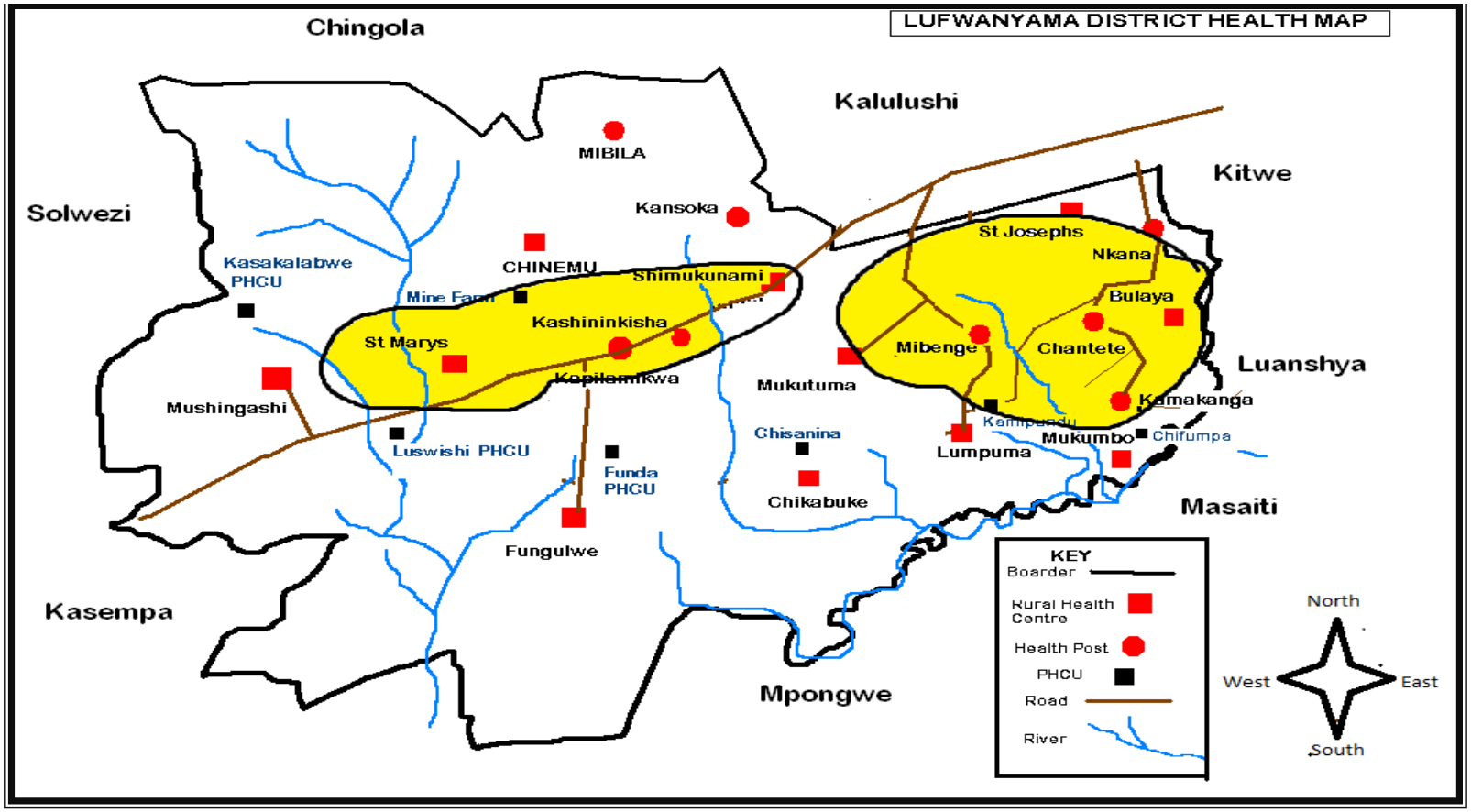
However, discrepancies in prevalence of malaria show that malaria is high in IRS areas than non IRS areas. "The IRS areas (Chinemu, Mibenge, Nkana, Shimukunami, St.Joseph's and St. Mary's Catchment areas) on average had 6175 confirmed malaria cases (180 per 1000 population) in 2009, 23118 confirmed malaria cases (654 per 1000 population) in 2010 and 22123 confirmed malaria cases (609 per 1000 population). While the non IRS areas (Bulaya, Chikabuke, Chantete, Kapilamikwa, Mukutuma, Lumpuma, Fungulwe, Kansoka, Mibila, Mukumbo and Mushingashi) on average had 4374 confirmed malaria cases (94 per 1000

population) in 2009, 19773 confirmed malaria cases (413 per 1000 population) in 2010 and 23028 confirmed malaria cases (468 per 1000 population) in 2011 (Lufwanyama DHIS, 2012) see appendix III.

In general, Lufwanyama District recorded malaria incidences of about 213.1 and 374.8 per 1000 population in 2009 and 2010 respectively. In 2011, compared to the preceding years the highest cause of morbidity and mortality in the District was malaria with an incidence at 512 per 1000 population" (Action Plan Report, 2012).

Given the data and situation above, research in Lufwanyama has not been done to document any associations of Indoor Residual Spraying on the prevalence of malaria since the introduction of Roll back malaria in the district. So far in the absence of research, we cannot account for the roles of factors like demographic, socio-economic, cultural, geographical and environmental may influence prevalence of malaria in view of IRS. There is also absence of empirical data that can suggest that the community has negative perceptions towards acceptance of IRS.

Figure 1. Lufwanyama Map



Source: Japan International Development Aid (JICA) Zambia Maps 2011.

Highlighted in the Lufwanyama map are areas where malaria cases are high. And these same areas are the ones that are always sprayed annually.

1.2 Conceptual Framework

Several research studies have shown that high knowledge about malaria among a community enables practice of preventive and control strategies" Kaufman and others (2012). "Other studies have also associated gender, age, education and poverty levels, to practices towards malaria prevention and control" (Temu, 2012 and Godesso, 2008). Perceptions, threat and susceptibility are believed to have an influence on practices adopted by the community to prevent and control malaria (Sharma and Mahrotra, 1986). "Also there are a broad range of factors that are critical to the effectiveness of IRS, where the population is receptive to IRS and a high level of coverage within the targeted population which can be influenced by some geographical and environmental factors" (RTI International 2010).

The assumptions in this study are that the prevalence of malaria in Lufwanyama is contingent upon the numbers of household that are sprayed with IRS on condition further that a number of factors influence heads of households and these rate to a number of factors including:

Demographic

- Sex, Age
- Marital Status

Socio-economic

- Source of income, Education,
- Household structures

Cultural

- Perceptions,Involvements,
- Acceptability

Environmental

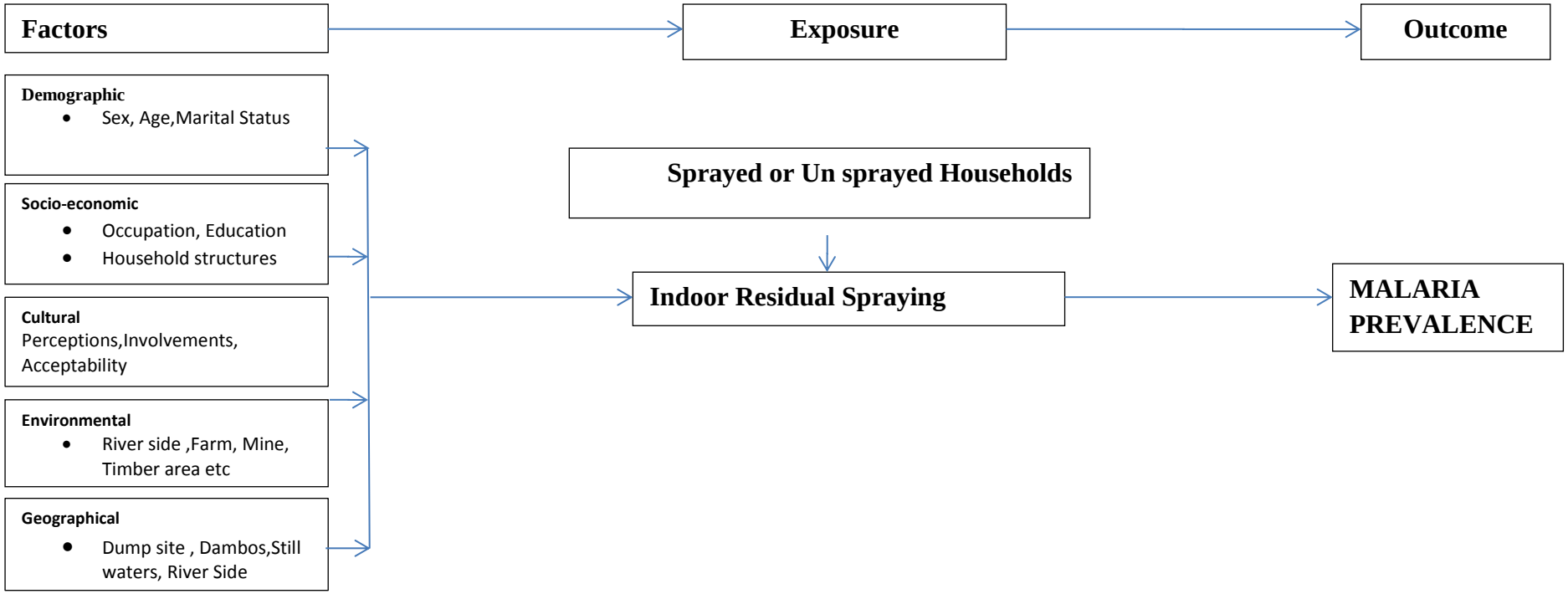
- River side ,Farm, Mine, Timber area etc

Geographical

1. Dump site , Dambos,Still waters, River Side

In order to show pathways by which the factors are expected to influence malaria as an outcome variable, the conceptual framework below has been constructed. The arrows show how factors above can probably influence IRS coverage and malaria prevalence.

Figure 2: Conceptual Framework Of The Factors Associated With Malaria Prevalence.



1.3 Justification

The main significance of embarking on this study is to justify its relevance to current situation concerning the need for the nation to bring malaria to zero cases, so that people in both urban and rural areas can be free of malaria.

To date, governments' response in reducing malaria has been an integration of interventions. Mostly all interventions have been applied in both rural and urban areas. Indoor residual spraying as an intervention is assumed to reduce malaria; however, factors that lead to increase in malaria cases in areas where this intervention has been applied are not clearly understood by the District. Current routine data sources are inadequate to fully inform effective programme monitoring and evaluation, hence, the weakening in understanding the impact of these interventions. This study is aimed at generating better understanding and hence, creating evidence for formulating policies and conduct research that are appropriate for targeting control interventions at all intensities of transmission.

CHAPTER TWO

2.0 LITERATURE REVIEW

The primary prevention of malaria is essentially achieved through two main interventions: Indoor Residual Spraying and Insecticide Treated Nets (Pluess et al 2010).

IRS is a standardised and well-established control method for mosquitoes. It has been used widely in Asia, the Pacific and Latin America, while in Africa its use has been more limited to the margins of malaria distribution in southern Africa and to epidemic-prone countries often at higher altitudes. The W.H.O has recently proposed extending its operation area in Africa. The size of the operational area depends on local circumstances and is influenced by the distribution of malaria and malaria vectors, the distance from important breeding sites, the flight range of the vectors and demographic features (World Malaria Report 2012).

"Historically, IRS has reduced malaria transmission in many settings in the world, but the health effects of IRS have never been properly quantified" (World Malaria Report 2012). This is important, and would help to compare IRS with other vector control interventions.

2.1 Demographic and Socio-Economic factors

Associations between potential risk factors and control interventions have been assessed, and several studies have associated age, sex, education and poverty levels, to practices towards malaria prevention and control" (Temu 2012 and Godesso, (2008).

Individual patient data were collected from one health facility within the district 8 months before and 16 months after IRS. There was a consistent decrease in the proportion of patients diagnosed with clinical malaria after IRS for patients under five and above five years of age but this effect of IRS reduced over the subsequent 12 months. For a considerable period IRS was deemed effective in reducing malaria morbidity, but it became ineffective beyond 12 months period according to tests that were conducted using blood smears which indicated positive malaria. Malaria infection was likely to be over-estimated in groups of children remaining at home and underestimated in children not found at home who were likely to be healthy children, hence attending school. (Temu, 2012).

