Household knowledge, perceptions and practices of mosquito larval source management for malaria prevention and control in Mwanza district, Malawi: A cross-sectional study

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Research

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Abstract

Background

Mosquito larval source management (LSM) is a key outdoor malaria vector control strategy in rural communities in sub-Saharan Africa. Knowledge of this strategy is important for optimal design and implementation of effective malaria control interventions in this region. This study assessed household knowledge, perceptions and practices of mosquito LSM methods (draining stagnant water, larviciding, clearing grass/bushes and clean environment).

Methods

A cross-sectional design was used whereby 479 households were selected using two-stage sampling in Mwanza district, Malawi. A household questionnaire was administered to the head of the house. Respondents were asked questions on knowledge, perceptions and practices of mosquito LSM methods. Multivariable logistic regression model was used to identify factors associated with high-level knowledge of mosquito LSM methods.

Results

Majority of the respondents (64.3%) had high-level knowledge of mosquito LSM methods. Specifically, 63.7% (200/314) had positive-perceptions about draining stagnant water whereas 95.3% (223/234) practiced clean environment for malaria control and 5.2% had knowledge about larviciding. Compared to respondents with primary education, those with secondary education were 3.04 times more likely to have high-level knowledge of mosquito LSM methods (AOR = 3.04, 95% CI 1.30–7.14), whereas those with no education were 0.40 times less likely to have high-level knowledge of mosquito LSM methods (AOR = 0.40, 95% CI 0.24–0.67). Respondents living in mudwalled households were 0.54 times less likely to have high-level knowledge of mosquito LSM methods as compared with those living in brickwalled households (AOR = 0.54, 95% CI 0.32–0.92).

Conclusions

Larviciding was the least mentioned method whereas positive-perceptions for larviciding and clearing grass/bushes were low. Targeted health promotion interventions may improve knowledge, perceptions and practices of mosquito LSM methods in communities.

Background

Malaria remains a global health challenge due to its high disease burden (1). Sub-Saharan African (SSA) region has high temperatures and rainfall climate that present favourable breeding environment for malaria transmitting anopheline mosquitoes (2). As a result, malaria is the leading cause of death and illness in SSA (1). In addition, over 15% of hospital admissions in this region are due to malaria (3). Malawi is one of malaria high-risk countries in SSA with 95% of its inhabitants at-risk (4). Furthermore, malaria is among diseases that lead in Years-Lost-to-Disability (5) and over 40% of hospital admissions among under-five children and 30% of outpatient-visits are due to malaria in Malawi (4);(6). Thus an effective policy setting is critical in malaria fight in Malawi in the wake of financial constraints and increased resistance of *Plasmodium falciparum* to anti-malarial drugs (1). Hence, World Health Organisation (WHO) established a Malaria Policy Advisory Committee (MPAC) to advise member states on policy setting process and implementation (7). The Committee advises countries to explore additional vector control methods to control, reduce and eliminate malaria (8). Most malaria control interventions ignore the main culprit: outdoor transmission (9). Malawi spends much financial resources on indoor transmission interventions (5). Thus, outdoor mosquito biting remains a challenge in Malawi as well as most sub-Saharan countries (10). Limited community participation has been identified as the main barrier to mosquito LSM methods, also known as source reduction as it is considered expensive (11). However, previous research suggests source reduction as cheap and easily implementable at household level (12). This study assessed knowledge, practices and perceptions of mosquito LSM methods in order to inform health practitioners on how to design and implement effective malaria control interventions in rural communities in Malawi.

Data And Methods

Study design

A cross-sectional design was conducted in Nthache area in Mwanza district, Malawi (Fig. 1).

