Assessing the Determinants of Open Defecation Free Communities based on the Socio-Demographic and Economic Status of Household Heads in the Mion District of Northern Region, Ghana

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Abstract- The study was conducted in twenty open defecation free communities of the Mion District in the Northern Region with the objective of assessing the determinants of open defecation free communities based socio-demographic and economic status of household heads correlational analysis. The study design was mainly quantitative and involved225 respondents. The study found that, 73.4 percent have hand washing facilities for washing their hands after defecating but no soap, 62.2 percent of the respondents indicated had hand washing facilities, water and soap. The correlation analysis shows that there was a relationship between household size and open defecation free communities (p=0.000), age of respondents and open defecation free communities (p=0.000), religion and open defecation free communities (p=0.000) and the presence of water at toilets and open defecation free communities (p=0.017). The relationship between the use of soap and open defecation free communities could not be determined (p=0.050). Eighty-four(21.3%) percent of the respondents indicated that the high cost of constructing toilets was the reason why they had no household toilets. Other factors why toilets were not constructed in homes were lack of technical support (14.7%), waiting for external support (33.3%) and the notion that household toilets were not necessary (30.7%).The study concludes that the determinants of open defecation free communities in the Mion District are age, household size, religion and belief systems, and the presence of water and income of residents. The study recommends that governmental and nongovernmental agencies in water and sanitation must support the aged and the poor to construct household toilets. All agencies supporting water and sanitation must harmonize their activities on community led total sanitation and further education and sensitization is necessary to ensure that communities that attained open defecation free status do not relapse into open defecation.

Keywords: climate change, household toilets, open defecation, sanitation, water resources.

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I. Introduction

Globally, achieving good sanitation has remained a mirage. Nearly 2.5 billion worldwide have no access to improved sanitation (WHO/UNICEF, 2006; WHO/UNICEF, 2013); 946 engage in open defecation WHO/UNICEF, 2015) and over 780 million have no access to improved drinking water (WHO, 2006). As a result, the United Nations calls for ending open defecation and universal access to adequate and equitable sanitation in the Sustainable Development Goals (SDGs) (UN General Assembly, 2015). These have become a challenge in developing countries as over 80 percent of diseases are due to poor sanitation (WHO/UNICEF, 2006) and cause the death of one and a half million death in children under 5-years (WHO/UNICEF, 2013).

In Ghana, nearly 28.0 percent of the population has no access to good sanitation (Plan International, Ghana, 2013). Northern Region in Ghana is poor in sanitation. In 2006, it was reported that nearly 73 percent of the population were engaged in open defecation with over two metric tonnes of human excreta generated daily. Most of the inhabitants are farmers and use human excreta to fertilize their farm lands or are disposing away in the open fields (Plan International, Ghana, 2015). This is because; the engineering land field site is only in the regional capital Tamale and most households depend on public toilets.

It was therefore important to introduce Community Led Total Sanitation (CLTS) to improve sanitation in rural districts who have no household toilets to protect them from sanitation related diseases, poverty and death. CLTS was first introduced in Ghana in the towns of Mankessim, Asesewa and Bawjiase in the Central Region in 2006 by the Community Water and Sanitation Agency (CWSA) and was later supported by Plan International Ghana (Plan International Ghana, 2013) and United Nations Children Emergency Fund (UNICEF) to scale up in 2010. As CLTS gained recognition of success, the Government of Ghana

(GoG) revised the National Sanitation Policy of 1999 (Ministry of Local Government and Rural Development (Plan International, Ghana, 2013)to update its scope and to address the underlying causes of poor sanitation and improve the health of the citizens. The national environmental and sanitation policy in Ghana had a co-ordinating council mandated to acquire and protect lands for the purpose of treatment and disposal of waste; to encourage public and private developers to factor waste management in their developmental plans; to streamline the cost and payment of sanitation services; ensure the ownership of household toilets; to introduce environmental and sanitation day that will be celebrated once a year and to established bylaws to regulate sanitation and prevent pollution in their districts (Plan International, Ghana, 2015). GoG also adopted the CLTS approach as a national strategy for expanding sanitation and hygiene practices, and developed an open defecation free (ODF) protocol for assessing communities' ODF status, and systems of award and recognition of ODF communities. Factors that enabled the implementation of CLTS and which could contribute to its sustainability in Ghana are supportive government policies and strategies and national guidelines for CLTS implementation, and CLTS coordinating committees (Crocker and Bogle, 2015).

CLTS is a relatively new approach, with both opportunities and challenges. CLTS may not be sustainable (Guiteras et al., 2015) as it is appropriate in high baseline open defecation (Crocker et al., 2016) and high social capital (Cameron et al., 2015). CLTS is more sustainable where there is a supportive enabling environment such as sufficient follow-up visits, market-access to latrine products and materials and socially cohesive of communities (Hanchett et al., 2011; Mukherjee et al., 2012; Tyndale-Biscoe et al., 2013;Cavill et al., 2014). There is limited literature on the impacts and sustainability of CLTS (Garn et al., 2016), and creating longer term reports on sanitation impacts is a new research priority (Waddington et al., 2009).