Sex particularly of the head of household is another important factor especially with regards to acceptance to IRS. "Often, in a household especially in the rural areas, the man is seen as

the head of the household and a final decision maker for issues that would impact his family. But Kaufman and others (2012) noted in their study that the decision whether or not to accept IRS was not made exclusively by men. Many women said they were involved in making the decision along with the head of the household, and these women generally supported the spray process. For those women who reported to not have as much decision making power, there was fear that a head of household who refuses IRS is putting pregnant women and children at risk unnecessarily.

"The challenges to IRS in some societies is the worry that since the exercise requires moving all of one's possessions outside of the home, one reason for rejecting IRS was that it would allow neighbours to see all of one's possessions (and thus level of wealth). There was a fear of being ridiculed by neighbours because of poor quality possessions". (Kaufman et al. 2012). "On the other hand, during spraying, the rich households have no willingness to admit the health workers to their home. They refuse them with the simple reason that preparation of the house for spraying leads to disarrangement of house furniture. Since, these houses become a reservoir for some mosquitoes, the complete eradication of the vector by DDT would be impossible" (Agyepong, 1992). And more often than not refusers of IRS tend to be more knowledgeable people such as teachers, drivers, extension workers, and other civil servants who do not simply follow the orders of the local government or the sprayers but are skeptical about the process until they see true results (Kaufman et al. 2012).

2.2 Knowledge of Malaria and IRS Acceptability, Perception and Involvement

As reviewed in Kaufman's study people's culture, occupation and education seems to be an important driver in the knowledge, perception and acceptance or rejection of IRS as an intervention to malaria. Education depended on how much they know about IRS (Kaufman et al, 2012). "The choice of control methods appropriate for a specific community requires an understanding of the role the community as a whole in malaria management programs" (Godesso, 2008)

In a study to identify attitudes and misconceptions related to acceptance or refusal of indoor residual spraying (IRS) in Tanzania for both the general population and among certain groups (e.g., farmers, fishermen, community leaders and women). Kaufman and others (2012) noted

that Knowledge and perception towards malaria lay the groundwork for acceptance or rejection of malaria interventions, IRS included. Perception about IRS is mixed. A substantial number of participants correctly associated malaria, mosquito bites, and IRS. Most participants were aware of what needed to be done before the spray team's arrival, as well as what the spray teams would do during their visit. However, participants did not know how the insecticide works, the after effects, or what would happen further down the road with continuous spraying. If residents were not present for village meetings during which the process was explained or did not receive an informational flyer, they tended to know very little about the exercise.

"The reasons why IRS might be refused is because of the initial ignorance community has about IRS. Some community members initially refuse, until they see their neighbours receiving benefits from the spray without side effects, and then opt to accept. Other people do not know enough about the spraying process due to absence during information, education and communication (IEC) or not receiving the flyer explaining the process. However, once they receive more information, most people generally accept it. Another key reason for refusal was uncertainty as to whether or not the process would indeed be effective in killing mosquitoes. The focus was on reported side effects. Complaints about itching or rash were the most common, followed by stomach upset. Also Lack of information on why spraying is done has been reported both as a potential problem and a barrier to IRS acceptance. It is argued that Sprayers often arrive without forewarning and have little ability to give information on why spraying is being done and the benefits of spraying. They quoted Montgomery et al. who argued to say "people do not understand why IRS was conducted but accepted it. Other studies have found that many respondents object to spraying since they do not understand how it works. Many households believe that spraying is not effective in preventing malaria" (Kaufman et al. 2012).

The community involvement in IRS activities was found to be significant in efforts to achieve a successful IRS campaign. Godesso (2008) observed that use of community-based programmes for malaria control is a common approach in many endemic countries, which started some years after the Alma Ata Declaration on Primary Health Care (PHC) in 1978. For malaria control, whether today or tomorrow, people's participation is absolutely, and in the future, much will depend on the 'community will' (Sharma and Mahrotra,1986). "The community can no longer remain a spectator, but must either be actively involved with vector control or make a financial contribution to control. The use of local community

potential is paramount to sustainable vector control and that effective malaria control depends amongst others community's understanding of the need and rational for malaria control" (Kibe, 2006).

In addition, communities should be allowed to own IRS activities to increase acceptance rate. It shouldn't coincide with major local community programs such as harvest time and so forth.. In the case of what happened in India, the Deepawali festival coincided with IRS activities and the locals had no choice but to white wash and mud plaster their houses after the activity was already done (Sharma, 2005). Hence, it is important to consider local events of an area as well before conducting such activities.

2.3 Household Structure, Environment and Geography

The principle of IRS is that the internal walls of the house and structures are sprayed with an appropriate chemical that remains lethal to the mosquitoes for several months. Once the mosquitoes rest on the sprayed walls, they pick up chemicals on their feet that paralyses their nerves leading to death thereby cutting down the transmission of the disease to another person (WHO, 2011). A study on household risk factors for malaria infection among children in the Ethiopian highlands was conducted in northern Ethiopia. To identify risk factors responsible for variations in a hypo-endemic highland malaria setting, 14 factors were analysed and discovered that earth roof, windows, open eaves and sleeping rooms were significantly associated with malaria (Ghebreyesus, 2000). "Effectiveness of IRS is mainly achieved through the residual insecticide film on the wall/surface which releases a lethal dose to unsuspecting mosquito as it rests before or after its sucking/ feeding blood from its victims. Hence the surface must be able to retain the insecticide film. Of concern in rural areas is the existence of thatched roofed structures and mud walls which are prone to absorbing moisture due to driving rain or potential leaking roofs. Hence, Dump, mud walls and thatch due to leaking roofs on residual insecticides must be taken into consideration" Blessius, (2008).

"Lopsided interaction of man with physical environment has adversely affected its nature and made conducive habitat for the rejuvenation of the vector of malaria. Firstly, at the level of the built environment, the size and structure of a settlement has an important influence on the character of potential breeding sites for malaria. Spontaneous settlement with poor drainage system can be one possible factor which complicates the management and

control of malaria. In short, the way community modifies and alters the environment should be taken into account in an effort to malaria management and control". Wood et al (1991) found that high-mosquito-producing fields were located in areas with a diversity of land use, including livestock pastures. According to Carter et al, the disease is concentrated around particular mosquito breeding sites and transmission is limited to the areas close to them.

Geography is one important factor for the successful implementation of IRS in any area. Before IRS begins, detailed information on the target areas should be collected. This should include the location, and accessibility of households and structures to be sprayed. Information on roads, location of villages, water points and important geographical features such as lakes, streams and mountains, should be known. Areas of economic importance, such as irrigation schemes, mines and tourism centres are a priority for IRS. These areas are usually of high population density hence priorities for protection from malaria. In addition, the populations that live in these areas usually comprise a mix of migrant workers from areas with different levels of malaria endemicity and immunity including malaria free areas. Such a mix creates situations conducive to epidemics (WHO, 2013).

Cohen and others (2008) noted that those houses in which individuals developed clinical malaria in multiple years were located much closer to regions of high predicted wetness than were houses without malaria. They suggested that an incorporation of factors such as land characteristics, vegetation differences, or human modification of the environment, may improve the prediction of their model. It is well known that malaria vectors may travel some distance to find a blood meal, though studies of malaria risk around known breeding sites, including swamps, have demonstrated increased transmission within several hundred meters of these sites (Cohen et al, 2008).

Most of the previous studies highlighted above conducted self-administered questionnaires in urban setting to solicit information from respondents. And most of them where conducted in a setting of moderate malaria transmission intensity. Some studies that were carried out concentrated only on clinical Malaria at specified age groups, that will not be the case for this study as it will concentrate on confirmed cases of Malaria in all age groups. Some assumed causality between related factors and malaria prevalence. Finally, most of the studies above did not concentrate on IRS only but conducted them together with other interventions which could have affected most of the outcomes. In Lufwanyama no other mass intervention against malaria has been conducted in the last four years except indoor residual spraying. The last

mass intervention which was conducted together with IRS was distribution of ITNs in 2008. This was the period when IRS was first introduced in Lufwanyama and there was already a campaign to reduce malaria using ITNs and other intervention programs.

2.4.1 Research Question

Could we say that there are correlates of malaria prevalence in Lufwanyama that militate the use of IRS?

2.4.2 General Objective

To determine factors associated with Malaria prevalence in areas where Indoor Residual Spraying is conducted in Lufwanyama District.

2.4.3 Specific Objectives

1. To establish the association between Indoor Residual Spraying and prevalence of malaria.
2. To determine whether demographic, socio-economic, cultural, geographical and environmental factors associated with malaria prevalence in Lufwanyama.
3. To assess community perception, involvement and acceptability of Indoor Residual Spraying.

CHAPTER THREE

RESEARCH METHODOLOGY

This study was quantitative in nature. Data regarding geographical location, environmental factors, socio-economic, and cultural factors (community knowledge, perception, involvement and acceptability) was collected by adopting questions from the literature reviewed in order to solicit for information from respondents. The factors will be used to assess factors associated with malaria in areas where IRS is conducted in Lufwanyama district.

3.1 Variables

The Table below shows the dependent and independent variables that were used in the study. It shows how the dependent and independent variables were measured by describing the data measurement and scales of measurement of each variable.

Table. 1 Data Measurement and Scales of Measurement of Each Variable

DEPENDENT VARIABLE	INDICATOR	DATA MEASUREMENT	SCALES OF MEASUREMENT
Malaria prevalence	Number of malaria cases	Prevalence	Ratio
INDEPENDENT VARIABLES	INDICATOR	DATA MEASUREMENT	SCALES OF MEASUREMENT
Age	Age in years	number	Interval
Gender	Male or Female	Number (n), Percent (%)	Nominal
Education	Level of Education	Primary, Secondary, College, University and Non	Nominal
Income	Source Of Income	Formal employment, Trading & Selling, Farming and Craft/creative worker	Nominal
Indoor residual spraying	Sprayed households	Coverage Number (n), Percent (%)	Ratio
Housing Structure	Structure materials	Floor, roof, external walls, eaves, windows	Nominal
Geographical factors	Location	River side area, Farm area, Mine area Timber area.	Nominal
Environmental factors	Area	Dump site area, Dambos Area still waters and	Nominal

Statistical significance :(Pearson and Fishers exact Chi-Square Tests)

3.2 Study Setting

The study was conducted in Lufwanyama district which is located on the Copperbelt Province. The district recorded the highest prevalence malaria of 512 per 1000 population and seconded by Masaiti district which had about 346 per 1000 population (DHIS, 2012). The study specifically focused on catchment areas where IRS was conducted. Catchment areas included St. Joseph, St. Mary's, Shimukunami, Nkana, Chinemu, and Mibenge.

3.3 Type of Study

This study was a cross-sectional study. This is because it intended to assess factors associated with malaria in areas where IRS was conducted. Therefore, assessment of factors and malaria was performed at some point in time. This gave the researcher a 'snapshot' of the cases of malaria and potential factors in Lufwanyama at a particular time.

3.4 Study Population

The population for the study included all households sprayed in Lufwanyama. The total number of households in Lufwanyama according to 2010 Census of Population and Housing is 15,597. Therefore, the target population for this study was about 15,597 households in Lufwanyama.

3.5 Sample Selection and Procedure

A subset of the described population above was selected comprising the total of sprayed households in Lufwanyama.

3.5.1 Inclusion criteria

The sampling unit for this study was an individual household in Lufwanyama and the respondents were all heads of households that consented to participate in the study or a proxy that is any member above the age of 16 years present, focus was on households.

3.5.2 Exclusion criteria

The study excluded all minors, that is, members of the household under the age of 16 years. This is under the assumption that minors may not have adequate knowledge regarding the subject matter.

Also all non IRS households were excluded.

Mixed sampling method was employed. First, cluster sampling was used, and the reason for using this method was that the population of Lufwanyama in terms of indoor residual spraying (IRS) is divided in two regions, a part of the western region is sprayed and also a part of the eastern region is sprayed. These parts of the regions were clustered and households were systematically sampled. The Systematic random sampling consisted of choosing a sample of households by randomly selecting the first household and then selecting every K^{th} household thereafter. The K^{th} household was found by the total number of housing units in Lufwanyama which is 15,597 divided by the sample size which is 390, hence, at every 39th household, the housing unit was sampled. Mainly the purpose of using this method is that the systematic method of selecting a sample often saves time in selecting the sample units.

A minimum sample size was calculated using Yamane's Sampling method (see appendix iv).

Sample size

Where;

Sample size for ±5 percent

Precision levels with confidence interval level is 95%

Probability value =0.05.

Using the number of housing units 15,597, the sample for the study was 390.