<<Insert Fig. 1 here>>

Sampling

A sample size of 497 households was calculated using Cochran formula (13). A non-response rate of 10% and a proportion of 30% with knowledge of mosquito LSM methods were assumed based on a similar study in rural Kenya (14) A design effect of 1.4 was calculated based on a cluster size of 15 and a rate of homogeneity of 0.025 (15). Level of precision was set at 0.05. Sample size was adjusted to 500 to maintain same number of households per cluster (20 households/cluster * 25 clusters). However, 479 households were interviewed because 21 were not available. A two-stage cluster random sampling procedure was used. In Stage 1, twenty five (25) clusters were randomly selected from 43 villages that form Nthache area using probability proportional to population size. Each selected village formed a cluster or two clusters depending on population size. Prior to random selection of clusters, a sampling interval (SI) was calculated after dividing the total population in study area (33,870) with the 25 clusters. Cumulative population sizes for the villages were calculated. These were sizes of the population for each village plus the sum of all villages which came before it on the list. A range for each village according to its cumulated population was developed. To determine clusters, a number 52 was randomly selected between 1 and SI (1,354.8). The village with a range that 52 fell was identified as the first cluster. Then, the SI was added to 52 to determine the second cluster. This process continued as SI was added to the immediate calculated result until 25 clusters were identified (13). In stage 2, village registers from village heads were used to assign identification numbers to households in clusters. The identification numbers were put/mixed in a pot. The village heads or their representatives randomly selected 20 households per cluster.

Research variables

A validated household questionnaire was used to collect data. Respondents were asked questions on socio-demographic characteristics, knowledge, perceptions and practices related to specific mosquito LSM methods. An adult member in the household was interviewed (> 18 years-old). In child-headed households (< 18 years-old) the heads were interviewed. Household heads or an adult from the sampled household who had consented to respond to survey questionnaires were included.

Sex of the respondent was classified and coded as female, 1 and male, 2. Data on age was collected as a continuous variable and categorized as well as coded into a binary variable of ≤ 35 years-old, 1 and > 35 years-old, 2. Education status was classified and coded as primary, 1, secondary, 2, none, 3, and informal/pre-primary, 4. Marital status was classified and coded as married, 1, single, 2, widowed, 3 and divorced/separated, 4. Pregnancy status was classified and coded as being not-pregnant, 1 and pregnant, 2. Occupation was classified and coded as crop farming, 1, mixed-farming/pastoralist, 2, business/self-employed, 3, unemployed/student, 4, employed, 5, housewife, 6 and other, 7. Household ownership was classified and coded as owned, 1 and rented, 2 whereas household floor was categorized and coded as natural/earth, 1 and cement/tiles, 2. Household roof was classified and coded as grass/thatch, 1 and ironsheets, 2 whereas wall type was classified and coded as brickwall, 1 and mudwall, 2. Energy used was classified and coded as firewood, 1 and charcoal, 2.

Level of knowledge was measured as a binary variable (1 - high and 0 - low). A scoring system known as knowledge score was developed to assess the level of knowledge. To score full points, respondents had to mention four methods: draining stagnant water (1 point), larviciding (1 point), clearing grass/bushes (1 point) and clean environment (1 point). The total score was 4 points. A mean score of 1.7 was calculated. Respondents with scores above this were deemed to have high-knowledge whereas those below it were deemed to have low-knowledge (16). Respondents were asked to mention specific mosquito LSM methods. They could provide multiple responses from this list: draining stagnant water, larviciding, clearing grass/bushes and clean environment. Those who stated correct answers were deemed as having knowledge of those specific methods and the remaining as not having knowledge. The responses were coded as 1 - “having knowledge” and 0 - “not having knowledge.” Respondents were asked to mention one specific mosquito LSM method they perceived as the most effective for malaria control among those they initially expressed knowledge of. The responses were coded as 1 - “positive-perceptions” and 0 - “not positive-perceptions.” Respondents were asked to mention specific mosquito LSM methods they practice for malaria control they initially expressed knowledge of. The responses were coded as 1 - “practiced” and 0 - “not practiced.”

Statistical analysis

Descriptive statistics related to a range of socio-demographic characteristics and levels of knowledge, perceptions and practices of mosquito LSM methods were calculated. Two logistic regression models were used to identify factors associated with levels of knowledge, perceptions and practices of mosquito LSM methods. Model 1 adjusted for sex whereas Model 2 adjusted for pregnancy status and selected socio-demographic variables. All statistical analyses were done using SPSS version 18.

Ethical considerations

Ethical approval for this study was obtained from the Malawi National Health Science Research Committee (Approval number: 2158).