The concept of CLTS began in the year 2000 and has since being adopted by over 60 countries including Ghana. These countries have included CLTS in their national policies (Institute of Development Studies, 2016). CLTS appealed to strong emotions such as self-respect, shame and disgust. A central tenet of the approach is that behavior change occurs when emotional responses are combined with cognitive understanding. CLTS uses three main triggers to bring about behavior change. Direct observation of defecation practices, hands-on demonstration and handling of feces provoke shame and disgust when participants realize that feces can get into the body through the mouth. If this trigger is effectively executed, a collective sense of urgency for change is created. Instead of focusing on households, CLTS creates a collective sense of disgust and uses peer pressure to generate a need for collective action. CLTS uses public, visual monitoring of achievement and recognition of successes. It maintains the momentum of change by motivating pride and competition to boost the household's commitments in public. A potential weakness of CLTS is that the effectiveness of the triggering process depends on external factors such as the quality of the facilitation, and the degree of participation by the community (Crocker et al., 2016).

The benefits of CLTS include not having to go out before dawn or after dark, safety from the associated risks of violence and sexual abuse, time saved and less embarrassment (Crocker and Bogle, 2015). As a result of these benefits, several agencies collaborate in implementing CLTS in rural communities. Among them are UNICEF, USAID, SNV Netherland Development Organization, Global Communities, Water Aid Ghana, World Vision International, and local organizations such as Pres by Water, Catholic Relief Services (CRS) and Afram Plains Development Organization (APDO). CLTS is participatory and generally includes capacity building in addressing open defecation (Kar and Chambers, 2008; Pickering et al., 2015). Their successes have been the provision of water, sanitation and hygiene through participatory rural appraisal (PRA) techniques (Crocker et al., 2016). In CLTS the communities understand that the process is a shift towards a zero subsidy approach rather than providing them with money to construct latrines.

In earlier studies by Crocker et al., (2016) in Ghana, it was found that open defecation has decreased in CLTS implemented communities. Also, health extension worker-facilitated CLTS performed better than teacher-facilitated CLTS in Ethiopia (Crocker et al., 2016).It is reported that the Northern Region ranks third highest among ten Regions with 72.9 percent open defecation. Since the inception of CLTS in the Northern Region, many interventions have been made and the Mion District is at the verge of attaining district's wide ODF status. However, no impact study has been conducted to assess its successes and sustainability. The study therefore intends to assess the determining factors of achieving ODF status using socio-demographic and economic status of household heads in the Mion District.

II. Study Area and Methodology

a) Study Design

The study employed the use of quantitative technique to collect the data. Quantitative research is a formal, objective and systematic process in which numerical data is collected and utilized to obtain information about the work. Structured questionnaires were used for the quantitative data (JMP, 2012)and confirmed by observation and interview with staff of the Mion District Assembly using the indicators below:

Cleanliness of the latrine;

Existence and condition of hand washing facilities;

Refuse site management;

Safe disposal of waste water from bathrooms and kitchens;

Management of shrubs and bushes around the community (OD risk);

Compliance with Community Action Plans;

Updated Community Defecation Map/extended to maps tracking other hygiene practices;

Availability of community-enforced by-laws and sanctions e.g. against open defecation;

Food hygiene and safety practices appropriate to local lifestyle;

Household water safety;

Proper disposal of animal waste/ confinement of animals;

Water source protection;

Availability of sanitation and hygiene products and services desired by consumers and

Availability of financing for consumers and suppliers.

Source: Joint Monitoring Programme for Water Supply and Sanitation (JMP) (2012

b) Study Area

The Mion District Assembly was established on 6th February, 2012 by LI 2064 and was officially inaugurated in June 2012 as one of the Forty-six (46) newly created District Assemblies in Ghana. The capital of the district is Sang. The Mion District is located in the eastern corridor of the Northern Region of the Republic of Ghana between latitude 9^0 – 35^0 North and longitudes 0^0 – 30^0 West and 0^0 – 15^0 East. The District shares boundaries with Yendi Municipal to the East, Tamale Metropolis and Nanton District the West, Gushegu and Karaga to the North and Nanumba North and East Gonja Municipal to the South. The distance from the district capital Sang, to the regional capital, Tamale is about 63km.