3.6 Data Collection

The data collection method that was used is primary source of data. The index period for primary data collection was a year after Lufwanyama IRS activities of 2013. The data

collection instrument that was used to collect field data was a structured face to face Interview questionnaire (Appendix i). A face to face interaction between the interviewer and the interviewee (respondent) by using a structured face to face Interview prevented subjectivity in interviews on the part of the interviewer and permitted time for respondents to make clarifications on some questions that could have been misunderstood. To avoid non-response, bias was minimized for those who could not understand English by interviewing in Lamba/Bemba being the local languages used in Lufwanyama.

3.7 Pre-test Study

About 30 households from the cluster of IRS areas were used to test the structured interview questionnaires. The Pretest study was done on different participants to avoid contamination of data. This helped in checking the precision and credibility of the questions designed in answering the objectives of the research study.

3.8 Data Analysis

Quantitative analysis was used to analyse primary data that was collected through structured interview questionnaires. STATA version 12 (http://www.stata.com, stata@stata.com) software was used for entering and analysing of data. A codebook was constructed from the layout of the questions in the questionnaire. Associations between variables were determined by utilizing Pearson and fishers'exact chi-square tests. The Z-test was used to compare proportions and to determine associations/relationship between variables. A p-value of 0.05 was set in the consideration of statistical significance of the results. Descriptive statistics were also generated for analysis of household factors.

Table 2.0 (see Appendix iv) shows contingency tables showing Dependent Variables and how they influenced Independent Variables. The tables show examples of dummy structure of how the questions were structured in the questionnaires. They also show the statistical tests that were performed to measure the variables. Cultural factors in being, community involvement, perception and acceptability of IRS were established through a structured interview questionnaire as guided from the Literature reviewed.

3.9 Limitation of the Study

The sampling frame for housing units in Lufwanyama has no defined description in terms of house numbers and demarcations. This limited the inclusion of some household and led data collectors to use their discretion on where to start the interview from. This led to some selection bias.

This research drew conclusion on IRS coverage against malaria for the period of twelve months (12). The Potency of IRS lasts for just over three (3) months hence the weakness in the concrete conclusion of the results.

This research was conducted in Lufwanyama an area with less or no literature for vector behaviour.

Volunteer bias was an important limitation to this study, since only those that agreed to participate by signing the consent form, were the only ones interviewed.

3.10 Ethical Consideration

The research was submitted to the University of Zambia Research Ethics committee for approval. Permission to conduct the research was obtained from Ministry of Health through Lufwanyama District Health Office. The study had no ethical concerns but Anonymity, confidentiality, privacy and respect to persons was observed during data collection. Respondents had to consent to the interviews and questionnaires were coded in preference for names.

3.11 Administration

The administration of the study was done by the principal investigator who had overseen all activities of the study which included among other things mobilisation and utilisation of resources as well as the collection and examination of the data.

3.12 Monitoring

The monitoring of the activities of the study was done by the principal investigator with the help of supervisors. The team monitored all the activities of the project including the time management to ensure that the project was completed in the time anticipated.

3.13 Utilization of Results

It was anticipated that the study would yield information which would help in highlighting some of the real factors that are associated with malaria prevalence in Lufwanyama district. The findings and recommendations from the results of the study are anticipated to be disseminated to the relevant stakeholders to ensure that results are utilized. It was of the view that the research findings will be considered and utilized in addressing the problem identified in the study.

The summary copies of findings of this study to be disseminated to the following:

- National Malaria Control Programme
- Ministry of Health.
- The University of Zambia Libraries.
- And also the study report will be prepared into a manuscript for publication in local and international journals.

CHAPTER FOUR

PRESENTATION OF FINDINGS

The following chapter presents the findings of the study. Characteristics based on catchment areas of Chinemu, Nkana, Shimukunami, Mibenge, St. Joseph's and St. Mary's were analysed. Further, analysis was done on malaria and coverage of IRS in relation to the factors associated with malaria prevalence. Data were collected exactly one year after Indoor Residual Spraying was conducted in these areas.

4.1 Sample Description

The Sample for this study was 390 households in clusters where Indoor Residual Spraying was conducted. Nkana Catchment area accounted for 47 (12.1%), Chinemu 31(8.1%), Shimukunami 45(11.6%), Mibenge 131(33.6%), St. Joseph's 63(16%) and St. Mary's 73(18.4%).

4.2 Demographic Data

Demographic data of the sample patterning to head of households' age, sex, marital status, education, income among others were analysed as follows;

4.2.1 Sample Distribution by Age and Sex

The larger proportion of household head sample was in the age range 25-34 (32%) whilst the least was between age range 65-74(4%) and above age ranges 75(1%). Some 53% of the sample of 390 head of households comprised of females, and 47% comprised of males. There were 182 males and 208 females respondents in total. The table 5-1 below gives in detail the percentage distribution of age by sex in the sampled areas.

Table 5-1: Distribution of the Sample by Age and Sex

Respondent's age range	Male n(%)	female n(%)	Total n(%)
15-24	13(7)	28(13)	41(10.5)
25-34	58(32)	66(32)	124(31.8)
35-44	56(31)	53(25)	109(27.9)
45-54	32(18)	37(18)	69(17.7)
55-64	13(7)	15(7)	28(7.2)
65-74	7(4)	9(4)	16(4.1)
75+	3(2)	0(0)	3(0.8)
Total	182(47)	208(53)	390(100)

4.2.2 Age and Marital Status of the Respondent

The table 5.2 below shows the percentage distribution of marital status of head of households according to age groups. The table 5.2 also shows that 298 (76.41%) respondents were married. This has shown that the status of the married was more frequent than any other status. Notably also is a significant relationship between age and marital status with a Fisher's exact chi-square test showing P-value of 0.000.

Table 5.2: Respondents distribution by age and marital status

Respondent's age group	Single	Married	Separated	Widowed	Divorced	Total	Fisher's exact chi^2 test
15-24	9	30	1	0	1	41	P <0.001
	22%	73%	2%	0%	2%	11%	
25-34	13	100	2	2	7	124	
	10%	81%	2%	2%	6%	32%	
35-44	2	95	3	3	6	109	
	2%	87%	3%	3%	6%	28%	
45-54	3	44	0	16	6	69	
	4%	64%	0%	23%	9%	18%	
55-64	1	17	0	7	3	28	
	4%	61%	0%	25%	11%	7%	
65-74	0	9	0	5	2	16	
	0%	56%	0%	31%	13%	4%	
75+	0	3	0	0	0	3	
	0%	100%	0%	0%	0%	1%	
Total	28	298	6	33	25	390	
	7%	76%	2%	8%	6%		

4.2.3 Age and Education Status of Respondent

Table 5.3 below shows that the majority of the respondents reached primary(54%) and secondary(36%) levels of education with only 19% reaching college and 1 respondent representing 0.3% had reached university level. The table 5.3 also show that 5% of the respondent never had any form of education. The age group 25-34 years had the highest number of those who had their primary and secondary education. The respondent who reached university level was in the age group 45-54 years.

Table 5.3: Respondents distribution by Age and Education Status.

Respondent's age group	**Primary**	**Secondary**	**College**	**University**	**non**	**Total**	**Fisher's exact chi^2 test**
15-24	17	22	1	0	1	41	
	8.10%	15.49%	5.26%	0%	5.56%	10.51%	
25-34	62	51	9	0	2	124	
	29.52%	33.92%	47.37%	0%	11.11%	31.79%	
35-44	62	38	5	0	4	109	
	29.52%	26.76%	26.32%	0%	22.22%	27.95%	
45-54	41	24	1	1	2	69	
	19.52%	16.90%	5.26%	100%	11.11%	17.69%	
55-64	16	4	3	0	5	28	P <0.001
	7.62%	2.82%	15.79%	0%	27.78%	7.18%	
65-74	11	2	0	0	3	16	
	5.24%	1.41%	0%	0%	16.67%	4.10%	
75+	1	1	0	0	1	3	
	0.48%	0.70%	0.00%	0.00%	5.56%	0.77%	
Total	210	142	19	1	18	390	
	54%	36%	5%	0.30%	5%	100%	

4.2.4 Age and Duration of Stay in the House

Table 5.4 below reveals that there is no relationship between being in a certain age category and duration of stay in that household. This is indicated by the P-value greater than 0.05 (0.474). It further shows that mobility, that is, shifting from one place to another, was more evident in the age group 25 to 34, in which 6 respondent(less than 6 months) and 4 respondents(less than a year) had made movements in the last 12 months. In total 22 respondents shift from one household to another in the last 12 months prior to the interview.

Table 5.4: Respondents distribution by age and Duration of Stay in the Household

Respondent's agegroup	**Less than 6 months**	**Less than a year**	**Over 1 year**	**Fisher's exact chi^2 test**
15-24	2	2	37	P>0.05
	20%	20%	10%	
25-34	6	4	114	
	60%	40%	30.81%	
35-44	1	1	107	
	10%	10%	28.92%	
45-54	1	0	68	
	10%	0.00%	18.38%	
55-64	0	3	25	
	0.00%	30%	6.76%	
65-74	0	0	16	
	0.00%	0.00%	4.32%	
75+	0	0	3	
	0.00%	0.00%	0.81%	
Total	10	12	370	
	2%	3%	95%	

4.2.5 Age and Source of Income

Table 5.5 below shows that the majority of respondents from the sample were farmers 73% (n=390) of which the majority of them were within the age group 25 to 34 years. Others were traders & sellers (12%), those from formal employment such as teachers and nurses etc (8%), crafts and creative workers (21%) and the rest (4%) had other means of obtaining income. There exists a relationship between source of income and the age of the respondent (P-value < 0.05).

Table 5.5: Respondents distribution by age and source of Income.

Respondent's age range	Formal employment n(%)	Trading & selling n(%)	Farming n(%)	Craft/creative worker n(%)	Other n(%)	Fisher's exact chi^2 test
15-24	2(5)	8(20)	26(63)	2(5)	3(7)	P-value 0.001
25-34	16(13)	21(17)	77(62)	10(8)	0(0)	
35-44	9(8)	11(10)	83(76)	6(6)	0(0)	
45-54	2(3)	7(10)	59(86)	1(1)	0(0)	
55-64	4(14)	0(0)	23(82)	1(4)	0(0)	
65-74	0(0)	1(6)	13(81)	1(6)	1(6)	
75+	0(0)	0(0)	3(10)	0(0)	0(0)	
Total	33(8)	48(12)	284(73)	21(5)	4(1)	

4.3 Analysis of Malaria Prevalence and Other Characteristics of Interest

4.3.1 Association of Indoor Residual Spraying with Malaria

Table 5.6 shows the relationship between being informed prior to spraying and experience of malaria prevalence. The data reflects 258 (94.25%) of households who experienced episodes of malaria in the last 12 months and were informed prior to spraying against 88.24% who for one reason or the other were not informed prior to spraying. This relationship between being informed before spraying and episodes of malaria is not statistically significant as the P-value is 0.125.

Table 5.6: Proportion reporting malaria episodes whether household was informed or not prior to spraying of IRS

Informed prior to spraying	Any episode of malaria in the last 12 months			Pearson chi^2 test
	yes	no	Total	
Yes	213 (94.25%)	13(5.75%)	226(82%)	P>0.05
No	45 (88.24%)	6(11.76%)	51(18%)	
Total	258 (93%)	77(28%)	277	

4.3.2 Proportion of Household Sprayed and Episodes of Malaria

Table 5.6 below shows the relationship between sprayed households and experience of malaria in the 390 household sample. There exists a relationship in that the P-value indicates a value of 0.022; therefore the relationship is statistically significant. Of the 355 households that experienced malaria, 72.68% (n=258) came from sprayed households and only 27.32% (n=97) came from non-sprayed households, hence the significance of the difference.

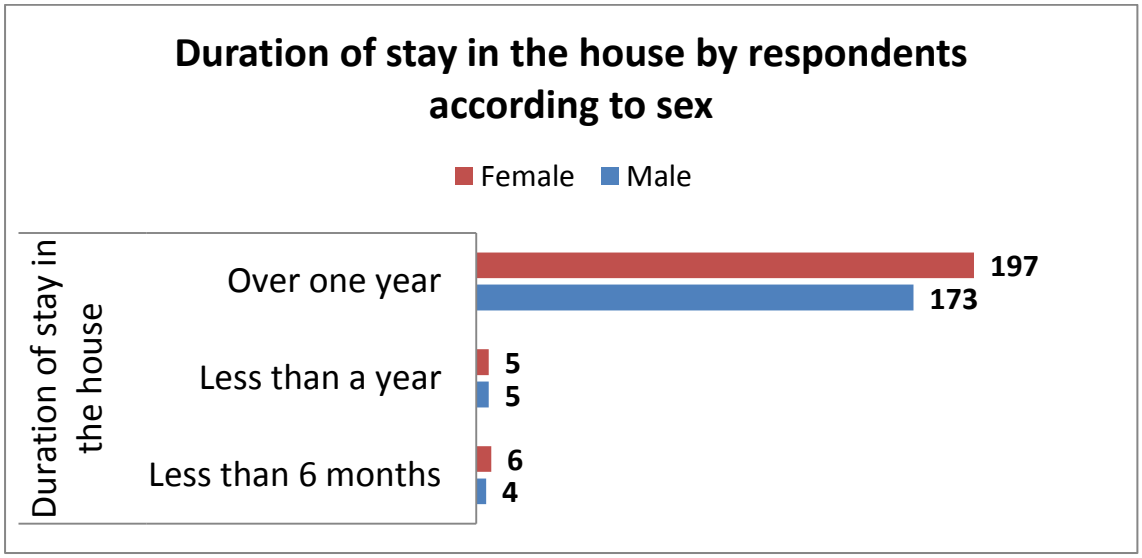
Table 5.7: Proportion of respondents reporting experiencing episode of malaria by IRS status.