Results

A total of 479 respondents, aged 16–81 years, participated in this study. Majority of the respondents (64.3%) showed high-level knowledge of mosquito LSM methods (Table 1).

Table 1
Socio-demographic factors of respondents and their levels of knowledge regarding mosquito LSM methods in Nthache area, Mwanza district

Characteristics	**N = 479** **n (%)**
Sex	
Male	140 (29.2)
Female	339 (70.8)
Age-group (years)[a]	
≤ 35 years-old	273 (57.0)
> 35 years-old	202 (42.2)
Marital Status	
Married	379 (79.1)
Single	22 (4.6)
Widowed	41 (8.6)
Divorced/Separated	37 (7.7)
Education status	
Primary	307 (64.1)
None	111 (23.2)
Secondary	56 (11.7)
Informal/pre-primary	5 (1.0)
Pregnancy Status (women-of-child-bearing-age between 15–49 years-old)	**N = 276**
Not-Pregnant	258 (93.5)
Pregnant	18 (6.5)
Occupation	
Crop farming	286(59.7)
Mixed-farming (crop & livestock)/pastoralist	93 (19.4)
Business/self-employed	42 (8.8)
Employee	25 (5.2)
Housewife	22 (4.6)
Unemployed/student	7 (1.5)
Other	4 (0.8)
Household ownership	
Owned	466(97.3)
Rented	13 (2.7)
Household floor	
Natural/earth	398(83.1)
Cement/Tiles	81 (16.9)
Household roof	

[a]Age of 4 (0.8%) respondents were missing in the dataset

Characteristics	N = 479 n (%)
Grass/thatch	292(61.0)
Iron-sheets	187(39.0)
Household wall	
Brickwall	344(71.8)
Mudwall	135(28.2)
Household energy used	
Firewood	433(90.4)
Charcoal	46 (9.6)
Levels of knowledge regarding mosquito larval source management methods	
High	308(64.3)
Low	171(35.7)
[a]Age of 4 (0.8%) respondents were missing in the dataset	

<<Insert Table 1 **here>>**

Table 2 shows household knowledge, perceptions and practices regarding specific mosquito LSM methods. A small proportion of the respondents (5.2%) had knowledge of larviciding. About 65.6% of the respondents had knowledge regarding draining stagnant waters as a malaria control method. Furthermore, 63.7% (200/314) of the respondents had positive-perceptions regarding draining stagnant waters as the most effective method for malaria control. Also, 39.8% (101/254) of respondents had positive-perceptions regarding clearing the grass as the most effective method for malaria control. We also observed that 90.2% (229/254) of the respondents practiced clearing grasses/bushes. Also, 95.3% (223/234) of the respondents practiced clean environment around the home for malaria control. This study also showed that 90.2% (229/254) of the respondents practiced clearing grasses/bushes. Also, 95.3% (223/234) of the respondents practiced clean environment around the home for malaria control.

Table 2
Knowledge, perceptions and practices regarding specific mosquito LSM methods among respondents in Nthache area, Mwanza district

Household knowledge	**N = 479** **n(%)**
Knowledge about draining stagnant water	314(65.6)
Knowledge about larviciding	25(5.2)
Knowledge about clearing grass/bushes	254(53.0)
Knowledge about clean environment	234(48.9)
Household practices	
Practices regarding draining stagnant water	**N = 314** 270(86.0)
Practices regarding larviciding	**N = 25** 8(32)
Practices regarding clearing grass/bushes	**N = 254** 229(90.2)
Practices regarding clean environment	**N = 234** 223(95.3)
Household perceptions	
Positive-perceptions regarding draining stagnant water	**N = 314** 200(63.7)
Positive-perceptions regarding larviciding	**N = 25** 8(32)
Positive-perceptions regarding clearing grass/bushes	**N = 254** 101(39.8)
Positive-perceptions regarding clean environment	**N = 234** 100(47.7)