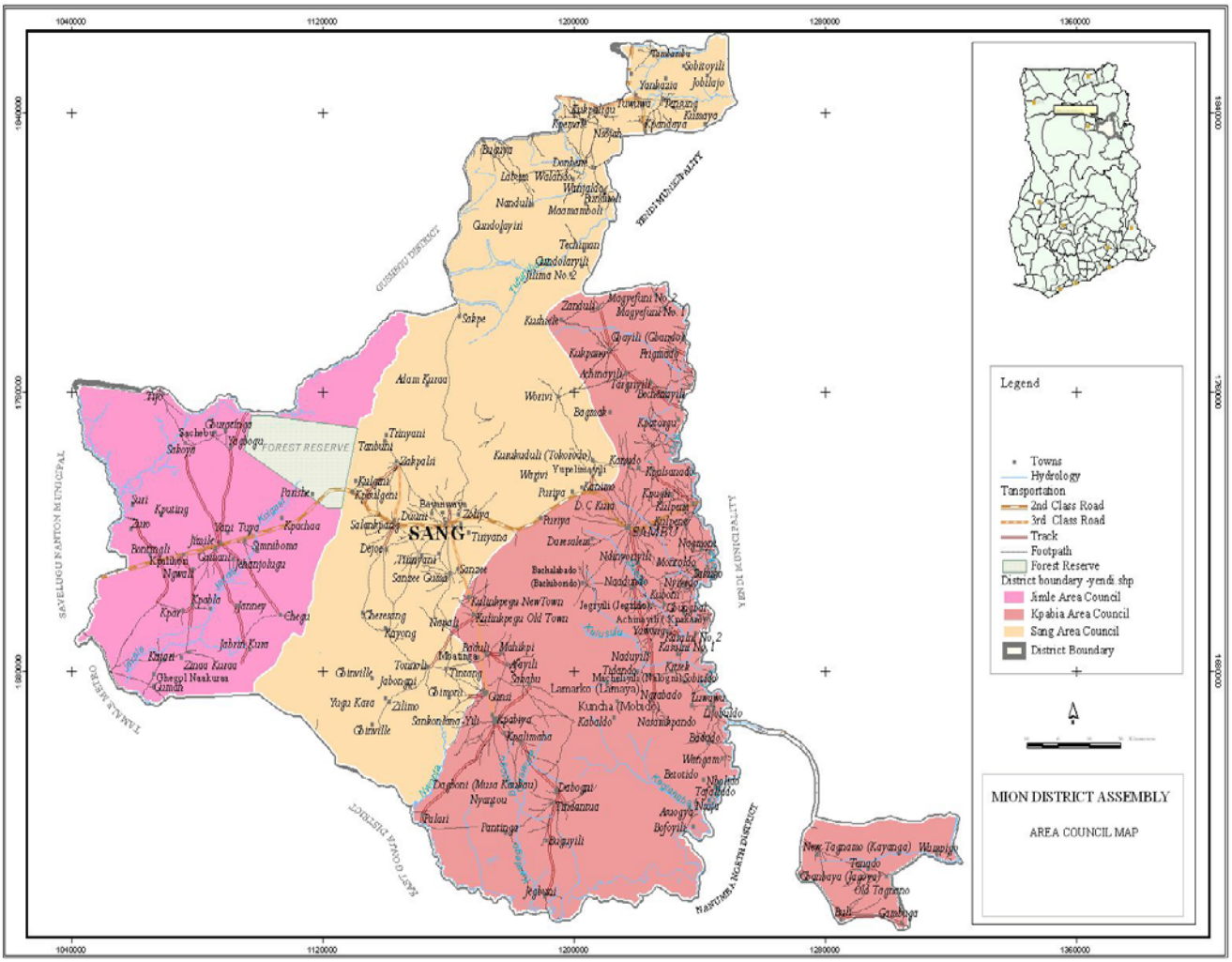

Figure 1: Map of Mion District

The District covers a surface area with a landmass of 2,714squarekilometres. There are three (3) Area Councils in the District Namely Sang, Kpabia, and Jimle. The District has 20 Electoral Areas and 171 communities. Mean annual rainfall for the district is 715mm. The raining season rainfall for the district is from April to October while the dry season is from November to March. Temperature ranges between 21^0C- 40 ^{0}C giving rise to high temperature range. The climate of the district is the guinea savannah type. The degraded savannah type of vegetation is found around settlements and heavily cultivated areas. The rampant and extensive bush burning is having an adverse effect on the vegetation and consequently the climate. High temperatures make the environment uncomfortable for both biotic and abiotic organisms to function effectively. Economic trees in the district include Shea trees, Dawadawa, Mango and Cashew.

The rock type is sedimentary and predominantly voltarian sandstone, shales and mudstones. The soils derived from the rocks range from laterite, ochrosols, sandy soils, alluvial soils and clay. The organic content of the soils is low and increasingly worsened by the extensive bush burning and bad agricultural practices. This to a large extent accounts for the low yield per acre of crops and its consequent food shortage during the dry or lean season in the district.

The population of the District is 81,812 (GSS, 2012) and is varied in terms of ethnicity with the Dagomba constituting the majority. The other ethnic groups include Konkomba, Akan, Ewe, Basare, Moshie, Chokosi and Hausa. The population is largely rural. About 92.0% live in the rural areas while 8.0% are in towns. The population growth rate is approximately 2.9% per annum. Some of the major towns in the District include: Sang, Sambu, Jimle, Kpabia, Zakpalsi and Sakpe. The main religious groupings are Moslems, Christians and Traditionalists. Migration pattern is more pronounced among the youth and especially female girls who basically travel down south to engage in menial jobs popularly called 'Kayaye'. Out migration by young girls exposes them to all forms of sexual abuse and low female school enrolment or high dropouts.

The state of environmental sanitation in the district is improving; however, a lot more needs to be done. Out of the total refuse generated, about 51% of it is collected but not dispose of properly. Meanwhile, most houses in the high density areas lack toilet facilities and drains.

With regard to excreta disposal management, the 2014 regional analysis of the 2010 population and housing census indicates that, 41.6% of the population in the district have access to improved toilet due to the implementation of the Community Led Total Sanitation (CLTS) whiles 58.4% are sharing and use unimproved sources of toilet such as public toilet (GSS, 2014).

c) Sample Size

The total households of Mion District stand at 7,139 and the average household size is 9.3 and there are three (3) Area Councils in the District namely Jimle, Sang and Kpabia (GSS, 2012). A sample size of 225 was selected from each of the area councils.

d) Determination of Sample Size

This study employed multiple stages. First of all, simple random sampling was used to select 20 ODF communities from the Mion District Assembly for the study (Table 1). These communities were selected because they were part of those communities in which community led total sanitation (CLTS) is been implemented in the district and therefore have knowledge regarding the implementation of the CLTS and what open defecation free (ODF) communities are. Also, these communities were selected because of the willingness of the community members to respond to the survey questionnaire and above all the accessibility of the researcher to the community leaders to assist in the mobilization of the heads of households.