Household sprayed	Any episode of malaria in the last 12 months			Pearson chi^2 test
	yes	no	Total	
Yes	258 (72.68%)	19(54.29%)	277(71%)	P< 0.05
No	97 (27.32%)	16(45.71%)	113(29%)	
Total	355 (91.03%)	35(8.97%)	390	

4.3.3 Duration of Stay in the House by Respondents According To Sex

Figure 5.1 shows the duration of stay by respondents according to their sex. It shows that the majority of the respondents have stayed in their households for over a year prior to the interview. This indicates that of the 390 households targeted, about 94% (n=367) of respondents did not move or relocate to another place after IRS spraying. Though there were some variations in the male (44.4%) and female (50.5%) households, there was no significant relationship between duration of stay in the house and sex of respondent (P-value 0.894).

Figure 3. Duration of Stay in the House by Respondents According To Sex



4.3.4 Malaria Prevalence and Duration of Stay in the House

The results in table 5.8 show that of the 390 respondents only 20 (5.13%) respondents had in total stayed in their households for less than 6 months (2.56%) and less than a year (2.56%), and of these respondents 70% had malaria and only 30% did not have malaria. Overall there exists a relationship between duration of stay in the house and prevalence of malaria with a Probability value of 0.000.

Table 5.8 Survey respondents reporting experiencing malaria case during the last 12 months preceding the survey by duration of stay in the house hold.

Duration Of Stay in the household	Malaria	No Malaria	Fisher's exact chi^2 test
less than 6 months	5(50%)	5(50%)	P<0.05
less than a year	9(90%)	1(10%)	
over 1 year	341(92%)	29(7.84%)	
Total	355(91.03%)	35(8.97%)	

4.4 Household Structure, Geography and Environment

Table 5.9 presents some cross tabulations of malaria cases against household structure variables. The percentage of malaria cases in those households whose rooms were less than or equal to three (3) was higher 65.3% (n=231) than those whose rooms were equal or more than four 34.8% (n=123). Similar pattern with those who had less than or equal to two (2) sleeping rooms 78.5% (n=278) against those who had equal or more than three (3) sleeping rooms. The average number of rooms for each household was three (3) and the average number of sleeping rooms was two (2). Using a Z-test, the results for both number of rooms and sleeping rooms indicated that there was an association between number of rooms and sleeping rooms as regards to malaria with p-value <0.05.

Regarding the structure of households, the results show that those households with floors made of earth/sand, dung, or other experienced a lot of malaria cases 78.3% (n=278) than those whose floors were made of ceramic tiles, cement, and carpet etc 21.8% (n=76). Ironically, those houses whose roofs were constructed with thatch, straw, or other experienced few malaria cases with a percentage of 31.1% while those with roofs made of iron sheets, or tiles experienced high malaria cases. Houses with external walls made of un-burnt bricks, mud and poles, thatch/straw, timber, stone, burnt bricks with mud, other experienced a lot of malaria cases 83.4% (n=296) while those made of burnt bricks with cement, or cement blocks had few malaria cases 16.4% (n=58). For each construction material types for household floors, roofs and external walls there exist a significant relationship with malaria cases in all with a p-value <0.05.

Table 5.9 Malaria cases in relation to Household structure variables using Z-tests.

Household with malaria malaria			**Statistical test results**
Household Structure Number Of Rooms In The House	Malaria N(Percent)	Total	P-Value
<=3 rooms	232(65.3)	232(65.3)	**0.000**
>=4 rooms	123(34.8)	123(34.8)	
Total	**355(100)**	**355(100)**	
Number of sleeping rooms	Malaria N(Percent)	Total	P-Value
<2	278(78.5%)	278(78.5%)	**0.000**
>=3	77(21.7%)	77(21.7%)	
Total	**355(100)**	**355(100)**	
Structure Materials Of The House Floor	Malaria N(Percent)	Total	P-Value
Earth/Sand, Dung, or other	277(78.0%)	277(78.0%)	**0.000**
Ceramic Tiles, Cement, Carpet etc	78(22.0%)	78(22.0%)	
Total	**355(100)**	**355(100)**	
Roof	Malaria N(Percent)	Total	P-Value
Thatch, straw, or other	110(31.0%)	110(31.0%)	**0.000**
Iron sheets, or tiles	245(69.0%)	245(69.0%)	
Total	**355(100)**	**355(100)**	
External Wall	Malaria N(Percent)	Total	P-Value
Un-burnt bricks, mud and poles, thatch/straw, Timber, stone, burnt bricks with mud, other.	296(83.4%)	296(83.4%)	**0.000**
Burnt bricks with cement or cement blocks	59(16.6%)	59(16.6%)	
Total	**355(100)**	**355(100)**	

Table 5.10 presents other cross tabulations of malaria cases against household structure, geography and environmental variables using ANOVA (Bartlett test for equal variance). The findings show that there existed a significant association between eaves of the house and malaria cases (P-Value <0.031). Houses with eaves open had 24.8% (n=88) of malaria cases, those partially open had 39.2% (n=139) and those whose eaves were closed had 36.06% (n=128) of malaria cases.

Table 5.10 also show percentage distribution of malaria among households with windows with glass or screens 16.3% (n=58), windows with curtains or shutters 83.4% (n=296) and

houses with no windows 0.3% (1). The differences in the types of windows among houses contributed to variations of malaria cases significantly (p-value <0.14). The study also revealed that there exists a relationship between the location of a household and malaria cases (p-value <0.017). The percentage differences showed that houses located near river side, still water, and streams dam area had 51.0% (n=181)of malaria cases, those near eucalyptus trees area, farm area and timber area had 42.3% (n=150) and those near mine area and dump site area 2.8% (n=10) while households in other locations recoded 3.9% of malaria cases.

Environmental condition is an important aspect in the prevention of malaria. Household with different family size tend to have variations in malaria experience. Table 5.10 also shows that households with family size under five (5) had less malaria 33.8% (n=120) while those with family size above five (5) had 66.2% (n=235) of malaria cases. The average family size out of the 390 sample was five (5). This further shows a statistical significance between family size and malaria cases with a P-value <0.016. The Table further reveals conditions of the houses as regards to whether the house was mad, painted, plastered etc. It shows that those whose households were mud & plastered or painted recorded about 17.2% (n=71) of malaria cases, while those with mud but not plastered or painted houses had 57.7% (n=255) malaria cases. houses not mud & not plastered or painted recorded 7.2% (n=28) of malaria cases, those not mud but plastered or painted had 7.4% (n=29) of malaria cases and finally those with small rooms had 3.6% (n=14) of malaria cases. These findings indicated a statistical significance between conditions of rooms of households and malaria with a p-value <0.001.

Lastly, the table shows the surrounding of the households. Houses whose land is under vegetation (surrounded by trees, tall grass) showed 85.5% (n=318) of malaria cases, while those near dump site showed the least malaria cases with 0.8% (n=3). Households surrounded by Still waters, nearby drainage etc had 4.1% (n=16) malaria cases. Households that kept livestock, animals etc recorded 26.2% (n=102) of malaria cases. This difference culminated into a statistical significance between household surroundings and malaria cases with a P-value <0.05.

Table 5.10: Malaria cases in relation to Household Structure, Geography and Environmental variables using ANOVA (Bartlett test for equal variance).

Household with malaria			**Statistical test results**
Eaves[1]	Malaria N(Percent)	Total	P-Value
Open	88(24.8%)	88(24.8%)	**0.031**
Partially Open	139(39.2%)	139(39.2%)	
Closed	128(36.0%)	128(36.0%)	
Total	**355(100)**	**355(100)**	
Windows	Malaria N(Percent)	Total	P-Value
Windows with Glass or Screens	58(16.3%)	58(16.3%)	**0.014**
Windows with Curtains or Shutters	296(83.4%)	296(83.4%)	
No windows	1(0.3%)	1(0.3%)	
Total	**355(100)**	**355(100)**	
Geography **Location Of The House**[2]	Malaria N(Percent)	Total	P-Value
River Side, Still Water, Streams Dam Area etc	181(51.0%)	181(51.0%)	**0. 017**
Eucalyptus Trees Area, Farm Area, Timber Area etc	150(42.3%)	150(42.3%)	
Mine Area, Dump Site Area etc	10(2.8%)	10(2.8%)	
Other……	14(3.9%)	14(3.9%)	
Total	**355(100)**	**355(100)**	
Environment Household Size	Malaria N(Percent)	Total	P-Value
Household with 5 or less members	120(33.8%)	120(33.8%)	**0.016**
Household with more than 5 members	235(66.2%)	235(66.2%)	
Total	**355(100)**	**355(100)**	
Condition Of Rooms[3]	MalariaN(Percent)	Total	P-Value
Mud & Plastered or painted	71(17.2%)		**0.001**
Mud but not Plastered or painted	255(57.7%)	255(57.7%)	
Not Mud & not plastered or painted	28(7.2%)	28(7.2%)	
Not Mud but Plastered or painted	29(7.4%)	29(7.4%)	
The rooms are small	14(3.6%)	14(3.6%)	
Total	**355(100)**	**355(100)**	
Household Surrounding[4]	MalariaN(Percent)	Total	P-Value
Land under vegetation (surrounded by trees, tall grass)	318(85.5%)		**0.012**
Dump site	3(0.8%)		
Still waters, nearby drainage etc	16(4.1%)		
Livestock, animals kept etc	102(26.2%)		
Total	**354(100)**	**354(100)**	

[1,2,3,4] these where multiple response answers but variation between the groups were treated independently of malaria analysis.

4.5 Perception of IRS

4.5.1 Experience with IRS based on household sprayed

Table 5.11 below shows respondents' experience with IRS after their houses have been sprayed. The Pearson's chi-square tests showed that there exists an association between household being sprayed and their experience with IRS. 27.1% (n=75) expressed a very bad experience after IRS was conducted in their homes compared to 22.4% (n=62) who expressed very good experience with IRS. The majority expressed a good experience 42.5% (118) out of those that had their houses sprayed (277). In total only 46.2% out of the 390 sampled household expressed good experience 118 (42.5%) and very good experience 62 (22.4%).

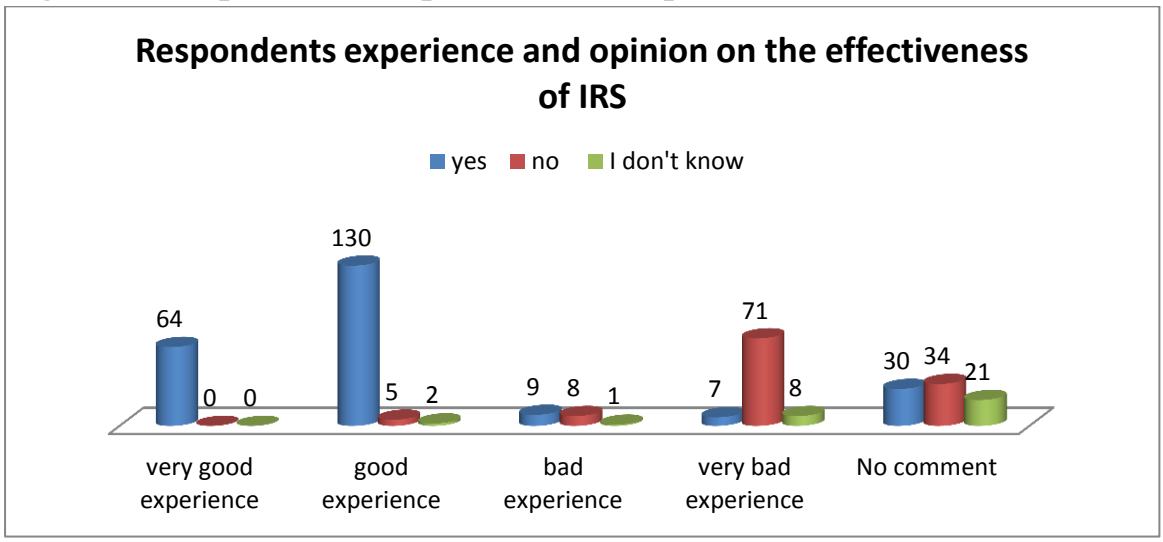
Table 5.11: Experience with IRS based on household sprayed

Household sprayed	experience with IRS					Pearson's chi^2 test
	No comment	Very bad experience	Bad experience	Good experience	Very good experience	P<0.05
YES	6(2.2%)	75(27.1%)	16(5.8%)	118(42.5%)	62(22.4%)	

4.5.2 Respondents' Experience and Opinion on the Effectiveness of IRS.

Figure 4 below shows an association between respondents' experience and opinion on the effectiveness of IRS with pearson chi^2 test indicating a statistical significance with p-value <0.05. Also In the graph there is a general pattern that the more the number of respondents who had a good experiences with IRS the better the opinion on its effectiveness.