<<Insert Table 2 **here>>**

Table 3 shows results of factors associated with high-level knowledge of mosquito LSM methods among respondents in Nthache, Mwanza. Compared to respondents with primary education, those with secondary education were 3.04 times more likely to have high-level knowledge (AOR = 3.04, 95% CI 1.30–7.14) whereas those without education were 0.40 times less likely to have high-level knowledge of mosquito LSM methods (AOR = 0.40, 95% CI 0.24–0.67). Compared to respondents practicing crop farming, those practicing mixed farming (including pastoralists) and the self-employed (including businesspersons) were 6.87 times and 3.56 times more likely to have high-level knowledge of mosquito LSM methods (AOR = 6.87, 95% CI 3.36–14.02) and (AOR = 3.56, 95% CI 1.46–8.72) respectively. Compared to respondents living in brickwalled households, those living in mudwalled households were 0.54 times less likely to have high-level knowledge of mosquito LSM methods (AOR = 0.54, 95% CI 0.32–0.92).

Table 3
Factors associated with high-level knowledge regarding mosquito LSM methods among respondents in Nthache area, Mwanza district

		High-Level Knowledge				
Factors	**Categories**	**COR**	**95% CI**	**AOR**	**95% CI**	**P-value**
Sex	Female	1.00	Ref	1.00	Ref	
	Male	1.37	0.90–2.09	1.08	0.66–1.78	0.749
Marital status	Married	1.00	Ref	1.00	Ref	
	Single	0.86	0.35–2.11	0.44	0.14–1.39	0.163
	Widowed	*0.39*	*0.20–0.74*	0.73	0.33–1.64	0.444
	Divorced/separated	0.72	0.36–1.44	0.91	0.43–1.92	0.800
Education status	Primary	1.00	Ref	1.00	Ref	
	Secondary	*2.94*	*1.34–6.45*	*3.04*	*1.30–7.14*	*0.011*
	None	*0.42*	*0.27–0.65*	*0.40*	*0.24–0.67*	*0.000*
	Informal/pre-primary	0.74	0.12–4.47	0.95	0.13–6.98	0.955
Occupation	Crop farming	1.00	Ref	1.00	Ref	
	Mixed farming/pastoralist	*5.55*	*2.83–10.85*	*6.87*	*3.36–14.02*	*0.000*
	Business/self-employed	*3.72*	*1.60–8.66*	*3.56*	*1.46–8.72*	*0.005*
	Unemployed/student	0.56	0.12–2.54	0.58	0.10–3.25	0.537
	Employed	0.95	0.42–2.16	0.88	0.37–2.12	0.777
	Housewives	0.52	0.21–1.24	0.49	0.19–1.28	0.146
	Other	0.25	0.03–2.41	0.32	0.03–3.59	0.355
Household wall	Brickwall	1.00	Ref	1.00	Ref	
	Mudwall	*0.52*	*0.35–0.79*	*0.54*	*0.32–0.92*	*0.022*
Household floor	Natural/earth	1.00	Ref	1.00	Ref	
	Cement/Tiles	2.02	1.16–3.50	1.26	0.63–2.52	0.519
Household roof	Grass/thatch	1.00	Ref	1.00	Ref	
	Iron sheets	1.72	1.16–2.54	1.29	0.74–2.26	0.374
P-values in italics show significance at $p \leq 0.05$						
Multivariate model adjusted for sex, marital status, education status, occupation, household wall, household floor and household roof						
NOTE: Age-group (years), pregnancy status, household ownership and energy type were not significant at bivariate level						

<<Insert Table 3 **here>>**

Discussion

The purpose of this study was to assessed knowledge, practices and perceptions of mosquito LSM methods in order to inform health practitioners on how to design and implement effective malaria control interventions in rural communities in Malawi. Our study showed a high-level knowledge of mosquito LSM methods in the study area. Our finding is in contrast with an east-central Tanzanian study that reported a low community knowledge of mosquito LSM methods for malaria control (17). This was due to failure by policy makers and implementers to prioritise mosquito LSM methods in rural areas. Our findings further showed that respondents without education were less likely to have high-level knowledge of mosquito LSM methods than those with primary education. This finding is similar to a Cameroonian study that showed that literate people had a better understanding about malaria messages through formal education and media (18). However, a Ghanaian study showed no significant association between education and knowledge of malaria control methods (19). Hence,

non-formal and informal education was recommended for malaria control related health promotion interventions. There is need for health workers to continue raising awareness on mosquito LSM methods in rural areas. These educational programmes could bring effective behavioural change (20).