Secondly a formula for determining sample size given by (Krejcie and Morgan, 1970) was used to determine the sample size of 225 respondents from a population of 542 household heads. Thus:

$$S=X^2NP(1-P)/d^2(N-1)+X^2P(1-P) \ldots \quad \ldots(1)$$

Where:

S=required sample size

X^2= The table value of Chi-square for 1 degree of freedom at desired confidence interval (3.841 or 1.96×1.96)

N=the population size=542

P=the population proportion (Assumed to be 0.5 since this would provide the maximum sample size)

d=the degree of accuracy expressed as a proportion (0.05). From the information above;

$S=3.841(542)(0.5)(1-0.5)/(0.05)^2(542-1)+(3.841)(0.5)(1-0.5)$

$S=520.4555/1.3525+0.96025$

$S=520.4555/2.31275$

$S=225.0375$

$S=225$

Thirdly, the sample size of 225 respondents was proportionally distributed to the communities based on the total number of households as given by the Mion District Assembly. The sample frame and the sample size of the communities are shown in table 1.

Table 1: Sampling Size in various communities

Name of Community	Total Household	Sample size
Jilma No.1	26	11
Jibilajo No.2	53	22
Nkwanta	18	7
Kpumale	35	15
Wasambo – B	27	11
Macheliyili	43	18
Kubagmado	12	5
Frigmado	22	9
Tuya	21	9
Namoni	18	7
Binagmando	24	10
Motondo	23	10
Sobitido	35	15
Nayinkundo	18	7
Kuboni	39	16
Bungbali	33	14
Yawondo	30	12
Bichado	28	12
Chirizang	19	8
zanduli	18	7
Total	**542**	**225**

Source: Field survey, 2020

Finally, the survey questionnaire was tested and mistakes corrected in other communities of the Mion District which were not part of the study communities.

e) Sampling Procedures

For the survey, the target population was made up of households in Mion District. As Curtis (1998) suggests, it is necessary in hygiene studies to focus on households because this is the level at which internal and external processes come together to produce health. In this regard, the concept of household was used as defined in the 2010 Population and Housing Census. For this census, a household was defined as a person or group of persons who live together in the same dwelling, share the same house-keeping arrangements and are catered for as a unit (GSS, 2012). By this definition, family members may not necessarily be household members based on their living arrangements. In the same vein, not everyone who lives in the same house can be defined as constituting a household. Further, length of time of stay of members was considered as some may just be visitors to the house and may not necessarily be permanent members of the household. Therefore, the study, focused on people who live in the same house and eat from the same pot and have access to the same facilities in the house at least six months before the study.

A complete sampling frame obtained from the District Assembly was used to select households to be included in the study. From this list of 542 households obtained from the district assembly, 225 households were chosen using the simple random sampling technique. Numbers were assigned to each household in the list and using the lottery method the numbers were picked till the sample size was obtained. The simple random technique ensured that every unit in the population had an equal chance of being picked for the study. It also provided a sample of people who live in the same community but occupy different types of houses and use different types of toilet facilities. This survey targeted household heads but in their absence any adult (18 years and above) who was found within the household was interviewed. For the selected staff of the NGOs, and the District Assembly purposive sampling was used because of their in-depth knowledge with regards to the subject matter at hand.

f) Pre-data collection procedures

Community entry can be very difficult without the use of social connections; therefore, it was necessary to contact as many relevant people as possible. This was also necessary not only to gain access to the community, but to erase as much as possible suspicion in the minds of the people. It also fostered a better understanding of the ways in which issues are handled, especially those pertaining to the study. The community entry was facilitated by the District Environmental Health Officer (DEHO) of the Mion District Assembly. The DEHO often conducts monitoring and supervision of his staff in the communities so he is popular among the people. This goodwill was further enhanced when natives who are part of the implementation (Natural leaders) in each of the communities were made translators for the study; community entry process was made fairly easy.

The researcher began data gathering in 2020 by first training four Assistant researchers and also familiarizing himself with the field. This was done by identifying and establishing rapport with key informants. These key informants were mostly suggested through formal and informal discussions with some of the community members. The first persons to be contacted were the assembly persons for the communities who represent the political authority at the community levels or electoral areas. They were contacted to give permission for the conduct of the study and to seek their assistance in identifying people whose views could be of immense help to the study. After explaining the intent and purpose of the study, the chiefs of the communities were met.

g) Data Collection

The study collected both primary and secondary data. The primary data was collected using a structured questionnaire at the household levels using a survey guide. The Secondary data was collected from registers of monitoring tools, quarterly reports, review reports, annual reports and plans of district and regional environmental health and sanitation unit offices so as to compare with primary data collected. The quantitative data was collected using questionnaire, which was designed as the result of intensive literature search, programme theory and conceptual framework of the pre-determined questions and responses. After numbering the households the questionnaire was administered to all heads of households selected for the study. In case of those selected household heads were absent another person who is 18years and above was selected. During data collection the head of households were requested for their consent to participate in the study.

h) Data Processing and Analysis

The data was checked for distribution and outliers. The questionnaire was coded and entered using Statistical Package for Social Sciences (SPSS) version 20; descriptive statistics was done to derive numerical and non-numerical data presentation models including, graphs and tables. The data was also analysed using correlation to find the relationship between socio-demographic data and open defecation free communities to established the determinants of open defecation.