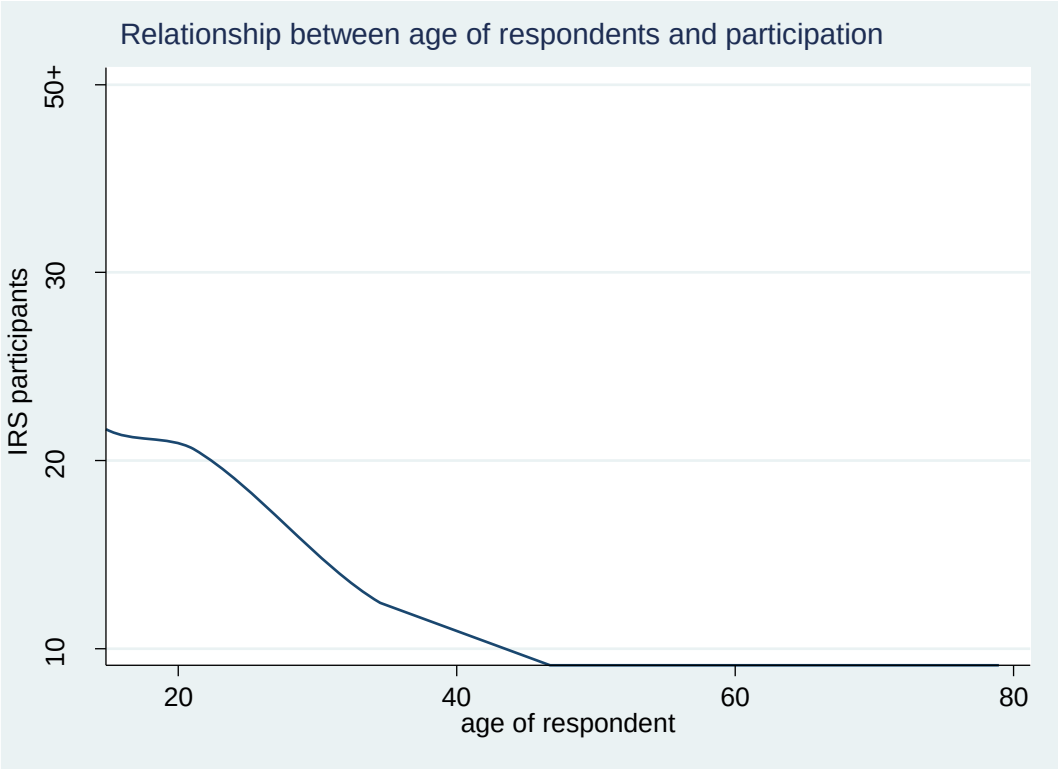
Figure 4: Respondents' experience and Opinion on the effectiveness of IRS.



4.6 IRS Acceptance and Community Involvement

Figure 5, below shows that as age increases the number of people participating in IRS activities reduced. The age ranges with a lot of respondents participating in IRS were within age range 25-34 years. However, there was no clear association to suggest that a respondent's age led to their involvement in the activities of IRS. The p-value indicated a value of 0.301, which is greater than the set 0.05 probability value.

Figure 5: Distribution of respondents' age and participation



However, what to note on the figure above (figure 5) is that the majority of the respondent did not participate in the activities of IRS, out of the 390 sampled, only 5.9% (n=23) participated and 357 giving a percentage of 94.10% percent did not participate.

4.7 Community Education and their participation and experience in IRS

4.7.1 Community participation in IRS and Education

Table 5.12 below shows that the majority of respondents only reached up to primary school level 54% (n=210) with 35.97% (n=132) having reached secondary school. In general, at least 95% (n=371) of the respondents had some form of education, however, only about 16.2% (n=62) participated in the activities of IRS, through contribution of funds, sensitization, outreach or general role of health workers in the IRS activities. Also to note is

that there exists a negative relationship between community involvement in IRS and education. There exists a wide gap between those who are educated and participated in IRS activities and those who are educated but did not participate in IRS activities. An association significant with a P-value of 0.05.

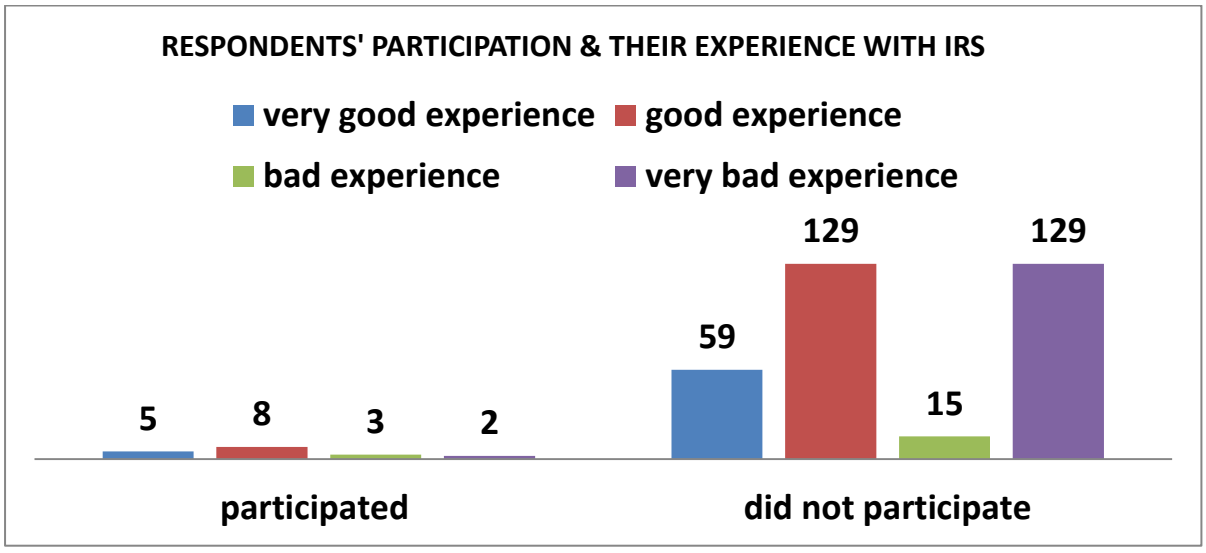
Table 5.12: Community participation in IRS and Education

Education	Community involvement in IRS			Fisher's exact chi^2 test
	yes	no	Total	
Primary	9 (39.1%)	201(54.8%)	210(54.0%)	P=0.05
Secondary	10 (43.5%)	132(36.0%)	142(36.4%)	
College	4(17.4%)	15(4.1%)	19(4.9%)	
University	0(0%)	1(0.3%)	1(0.3%)	
Non	0(0%)	18(4.9%)	18(4.6%)	
Total	23	367	390	

4.7.2 Respondents' participation and their experience with IRS.

Figure 6 below shows respondents' participation and their experience with IRS. About 18 (4.6%) respondents who participated expressed their experience with IRS and about 332 (85.1%) who did not participate also expressed their experience. Of those that participated, in total 72.2% expressed good to very good experience with IRS and only about 27.8% expressed bad to very bad experience with IRS. In the category of those that did not participate, about 56.6% expressed good to very good experience with IRS and about 43.4% expressed bad to very bad experience with IRS. It can be deduced that from either side a good percentage had overall good experience with IRS.

Figure 6: Respondents' participation and their experience with IRS.



4.8 Knowledge of Malaria

4.8.1 Respondents' response as a cure of malaria

Table 5.13: below shows the actions that respondents took after they had malaria. About 89% went to the clinic and took drugs and 11% just took medicine. 5% decided to have enough rest and 10% improved on their nutrition. At least more than three quarters of the respondents expressed knowledge about the cure of malaria.

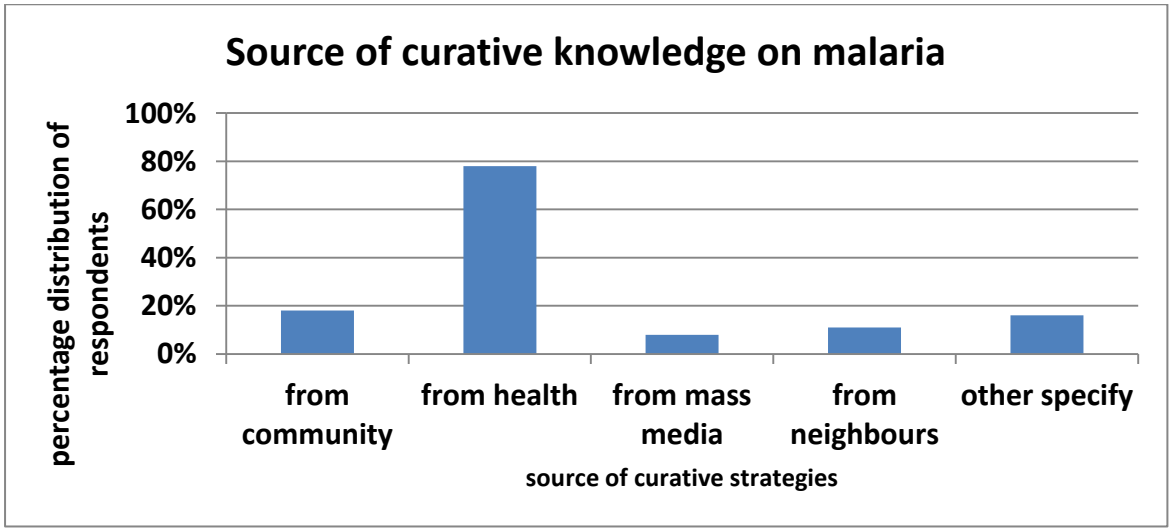
Table 5.13: Respondents' response as a cure of malaria

	went to the clinic & took drugs	took drugs	took herbs	went to the clinic but never took drugs	rested enough	good nutrition	didn't do anything	other
malaria	346 (89%)	42(11%)	3 (1%)	1 (0%)	20 (5%)	40 (10%)	0 (0%)	8 (2%)

4.8.2 Curative knowledge of malaria

Figure 7 below shows different sources of information regarding cure of malaria. Most of the respondents got their information from health facilities (78%) and about 18% got from community health workers. Lufwanyama being a rural area with few people having access to media, only 8% reported to have gotten the information from the media. 11% got from neighbours and 16% got from elsewhere. This is indicates that information coming from health facilities reaches communities and this is inclusive of malaria information.