Our study also showed a very low proportion of respondents with knowledge of larviciding as a malaria control method. This finding is similar to a study in east-central Tanzania that showed that the majority of respondents were unaware of larviciding (17). This was attributed to the fact that larviciding programmes were limited and restricted to urban areas hence rural people were unaware of it. Thus, there is a need for health promotion interventions in rural areas to include larviciding. Our results showed that close to two-thirds of the respondents had knowledge of draining stagnant water as a malaria control method. However, an Ethiopian study found that more than three-quarters knew draining stagnant water as a malaria control method (21). This, therefore, calls for continued awareness of draining stagnant water for malaria control in the study population.

Our study showed no significant differences between pregnant and non-pregnant women about levels of knowledge regarding mosquito LSM methods. This is against the background that pregnant women in Malawi attend antenatal care (ANC) services at least four times before delivery (6). These ANC visits provide health workers with a window of opportunity to offer routine health education on various topics, including malaria during pregnancy as it is a risk factor for delivery of premature babies (22). Oftentimes, ANC services provide intermittent preventive treatment and free LLINs to clients to enhance malaria prevention (5). Nonetheless, ANC service providers should also prioritise mosquito LSM methods awareness among pregnant women.

The findings suggested that respondents living in mudwalled households were less likely to have high-level knowledge of mosquito LSM methods as compared to those living in brickwalled households. However, an American study found that respondents from low-income households were highly motivated to control mosquitoes than those from high-income (23). Hence, it is necessary to target both low and high-income households with malaria prevention and control related health promotion interventions to improve knowledge. This study observed that few respondents had positive-perceptions for larviciding as a malaria control method. However, perceptions about safety of larviciding were a major challenge adversely affecting its acceptability in east-central Tanzania (17). Thus, health workers should prioritise awareness on safety of larviciding in rural areas. However, a qualitative study is recommended to assess the factors leading to few respondents having positive-perceptions for larviciding in the study population.

There were some limitations to this study. Firstly, associations derived from cross-sectional studies fall short of establishing temporal relationship between factors and levels of knowledge. Secondly, it is possible that individuals with knowledge of mosquito LSM methods might not be head of households or an adult member who answered the questions. Lastly, data collection was done during rainy season when malaria was at the peak. Hence, respondents could have been exposed to messages on mosquito LSM methods that influenced their responses. It is, therefore, important to generalize these results with caution as they may not necessarily reflect the levels of knowledge, perceptions and practices of mosquito LSM methods in the country.

Conclusion

The study established high-level knowledge of mosquito LSM methods. Education status and occupation were significant predictors of high-level knowledge. Larviciding was the least known mosquito LSM method. It is therefore important to promote awareness and practice of larviciding in the rural communities. Positive-perceptions for clearing grass/bushes and larviciding were low. Health workers should focus on targeted health promotion interventions regarding mosquito LSM methods.

Abbreviations

ANCs: ante-natal clinics; AOR:adjusted odds ratio; *b*:cluster size, CI:confidence interval; COR:crude odds ratio; LLINs:long lasting insecticide-treated nets; LSM:larval source management; MPAC:Malaria Policy Advisory Committee; NHSRC:National Health Sciences Research Committee; *roh*:rate of homogeneity, SI:sampling interval; WCBA:women of child-bearing age; WHO:World Health Organization.

Declarations

Authors' contributions

DM was involved in the design and development of the study protocol, data management, and analysis, oversee the logistics and administration of the field work and participated in the supervision of the field work and manuscript preparation. MK reviewed the design, study protocol as well as the manuscript and provided support in data management and analysis. KL reviewed the manuscript. All authors read and approved the final manuscript.

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Competing interests

The authors declare that they have no competing interests.

Availability of data and materials

The dataset is available on reasonable request to authors.