III. Results and Discussion

a) Socio Demographic Characteristics of Respondents

Information on the socio-demographic information of the respondents included both males and females. The least age of the respondents was 18 years with a maximum age of 60 years. There were a total of 225 respondents who responded to the structured questionnaire. Out of this, 170 were males representing 75.6 percent of the respondents and 55 females representing 24.4 percent of the respondents (Figure 2).

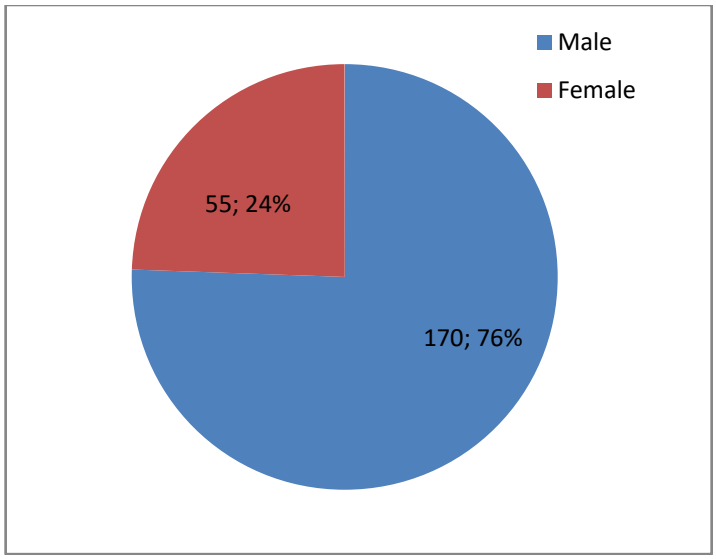

Figure 2: Sex of respondents. Source; Field survey, 2020

This is because; males are the household heads in the study district. The results showed that 29 respondents representing 12.9 percent of the respondents were between 18-25 years, 23.6 percent of the respondents were between the age 26-33 years, 21.3 percent of the respondents were between 34-41 years of age, 24.4 percent of the respondents were between 42-49 years of age, 12.9 percent of the respondents were between 50-57 years of age, whilst 4.9 percent of the respondents were 58-60 years of age (Table 2).

Table 2: Age of respondents

Age group	Frequency	Percentage
18-25 years	29	12.9
26-33 years	53	23.6
34-41 years	48	21.3
42-49 years	55	24.4
50-57 years	29	12.9
58-60 years	11	4.9
Total	225	100.0

Source; Field survey, 2020

Also, on education the study revealed that 78.7 percent of the respondents have no formal education, 16.9 percent of the respondents completed primary/JHS, 3.1 percent of the respondents had SHS education, 1.3 percent of the respondents had HND/Diploma (Figure 3).

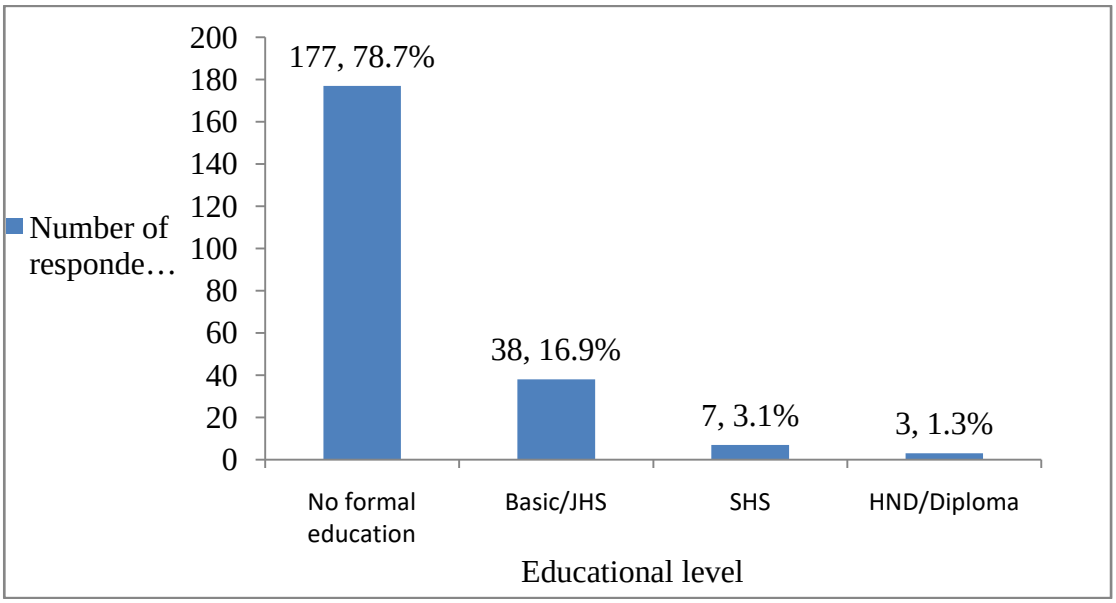

Figure 3: Educational level of respondents. Source; Field survey, 2020

On religion of respondents, the study revealed that 17.8 percent of the respondents were Muslims, 41.8 percent of the respondents were Christians, while 40.4 percent of the respondents were traditionalist (Figure 4).