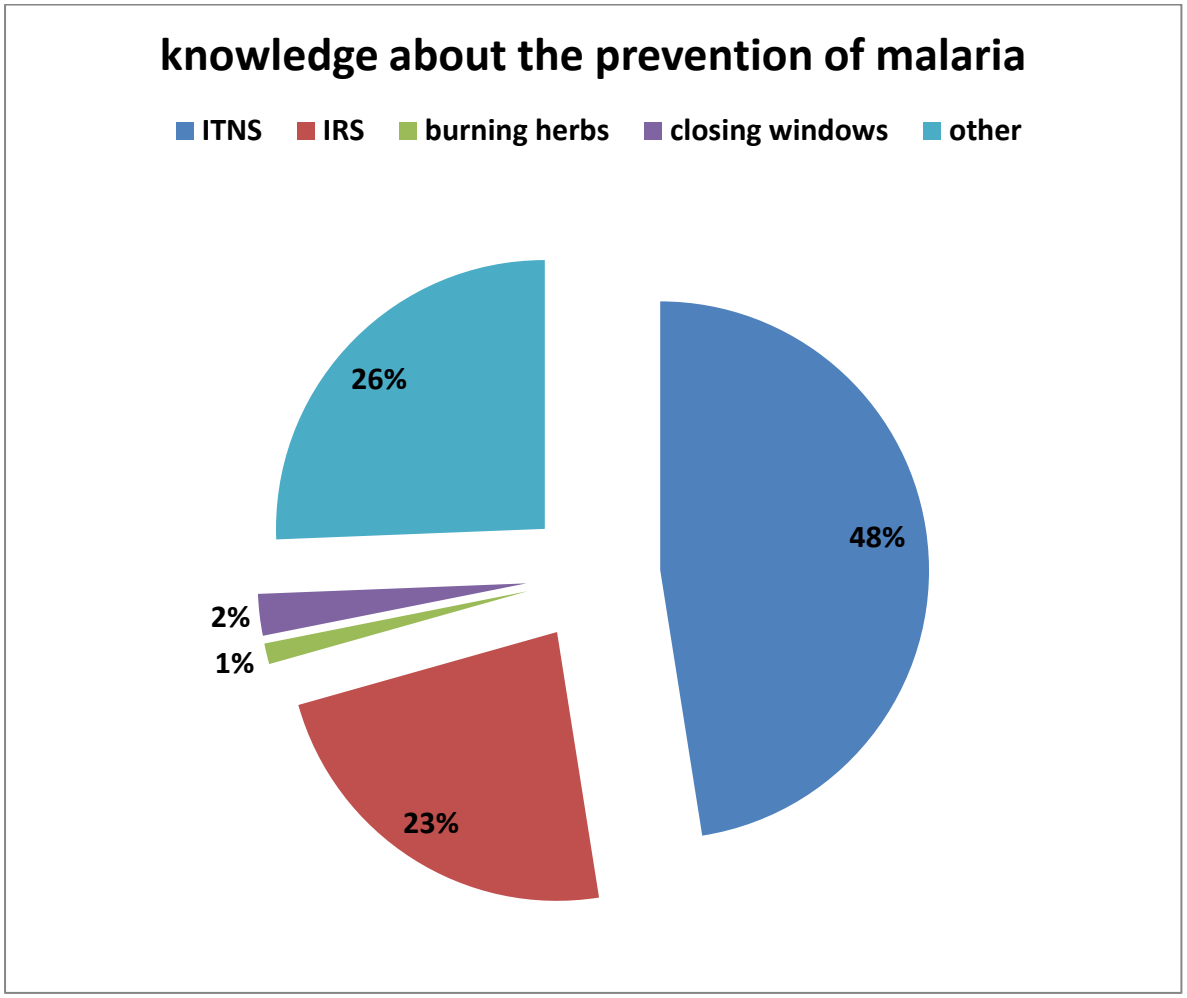
Figure 7: Sources of curative knowledge of malaria



4.8.3 Preventive knowledge of malaria

The figure below 8 shows a pie chart distribution of what the respondents thought was the best way to prevent malaria. The majority indicated that ITNs (48%) were the best method of preventing malaria, where only 23% showed that IRS was the best method for preventing malaria. Others thought conventional methods such as burning herbs (1%) and closing windows (2%) were the best methods. About 26% thought other means other than the contemporary usage of ITNs and spraying of IRS or conventional methods of burning herbs or closing windows.

Figure 8: knowledge about the prevention of malaria



CHAPTER FIVE

Discussion of Findings, Conclusion and Recommendations

This chapter discusses the results found in the study. The chapter analyses and details the findings of the factors associated with Malaria Prevalence in areas where Indoor Residual Spraying is conducted in Lufwanyama District. Key findings are analysed and where possible compared to the literature already reviewed. The chapter ends with a conclusion and some recommendations.

5.1 Age and Other Demographic Characteristics

The larger part of the distribution of age and sex of head of households was centred on the age range between 25-34, this could have been because most households were headed by younger individuals and also the proxy respondents were equally young. In Zambia, the general percentage distribution of household heads by age groups is within the range 25-34 (LCM 2006-2010) and this shows a similar pattern in this study as well as other studies. Significant to notice is that in both males and females highest number in terms of households was around the same age group but males as age progressed reduced faster than females. The significant relationship between age and marital status (p-value 0.000) confirms the assertion as indicated in the Living Conditions Monitoring Survey Report of 2006-2010 that as people get older, the proportion of the married decreases. There exists a significant (p-value 0.001) relationship between age and education status of respondents. This lies in tandem with aspirations of Sixth National Development Plan 2011-2015 and also The Millennium Development Goals. It was found that the majority of the respondents reached primary (54%) and secondary (36%) levels of education with only 19% reaching college and 1 respondent representing 0.3% had reached university level. 5% of the respondent never had any form of education. The respondent who reached university level was in the age group 45-54. Because of this level of education, confidence and ability to answer questions by respondents was assured. There was no significant relationship between being in a certain age category and duration of stay in that household. However, there was a relationship (p-value 0.001) between age and source of income. The findings show that the majority of respondents from the sample were farmers (73%) and followed by traders & sellers with only 12%.This reveals the strategic focus of the Six National Development Plan which states that in order to reduce the high poverty levels in the rural areas and promote rural development, focus should be on stimulating agriculture productivity and promotion of agro-businesses, hence, farming being

the major source of income. The 12% from traders and sellers could represent other people coming in and out of the district as Traders who buy maize, sweet potatoes, timber and emeralds (Lufwanyama District Action Plan 2012).

5.2 Analysis of Malaria Prevalence and Other Characteristics of Interest

There was no relationship (p-value 0.125) between being informed prior to spraying and episodes of malaria. However, there existed a relationship between sprayed households and experience of malaria in the 390 houses sampled. The findings show that of the 277 households that were sprayed, 93.14% experienced malaria. This could be that since about 370 of the respondents stayed for over a year since the IRS activities were conducted, that period could have been too long for assessment of IRS. As Temu (2012) observed IRS is deemed effective in reducing malaria morbidity, but it becomes ineffective as months go by and worse beyond 12 months period. Also this could be attributed to the wrong timing of IRS activities in Lufwanyama which for the last spray started in December, 2012 and ended in January, 2013. Malaria cases generally increase in December, peak in February and May and decline rapidly thereafter. The malaria transmission season follows the very distinct rainfall pattern for the area with rains starting in October or November and stopping in April, with the rainfall peak extending from December to March. House spraying should therefore ideally be carried out during October and November, preceding the peak seasonal increase in transmission (Sharp et al, 2002).

Also it could be because of the host of household structure, environmental and geographical factors coming into play. In the study, the findings showed that households that have rooms less than 3 had 65.25% malaria whilst those with equal or greater than 4 rooms had 34.75%.. And in the same households 78.53% who had episodes of malaria used less than 2 rooms as sleeping rooms and 21.47% with malaria used more than 3 rooms as sleeping rooms. This shows a significant relationship (p-value<0.05) between episodes of malaria and number of sleeping rooms in the household. The interaction with the environment and the way humans stay can encourage presence of the vector. As Wood and others (1991) observe, an uneven interaction of man with physical environment has adversely affected its nature and made conducive habitat for the rejuvenation of the vector of malaria. households that had earth/sand, dung, or other experienced 78.25% of malaria while those with ceramic tiles, cement, and carpet had 21.75%. Those with thatch, straw, or other had 31.07% of malaria

cases whilst those with iron sheets, or tiles had 68.93%. Those with un-burnt bricks, mud and poles, thatch/straw, timber, stone, burnt bricks with mud had 83.38% malaria cases whilst those with burnt bricks with cement, or cement blocks had 16.62%. Those with eaves open had 24.79% malaria cases while those with partially open 39.15% and those with closed eaves had 36.06% malaria cases. Those with windows with glass or screens had 16.34%, windows with curtains or shutters 83.38% and no windows 0.28%. From the above findings it can be seen on how important a structure is as regards to the effectiveness of IRS in preventing presence of the vector around the household. Those whose households had floors with ceramic tiles, cement, and carpet, roofs with Iron sheets, external walls with burnt bricks with cement, or cement blocks, eaves closed, and windows with glass or screens tend to have lower cases of malaria compared to those that had floors with earth/sand, dung, or other, roofs with thatch, straw, external walls with un-burnt bricks, mud and poles, thatch/straw, timber, stone, burnt bricks, eaves partially open or open completely, and those with windows with curtains or shutters. This conforms to a study on household risk factors for malaria infection among children in the Ethiopian highlands that was conducted in northern Ethiopia. In this study in order to identify risk factors responsible for variations in a hypo-endemic highland malaria setting, 14 factors were analysed and discovered that earth roof, windows, open eaves and sleeping rooms were significantly associated with malaria (Ghebreyesus, 2000). For IRS to effectively work, it should go beyond just mere spraying but by having good closed eaves, building structures with good floor, roof, walls and good windows.

Geographical location of the households showed that those that were near the river side, still water, streams dam area etc, recorded 50.99%, those near eucalyptus trees area, farm area, timber area etc recorded 42.25%, while those near mine area had 2.82% malaria cases and the rest 3.94%. Malaria was extremely low in mine areas, this could be confirming the findings of national malaria control survey that IRS target districts in the Copperbelt Province have the highest percentage (28.1%) of private agents conducting IRS activities, hence the reduction in malaria. Kagem, Chibuluma and Grizzly mines are among mines that offer intervention methods of malaria to their communities through ministry of health. Wood and others (1991) found that high-mosquito-producing fields were located in areas with a diversity of land use, including livestock pastures. According to Carter and others (2012) the disease is concentrated around particular mosquito breeding sites and transmission is limited to the areas close to them. This explains the high malaria cases in water and stream lands and also in farm and timber area. This clearly justifies why W.H.O report (2013) recommends

that before IRS begins, detailed information on the target areas should be collected. This should include the location, and accessibility of households and structures to be sprayed. Information on roads, location of villages, water points and important geographical features such as lakes, streams and mountains, should be known.

It is also important to observe that the environment surrounding the house is habitable. This study has shown its importance by recording malaria cases in households with different environmental conditions. Those with households mud & plastered or painted recorded 18.21% of malaria, those with mud but not Plastered or painted household recorded 57.69% malaria cases. While those whose households were not mud & not plastered or painted had 7.18% malaria cases. Those with not mud but plastered or painted households had 7.44% malaria cases. Households with small rooms had 3.59% of malaria cases. The results show that with a household fairly plastered already painted and sprayed, the chemical would remain strong for days and mosquitoes would be affected by its presence. This is also observed by Blessius (2008) that the effectiveness of IRS is mainly achieved through the residual insecticide film on the wall/surface which releases a lethal dose to unsuspecting mosquito as it rest before or after its sucking/ feeding blood from its victims. Hence the surface must be able to retain the insecticide film.

Those whose households were surrounded by land under vegetation (surrounded by trees, tall grass) recorded 85.5% malaria cases. Those situated near the dump site area only had 0.77% of malaria cases. Those whose surrounding had still waters, nearby drainage etc had 4.10% of malaria cases, and those who kept livestock, animals etc had 26.15% of malaria cases. The high cases in land under vegetation (surrounded by trees, tall grass) that is 85.5% malaria cases could have been exacerbated by the presence of too many people. The variation in malaria cases in this study confirms what Ngom and others, (2013) demonstrated. They explained that in pastoral areas, malaria vectors show heterogeneous trophic preferences linked to the specific localization. They further revealed that the temporal variations of malaria vector anthropophilic rates are influenced by the presence of standing water in the study area and this is exactly what seems to be the picture in Lufwanyama. Also it was seen that only 26.15% accounted for malaria cases in areas where they kept livestock and other animals and only 4.10% of malaria cases still waters and nearby drainage. The lower malaria cases could be attributed also to the behaviour of the vector. It is observed that in areas where livestock is preferably parked near settlement which constitutes the main source of water for

humans as well as livestock, mosquitoes take the blood meals from animals and rests inside human houses as suggested by Ngom and others (2013).

Considering that Lufwanyama land is mostly under vegetation and has good rainfall which has prompted temporal settlers to occupy land for seasonal farming, the decision by Lufwanyama district health office to target Farm areas (chinemu), Timber areas (mibenge), Prime areas with high population such as St.Joseph's, St. Mary's and Shimukunami, and also mine areas is consistent with W.H.O recommendation which suggest that areas of economic importance, such as irrigation schemes, mines and tourism centres should be a priority for IRS (WHO, 2013). These areas are usually of high population density hence priorities for protection from malaria. In addition, the populations that live in these areas usually comprise a mix of migrant workers from areas with different levels of malaria endemicity and immunity including malaria free areas. Such a mix creates situations conducive to epidemics (WHO, 2013). These findings also help support cohen and others (2008) models prediction which proposes that an incorporation of factors such as land characteristics, vegetation differences, or human modification of the environment is an important aspect in the elimination of malaria.