Ethics approval and consent to participate

The study was approved by the Malawi National Health Science Research Committee (NHSRC) at Ministry of Health (NHSRC approval number: 2158).

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Not Applicable

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Figures

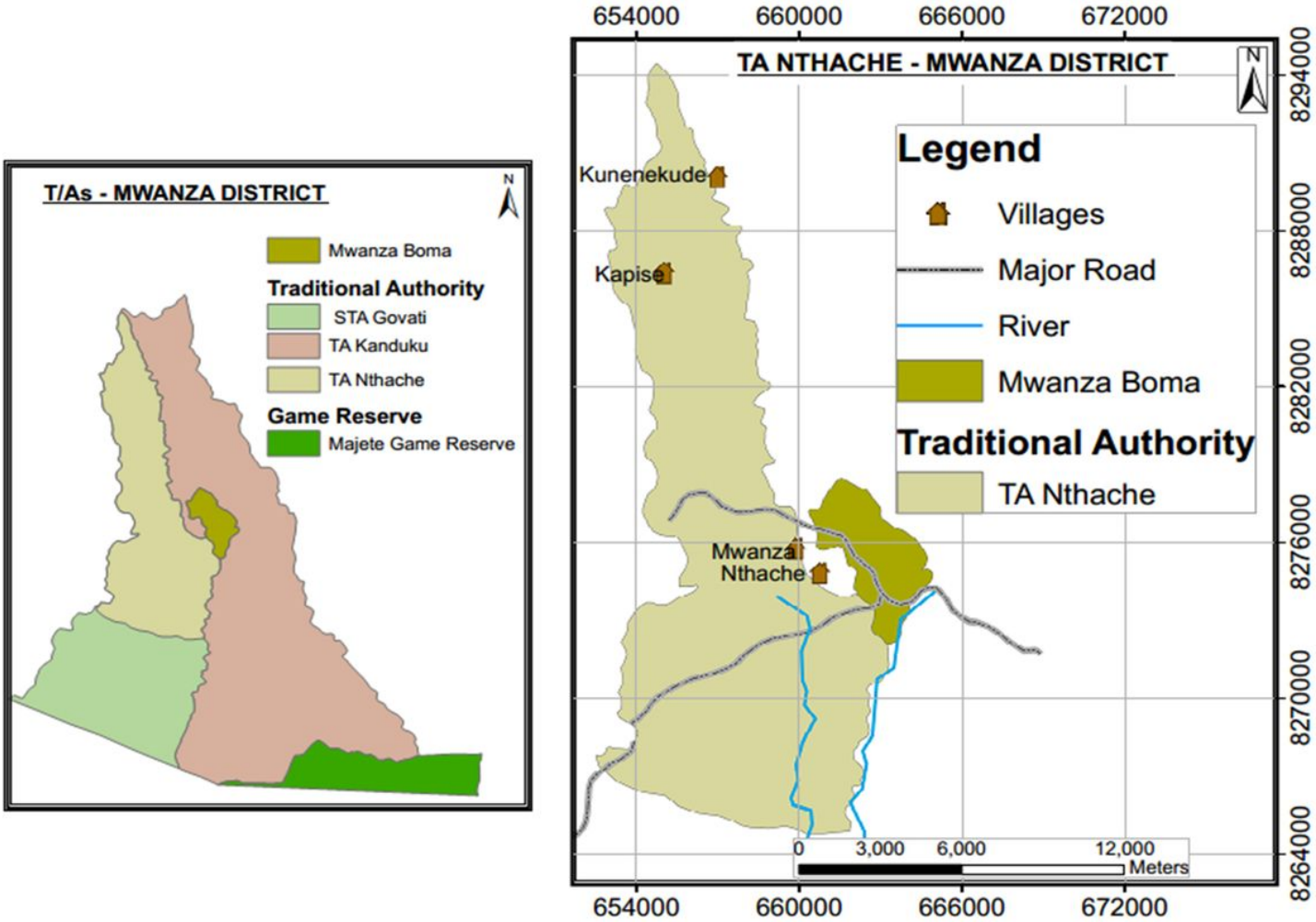

Figure 1

Map of Traditional Authority Nthache, Mwanza, Malawi