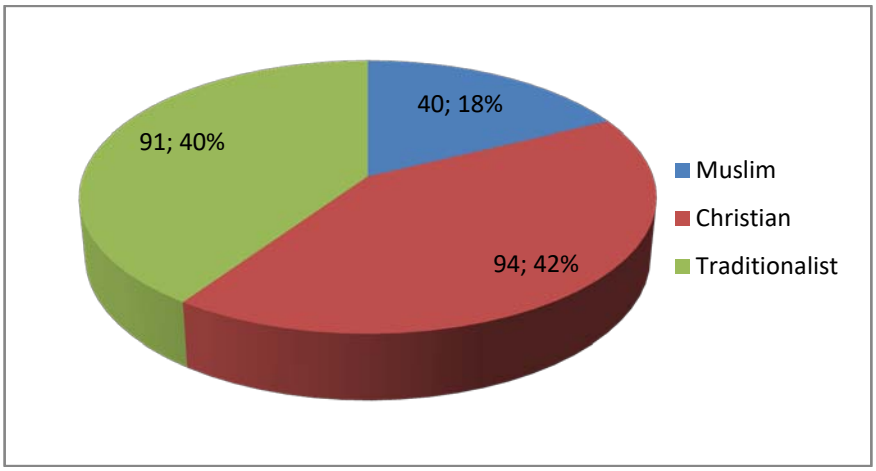

Figure 4: Religion of respondents. Source; Field survey, 2020

On the occupation of respondent's 86.7 percent of the respondents were farmers,7.1 percent of the respondents were traders, 3.6 percent of the respondents were government workers, 2.6 percent of the respondents were unemployed as shown in Figure 5.

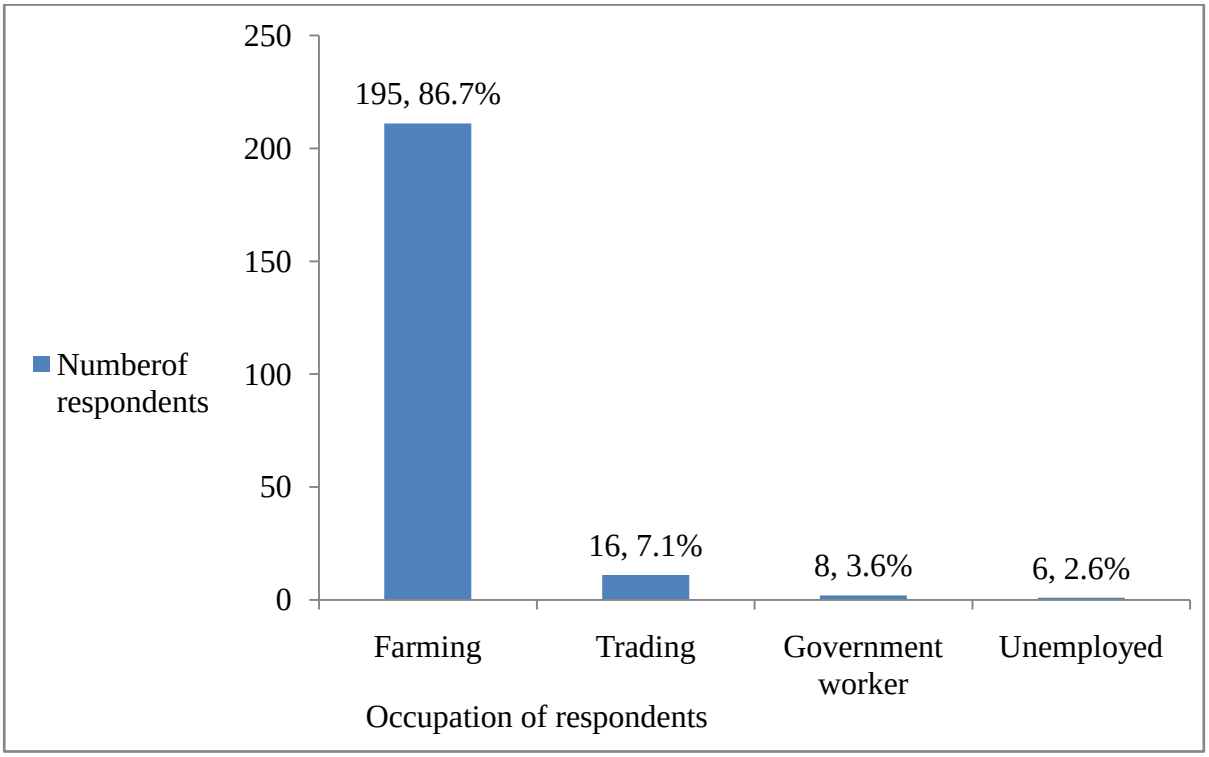

Figure 5: Occupation of respondents; Source: Field Survey, 2020

The dominance of farming in the Mion District is because the district is rural based. According to the Ghana Statistical Service, 92.0 percent of the district lives in rural areas. Abramovsky et al., (2016) observed that CLTS was effective in small, rural, homogenous communities as in the case of the Mion District.

b) Situational analysis of the implementation of Community-Led Total Sanitation (CLTS)