5.3 Knowledge of Malaria and IRS Acceptability, Perception and Involvement

5.3.1 IRS Acceptance, Community Involvement and Other Characteristics of Interest

Community acceptance and subsequent involvement of an intervention requires more than just an imposition of an intervention to them. For Malaria to reduce, other than following the prescribed preventive methods by the community and indeed health workers, there is need as well for the community to participate somehow in the preventive methods employed. But involvement may go with certain attributes such as experience with an intervention or indeed the level of education of people in that society. This study found that though there was no significant (p-value 0.301) relationship between a respondent's age and their involvement in IRS activities, it was discovered that the majority of the respondents did not participate in the activities of IRS regardless of the category of age. Out of the 390 sampled, only 23(5.9%) participated and 357 giving a percentage of 94.10% percent did not participate. This may

explain why IRS has not had the expected impact on the cases of malaria in Lufwanyama. Sharp (2002) explains that most programmes that do not involve the community tend to fail.

Also important to note is that involving communities means also conducting that activity at a time that does not coincide with important activities that already exists. Sharp further advises that activities shouldn't coincide with major local community programs such as harvest time and so forth. Lufwanyama land has farm blocks, fishing areas, game reserves, mines and timber processing areas. Time and again throughout the year people are busy involving themselves in one or the other activities. In India, it was observed that the usual schedule clashed with the Deepawali festival during which the majority of the inhabitants white washed or mud plastered their houses (Sharma, 1986). In other words, where possible communities should be allowed to own IRS activities to increase acceptance rate.

The study further found that the majority of respondents only reached up to primary school level (54%) with 35.97% having reached secondary school. In general, atleast 95% of the respondents had some form of education, however, only about 16.18% participated in the activities of IRS, through contribution of funds, sensitization, outreach or general role of health workers in the IRS activities. Education is an important component that needs to be taken into consideration when dealing with IRS activities. The very fact that the majority of the respondents had some form of education should help in the better delivery of the intervention and subsequently achieve the eradication of malaria but this has not been the case. The findings show that very few people despite having some education participated in the IRS activities. As reviewed in the literature of Kaufman's study people's culture, occupation and education are an important driver in the knowledge, perception and acceptance or rejection of IRS as an intervention to malaria. Education depends on how much people know about IRS. The choice of control methods appropriate for a specific community requires an understanding of the role the community as a whole in malaria management programs (Godesso, 2008).

5.3.2 IRS Perception

Perception can be based on experience over something. There exists a relationship (p-value 0.001) between household being sprayed and their experience. The study shows that about 75 (27.1%) expressed a very bad experience after IRS was conducted in their homes compared

to 62(22.4%) who expressed very good experience with IRS. The majority expressed a good experience 118(42.5%) out of those that had their houses sprayed (277). In general, 46.15% out of the 390 sampled household expressed good experience (118) to very good experience (62). These unsatisfactory findings may have contributed to negative performance of IRS. Not until communities have a good experience are they going to perceive IRS right. Some community members initially refuse, until they see their neighbours receiving benefits from the spray without side effects, and then opt to accept (Kaufman et al. 2012). The concern also is on side effects. Complaints about itching or rash and stomach upset could have been among other reasons why only 46.15% expressed good experience with IRS.

Experience triggers direction of an opinion on the effectiveness of IRS. In the graph (see figure 6) there is a general pattern that the more the number of respondents who had a good experience with IRS the better the opinion on its effectiveness. This agrees to what Kaufman and others (2012) noted that Knowledge and perception towards malaria lay the groundwork for acceptance or rejection of malaria interventions, IRS included. Perception about IRS is mixed. Many people express good opinion about something if they had good experience with it.

5.3.3 Knowledge of Malaria

Respondents' response as a cure of malaria and curative knowledge of malaria

The actions that respondents took after they had malaria complement the education level that exists in these communities. About 89% went to the clinic and took drugs and 11% just took medicine. 5% decided to have enough rest and 10% improved on their nutrition. At least more than three quarters (89%) of the respondents expressed knowledge about the cure of malaria. The study further shows that most of the respondents got their information from health facilities (78%) and about 18% got from community health workers. Lufwanyama being a rural place with few having access to media, only 8% reported to have gotten the information from the media. 11% got from neighbours and 16% got from elsewhere. This is indicative that information as coming from health facilities reaches communities and this is inclusive of malaria information. Also this justifies the advancement of Information, Education and communication (IEC) programs of all malaria activities by the district health office action plan. In a study to identify attitudes and misconceptions related to acceptance or refusal of indoor residual spraying (IRS) in Tanzania it shows that participants did not know how the insecticide works, the after effects, or what would happen further down the road with

continuous spraying because there was no prior knowledge about IRS. If residents are ignorant of IEC village meetings during which the processes are explained or do not receive any means of information, they tend to know very little about the exercise.

The choice for preventive methods depends mainly on the education level, perception, acceptability and participation that exist in the community. What is seen in Lufwanyama is that participation in IRS activities is extremely low 23(5.9%), this can dictate opinions of respondents as regards to choosing the best preventive methods for prevention of malaria. The choice of control methods appropriate for a specific community requires an understanding of the role the community as a whole in malaria management programs (Godesso, 2008). This study shows that the majority of the respondents indicated that ITNs (48%) were the best method of preventing malaria, where only 23% showed that IRS was the best method for preventing malaria. Others thought conventional methods such as burning herbs (1%) and closing windows (2%) were the best methods. About 26% thought other means other than the contemporary usage of ITNs and spraying of IRS or conventional methods of burning herbs or closing windows. Most of the respondents chose ITNs (48%) as the best preventive methods of malaria in their homes. The reason for this could be that of the knowledge they have prior implementation of an intervention. Kaufman and others (2012) noted that Knowledge and perception towards malaria lay the groundwork for acceptance or rejection of malaria interventions, IRS included. Many respondents object to spraying since they do not understand how it works. Many households believe that spraying is not effective in preventing malaria (Kaufman et al. 2012). Some object because they are not allowed to participate for one reason or the other. Kibe, (2006) observed that the use of local community potential is paramount to sustainable vector control and that effective malaria control depends amongst others community's understanding of the need and rational for malaria control.

5.4 Conclusion

The assumptions in this study suggest that the prevalence of malaria in Lufwanyama are contingent upon the numbers of household that are sprayed with IRS. Other factors include: demographic (sex, age, marital status and residence), socio-economic (source of income, education, household structures), cultural (perceptions, involvements and acceptability),

geographical (river side, farm, mine, timber area etc) and environmental (dump site , dambos, still waters, river side).

There was a relationship (p-value 0.001) between malaria prevalence and source of income and this conforms to findings that other studies have also associated gender, age, education and poverty levels, to practices towards malaria prevention and control (Temu, 2012, Godesso, 2008). The findings show that the majority of respondents from the sample were farmers (73%) and seconded by traders & sellers with only 12%. As indicated in the analysis above, Lufwanyama is comprised of mixed people, some coming for business and the majority of the indigenous being farmers. The majority spend time away from their homes by being in the fields, others fishing and trading in areas conducive for vector breeding.

There was an association between household structure, environmental and geographical factors and malaria prevalence. The factors that influenced malaria included: number of sleeping rooms (p-value 0.000), structure material of the households [floor p-value 0.000, roof p-value 0.000, external wall p-value 0.000, eaves p-value 0.031 and types of windows p-value 0.014), location of the houses (p-value 0.017), condition of the rooms (p-value 0.001) and surroundings of the household (p-value 0.012). This has indicated how malaria can be exacerbated by virtual of having poor housing conditions, inhabitable environments and geographical conditions.

The majority of the respondents did not participate in the activities of IRS regardless of their education or perception about IRS. Only 23(5.9%) participated and 357 giving a percentage of 94.10% percent did not participate. This may explain why IRS has not had the expected impact on the cases of malaria in Lufwanyama. About 89% of the respondents who had malaria went to the clinic and took drugs and 11% just took medicine. 23% showed that IRS was the best method for preventing malaria but most of the respondents chose ITNs (48%) as the best for prevention of malaria. As highlighted in the analysis above for elimination of malaria to work it takes more than just employing an intervention in that society. It goes with the perception, experience and participation that society has over that intervention. Refusal of an intervention by society can be through disagreement with the procedures and also through the perception the villagers have over the intervention.

5.5 Recommendations

Any strategy for controlling malaria vectors in Lufwanyama or indeed all pastoral areas in Zambia should take into account the diversity of mosquitoes' behaviour for better control measure choices and implementation. The ability of mosquitoes to evade fatal exposure to IRS represents the primary obstacle to eliminating malaria. As Killeen and others (2014) discussed, it remains unclear which behaviours are most important for buffering mosquito and parasite populations against vector control. Therefore, it is very important to invest in as many researches to tackle Vector behaviour in Lufwanyama.

Authorities in the Ministry of Health, National Malaria Control and other stakeholders may wish to look at contribution of IRS to malaria. Malaria control through IRS should be perceived by the beneficiaries with good intent but if the beneficiaries are not engaged, other interventions such as insecticide treated nets (ITNs) will always be favoured over IRS. Hence, there is need to redefine the community sensitization approaches in order to make IRS a genuinely participative, acceptable and well perceived intervention. Community sensitization can be in many folds; improving household structures, creating habitable environments and geographical conditions that favour lasting efficacy of the Dichloro-dipheny-trichloromethane.

Also as authorities for the control of malaria, there is need to foster plans that would ensure that before IRS is conducted in these houses, things such as structure of the houses, their location, environmental and geographical setup is taken into consideration. Not addressing this issue would render IRS an annual routine academic exercise.

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Appendix I:

Questionnaire

THE UNIVERSITY OF ZAMBIA
SCHOOL OF MEDICINE
DEPARTMENT OF PUBLIC HEALTH

STRUCTURED INTERVIEW SCHEDULE (QUESTIONNAIRE)

TOPIC: FACTORS ASSOCIATED WITH MALARIA PREVALENCE IN AREAS WHERE INDOOR RESIDEUAL SPRAYING IS CONDUCTED IN LUFWANYAMA

DATE:……

SERIAL NO:……

RESIDENTIAL AREA:……

Instruction to the interviewer

1. **Introduce yourself to the respondent and explain the purpose of the study before interview.**
2. **Make the respondent sign the consent before you start.**
3. **Assure the respondent of confidentiality and anonymity by explaining that all the information will be confidential and that his/her identity will be anonymous.**
4. **Do not force a respondent to participate, pull out politely where respondent is reluctant or unwilling to take part.**
5. **Ask questions as phrased. Only clarify where need arises without changing the meaning of the question.**
6. **Tick and fill responses appropriately to all the questions immediately.**
7. **Thank the respondent at the end of each interview.**

DEMOGRAPHIC, SOCIO-ECONOMIC DATA

Coding

1. What was your age on your last birthday?

   …….. ( ) ☐

2. What is your Sex?

   1. Male ( ) ☐
   2. Female ( )

3. What is your marital status?

   1. Single ( ) ☐
   2. Married ( )
   3. Divorced ( )
   4. Separated ( )
   5. Widowed ( )

4. How far did you go in your education?

   1. Primary ( ) ☐
   2. Secondary ( )
   3. College ( )
   4. University ( )
   5. Non ( )

5. For how long have you stayed in this house?

   1. Less than a year ( )
   2. Over a year ( ) ☐

6. How many people are in your household?

   1. 1 ( )
   2. 2 ( ) ☐
   3. 3 ( )
   4. 4 ( )
   5. more than 5 ( )

7. How many in your household are;

   1. Under 1 year ( )
   2. Between 1-5years ( ) ☐
   3. Above 5 years ( )

8. Where is your place of residence?

Catchment Area…… ( )

9. What is your main source of income? *(Tick only one)*

1. Formal employment (e.g. nurse, teacher etc.) ( )
2. Trading, selling (e.g. retailers, petty traders etc.) ( )
3. Agriculture, livestock, forestry, fisheries (e.g. subsistence farmers, market vendors, etc.) ( )
4. Craft/creative workers (e.g. wood traders, miner) ( )

CULTURAL FACTORS: IRS ACCEPTABILITY.