The study analyzes issues concerning the implementation of the CLTS in the Mion District in the Northern Region of Ghana. It looked at the income level of head of household and various sanitation issues that were raise with regards to the implementation of CLTS.

c) Household monthly income

The income earn by a household is a major factor in determining the social facilities that is provided in the household. The study looked at the income of the household heads per month, which revealed that 97.3 percent of the respondents earn <GHC500 per month while 2.7 percent of the respondents earn between GHC500-1000 per month.

d) Household size of respondents

The study indicates that 23.1 percent of the respondents have household size between 1-5 people, 36.4 percent of the respondents have household size between 6-10 people, 16.4percent of the households also have household size between 11-15 people, and 8.9percent have between 16 - 20 people. Also, 13.8percent of the respondents indicated that the number of people in their households were between 21-25 people, while 1.3 percent of the respondents have household size of over 26 people as shown in figure 6.

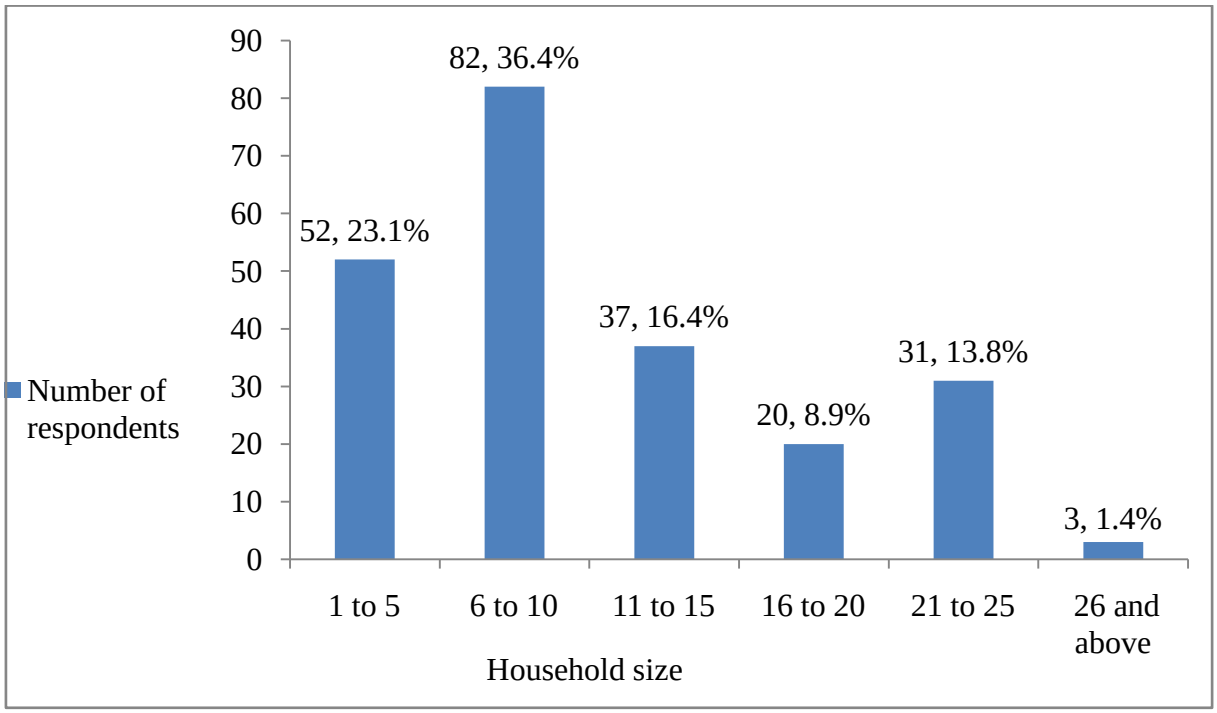

Figure 6: household size, Source: Field Survey, 2020

e) *Household Asset*

Nearly Eleven (11.1%) percent of the respondents own bicycles. Also 6.7 percent of the respondents own radio, while 8.9 percent of the respondents own Television (TV). The study further revealed that 17.8 percent of the respondents own farm animals whiles 26.7 percent of the respondents own farms.

The study showed that 4.4 percent of the respondents own motorbikes while 2.2 percent of the respondents own tricycles. Also 22.2 percent of the respondents own mobile phones(Figure 7).