10. Did a spray person (use local name) spray your house with insecticides to kill mosquitoes and other insects?

1. Yes ( )
2. No ( )

11. Were you informed about the spraying in the days before it happened?

1. Yes ( )
2. No ( )

12. Before spraying did you get any advice like removing or covering?

1. Clothes ( )
2. food/utensils ( )
3. Children ( )
4. animals take out from cattle shed ( )
5. Other Specify …… ( )

13. How long did it take for any member of your household to enter the house after spraying was completed?

1. After 1 hour ( )
2. Between 1to 5 hours ( )
3. After 5 hours ( )

14. Did you mud, plaster or paint the wall household after spraying?

1. Yes ( )
2. No ( )

15. If yes to Q 8, how long did it take for you to mud, plaster or paint wall after spraying?

1. Yes ( )
2. No ( )

KNOWLEDGE OF MALARIA

16. Did any member of your family experienced any episodes of fever in the last 12 months?

1.Yes	( )	☐
2.No	( )	

17. If yes "Tell me what you did to control Malaria"?

1.Clean the environment	( )	☐
2.Take drugs	( )	
3.Take herbs	( )	
4.Avoid too much sun	( )	
5.Rest enough	( )	
6.Good nutrition	( )	
7.Use indoor spraying	( )	

18. Where did you hear the above mentioned prevention strategies?

1.From community health workers	( )	☐
2.From health facility	( )	
3.From mass media	( )	
4.From neighbours	( )	
5.OTHER specify……	( )	

PERCEPTION OF IRS

19. What has been your experience with IRS? ……

…… ( ) ☐

20. In your opinion do you think IRS works for prevention of Malaria?

1. Yes	( )	☐
2. No	( )	
3. I don't Know	( )	

21. If YES to question 41, how effective do you think IRS is for prevention of Malaria?

1. Very effective	( )	☐
2. Effective	( )	
3. Relatively effective	( )	
4. Intermittently effective	( )	
5. Not effective	( )	

22. What do you think are the benefits of your house being sprayed?

1. Reduce mosquitoes ( )
2. Reduce cockroaches ( )
3. Reduce rats ( )
4. Prevent malaria ( )
5. Other Specify…… ( )

23. What do you think is the best way to prevent Malaria?

1. Sleeping Under ITNs ( )
2. IRS( )
3. Burning Herbs inside the house ( )
4. Closing Windows and Doors ( )
5. Other Specify…… ( )

COMMUNITY INVOLVEMENT IN IRS.

24. Did any member of your family participate in community control of malaria through IRS?

1. Yes ( )
2. No ( )

25. If yes to Q 18 what was their role?

1. Contributed funds ( )
2. Sensitization ( )
3. Outreach ( )
4. supported general role of health workers ( )

HOUSEHOLD STRUCTURE, GEOGRAPHY AND ENVIRONMENT INFORMATION

26. How many sleeping rooms do you have?.....( )

27. What is the major construction material of the floor of the house? *(Tick only one box)*

1. Earth/Sand, Dung, or other ( )
2. Ceramic Tiles, Cement, Carpet etc ( )

28. What is the major construction material of the roof of the house? *(Tick only one box*)

1. Thatch, straw, or other ( )
2. Iron sheets, or tiles ( )

29. What is the major construction material of the external wall Of the house? *(Tick only one box)*

1. Un-burnt bricks, mud and poles, thatch/straw, timber, stone, burnt bricks with mud, other( ) ☐
2. Burnt bricks with cement, or cement blocks ( )

30. Are The Eaves Of The House Occupied By This Household Open Or Closed? *RECORD OBSERVATION*. ☐

1. Open ( )
2. Closed ( )
3. Partially Open ( )

31. Type of Windows *RECORD OBSERVATION*. ☐

1. Windows With Glass or Screens ( )
2. Windows With Curtains or Shutters ( )

32. Location of the household (*Tick the appropriate Location of the household*) ☐

1. River Side, Still Water, Streams Dam Area etc ( )
2. Eucalyptus Trees Area, Farm Area, Timber Area etc ( )
3. Mine Area , Dump Site Area etc ( )

33. Condition of rooms in the House *RECORD OBSERVATION* ☐

1. Mud, Plastered or painted ( )
2. Not Mud, Plastered or painted ( )
3. The rooms are small ( )

34. Observe presence of the following around the house: ☐

1. Land under high vegetation ( )
2. Dump site ( )
3. Still waters, nearby drainage etc ( )
4. Livestock, animals kept etc ( )

Appendix II:

Table for IRS Coverage in Lufwanyama from 2009 to 2011 per catchment area

Health Facility	2009 POPULATION				2010 POPULATION				2011 POPULATION		
	IRS				IRS				IRS		
	pop	malaria	prevalence		pop	malaria	prevalence		pop	malaria	prevalence
Chinemu	2,895	440	152		2,979	2319	778		3,066	2178	710
MIBENGE	1,902	0	-		1,958	1610	822		2,015	1610	799
Nkana	3,309	1331	402		3,405	4990	1,466		3,504	4990	1,424
Shimukunami	6,617	429	65		6,810	3172	466		7,007	3170	452
St Josephs	9,678	3411	352		9,959	7133	716		10,248	7133	696
St Marys	9,926	564	57		10,215	3894	381		10,511	3042	289
	34,328	**6,175**	**180**	**-**	**35,326**	**23,118**	**654**	**-**	**36,351**	**22,123**	**609**

Health Facility	2009 POPULATION				2010 POPULATION				2011 POPULATION		
	Non IRS				Non IRS				Non IRS		
	pop	malaria	prevalence		pop	malaria	prevalence		pop	malaria	prevalence
Bulaya	4,136	999	242		4,256	3737	878		4,380	5506	1,257
Chikabuke	2,482	580	234		2,554	580	227		2,628	580	221
CHANTETE	2,015	0	-		2,015	1199	595		2,015	1199	595
Kapilamikwa	3,309	187	57		3,405	833	245		3,504	783	223
Mukutuma	6,617	552	83		6,810	2357	346		7,007	2106	301
Lumpuma	7,445	922	124		7,661	4161	543		7,883	4163	528
Fungulwe	4,963	183	37		5,107	1233	241		5,256	1233	235
KANSOKA	2,233	0	-		2,298	0	-		2,365	1785	755
MIBILA	2,068	0	-		2,128	1262	593		2,190	1262	576
Mukumbo	5,542	435	78		5,703	3232	567		5,869	3231	551
Mushingashi	5,790	516	89		5,959	1179	198		6,131	1180	192
	46,599	**4,374**	**94**	**-**	**47,896**	**19,773**	**413**	**-**	**49,227**	**23,028**	**468**

Note: Chantete, and mibila became fully operational in 2010 while Kansoka in 2011.
"Pop" means population

Appendix III:

Yamane's Table for Sampling

Sample size for ±3%, ±5%, ±7% and ±10% Precision Levels Where Confidence Level is 95% and P=.5.				
Size Of Population	**Sample Size (n) for Precision (e) of:**			
	±3%	**±5%**	**±7%**	**±10%**
500	a	222	145	83
600	a	240	152	86
700	a	255	158	88
800	a	267	163	89
900	a	277	166	90
1000	a	286	169	91
2000	714	333	185	95
3000	811	353	191	97
4000	870	364	194	98
5000	909	370	196	98
6000	938	375	197	98
7000	959	378	198	99
8000	976	381	199	99
9000	989	383	200	99
10,000	1,000	385	200	99
15,000	1,034	390	201	99
20,000	1,053	392	204	100
25,000	1,064	394	204	100
50,000	1,087	397	204	100
100,000	1,099	398	204	100
>100,000	1,111	400	204	100
a = Assumption of normal population is poor (Yamane, 1967). The entire population should be sampled.				

Appendix iv Dummy Tables

Table 2.1 Malaria Prevalence

No of malaria cases	Proportion malaria cases	
Proportion		Total
Total		Total (n)

Table 2.2 IRS Coverage

IRS coverage	Proportion			Chi2 test and P-value
Household	Sprayed	Non Sprayed households	Total	
Coverage				
Total			Total (n)	

Table 2.3 socio-economic- Education

Education	Number						Chi2 test and P-value
Respondents	Primary School	Secondary School	College	University	Non	Total	
Education Level							
Total						Total	

Table 2.4 socio-economic- Source of income

Source of income	Number					Chi Square test and p-value
Respondent	Formal employment	Trading, selling etc	Agriculture, livestock, forestry, fisheries etc	Craft/creative workers	Total	
Source of income						
Total					Total	

Table 2.5 Geographical Location

Geographical Location	Number				Chi Square test and p-value
	River Side, Still Water, Streams Dam Area etc	Eucalyptus Trees Area, Farm Area, Timber Area	Mine Area , Dump Site Area etc	Total	
Geographical features					
Total				Total n)	

Table 2.6 Environmental surrounding

Environment	Number or Percent					Chi Square test and p-value
	Land under high vegetation	Dump site	Still waters	Livestock	Total	
Environment surrounding						
Total					Total n)	

Appendix V a:

Information Sheet / Consent for Head of Household/Proxy

Introduction

My name is Joseph Simuchimba. I work for Ministry of Health as a Health Information Officer in Lufwanyama and I am currently pursuing a Master of Public Health in Population Studies at the University of Zambia, School of Medicine. As a requirement for this programme, I am expected to conduct a research study of my choice. My research topic is "**FACTORS ASSOCIATED WITH MALARIA PREVALENCE IN AREAS WHERE INDOOR RESIDUAL SPRAYING IS CONDUCTED IN LUFWANYAMA**."

Objective of the study

The main objective of the study is to determine factors associated with Malaria Prevalence in areas where indoor residual spraying is conducted in Lufwanyama District.

Procedure

Information will be collected using a structured questionnaire and a checklist. The questionnaire has questions which you are encouraged to answer to enable me collect the necessary information for the study. A checklist will be used to collect information regarding your household.

Confidentiality and Anonymity

As participants in this study, you are not obliged to reveal your identity. No name or any form of identity will appear on the form and the information obtained will be treated with the highest confidentiality it deserves at all levels of the study

Voluntary participation

Participation in the study is voluntary. You are free to participate or not. Once you have decided to participate, in the study you have the right to withdraw or seek clarification about the study. My contact details have been given below.

Risks/Benefits

The benefit for this study is that it will help determine factors associated with Malaria in your household and make recommendations to Ministry of Health and other partners for policy and planning implementation.

This study poses no risk of any physical or psychological harm.

In case of any clarifications that you may require, you can contact me on the following

Name : Joseph Simuchimba

Ministry Of Health
Lufwanyama District Medical Office
P.O Box 22540
Lusaka,

Email: simuchimbajoseph@gmail.com

Cell: +260977349529

OR

The Chairperson
ERES CONVERGE IRB
33 Joseph Mwila Road
Rhodes Park
Lusaka

Principal Investigator: Joseph Simuchimba Sign:……..

If you are willing to participate in this study, kindly sign the declaration in the space provided below

Declaration.

I have read and understood the information provided above and I do hereby consent to participate in this study.

Date: …….. Sign: …… THUMB PRINT

Witness

Date: …….. Sign: …….

Appendix V b:

Information Sheet / Consent for Proxy

Introduction

My name is Joseph Simuchimba. I work for Ministry of Health as a Health Information Officer in Lufwanyama and I am currently pursuing a Master of Public Health in Population Studies at the University of Zambia, School of Medicine. As a requirement for this programme, I am expected to conduct a research study of my choice. My research topic is "factors associated with malaria prevalence in areas where indoor residual spraying is conducted in lufwanyama."

Objective of the study

The main objective of the study is to determine factors associated with Malaria Prevalence in areas where indoor residual spraying is conducted in Lufwanyama District.

Procedure

Information will be collected using a structured questionnaire and a checklist. The questionnaire has questions which you are encouraged to answer to enable me collect the necessary information for the study. A checklist will be used to collect information regarding your household.

Confidentiality and Anonymity

As participants in this study, you are not obliged to reveal your identity. No name or any form of identity will appear on the form and the information obtained will be treated with the highest confidentiality it deserves at all levels of the study

Voluntary participation

Participation in the study is voluntary. You are free to participate or not. Once you have decided to participate, in the study you have the right to withdraw or seek clarification about the study. My contact details have been given below.

Risks/Benefits

The benefit for this study is that it will help determine factors associated with Malaria in your household and make recommendations to Ministry of Health and other partners for policy and planning implementation.

This study poses no risk of any physical or psychological harm.

In case of any clarifications that you may require, you can contact me on the following

Name : Joseph Simuchimba

Ministry Of Health
Lufwanyama District Medical Office
P.O Box 22540
Lusaka,

Email: simuchimbajoseph@gmail.com

Cell: +260977349529

Principal Investigator: Joseph Simuchimba Sign: ……

If you are willing to participate in this study, kindly sign the declaration in the space provided below

Declaration.

I have read and understood the information provided above and I do hereby consent to participate in this study.

Date: …….. Sign: ……

Witness

Date: …….. Sign: …….