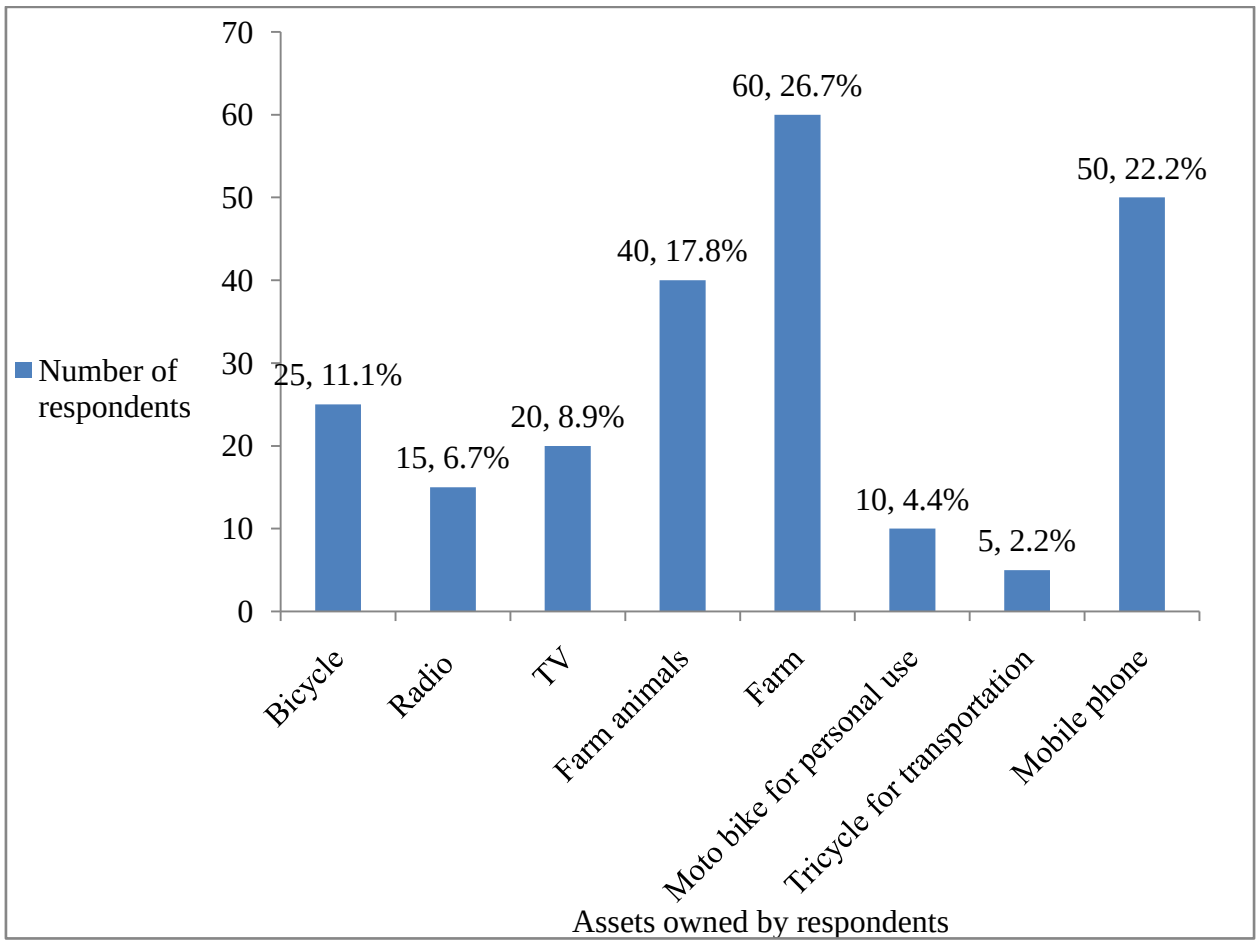

Figure 7: Assets of respondents, Source: Field Survey, 2020

f) Availability of Household Toilet

Also, on the question of households having toilets, the study revealed that as high as 94.1 percent of respondents were having household toilets, while 5.9 percent of the household do not own household toilet. This means that communities have more than the 80% thresh holds of household toilet coverage and were therefore open defecation free. The CLTS verification protocol states that a community can become ODF if 80% households have and use household toilets and the remaining 20% of households do not defecate in the open.

g) Cost of Household Toilet

The minimum amount needed to construct a basic toilet in 2012 ranged from US$35.00 for a basic pit latrine to US$180.00 for a VIP latrine (WASH Cost, 2012) but it is now US$283.33. Cheaper amount in the construction of latrines are at risks of long-term failure such as collapse of the super structure or substructures. If the cost of construction is high, most poor households and vulnerable groups like the aged and the destitute are unable to construct household latrines. The cost of building latrines vary because of variability in the US Dollar to Ghana Cedi rate and the variability in fuel prices in Ghana. Currently one US Dollar is five Ghana Cedis Seventy-nine pese was (1.00 US$=GHS 5.79) and the price of petrol for a litre is six Ghana Cedis, five pese was (GHS 6.05). The combined effect of these variables affects the cost of materials used for the construction of latrines at the households. For example, a bag of cement in the Northern Region is Fifty Ghana Cedis an equivalent of Eight US Dollars, Sixty-four cents (US Dollars 8.64) and a trip of sand is Five Hundred Ghana Cedis (US Dollars 86.36). These materials are important for the substructure. Other factors which are important and whose costs cannot be determined in the construction of a household latrine are cost of labor, building and constructional materials.

The survey on the type of toilet build by the households shows that 74.5 percent of the respondents build the traditional pit latrine, while 25.5 percent of the respondents build the improved pit latrine. This means that majority of the households in the communities build traditional pit latrine toilets in their houses.

h) Reasons for not having toilet in the household

The reasons given for not using toilets vary. The interview indicated that, they did not have money to construct household toilets. Others said they prefer

using the bush while some said they were not comfortable defecating on another person's feces when they are not sick. From the survey, high cost of construction of the toilet was indicated by 21.3 percent of the respondents as the reason why they do not have a toilet in their house Again, 30.7 percent of the respondents attributed the reason why they didn't want to construct toilet as not important for them. A further 14.7 percent of the respondents indicated that lack of technical support is the reason why they do not have toilet facilities in their households. Additionally, 33.3 percent of the respondents indicated that they were waiting for external support as a reason why they do not have toilets in their household as shown in Figure 8.

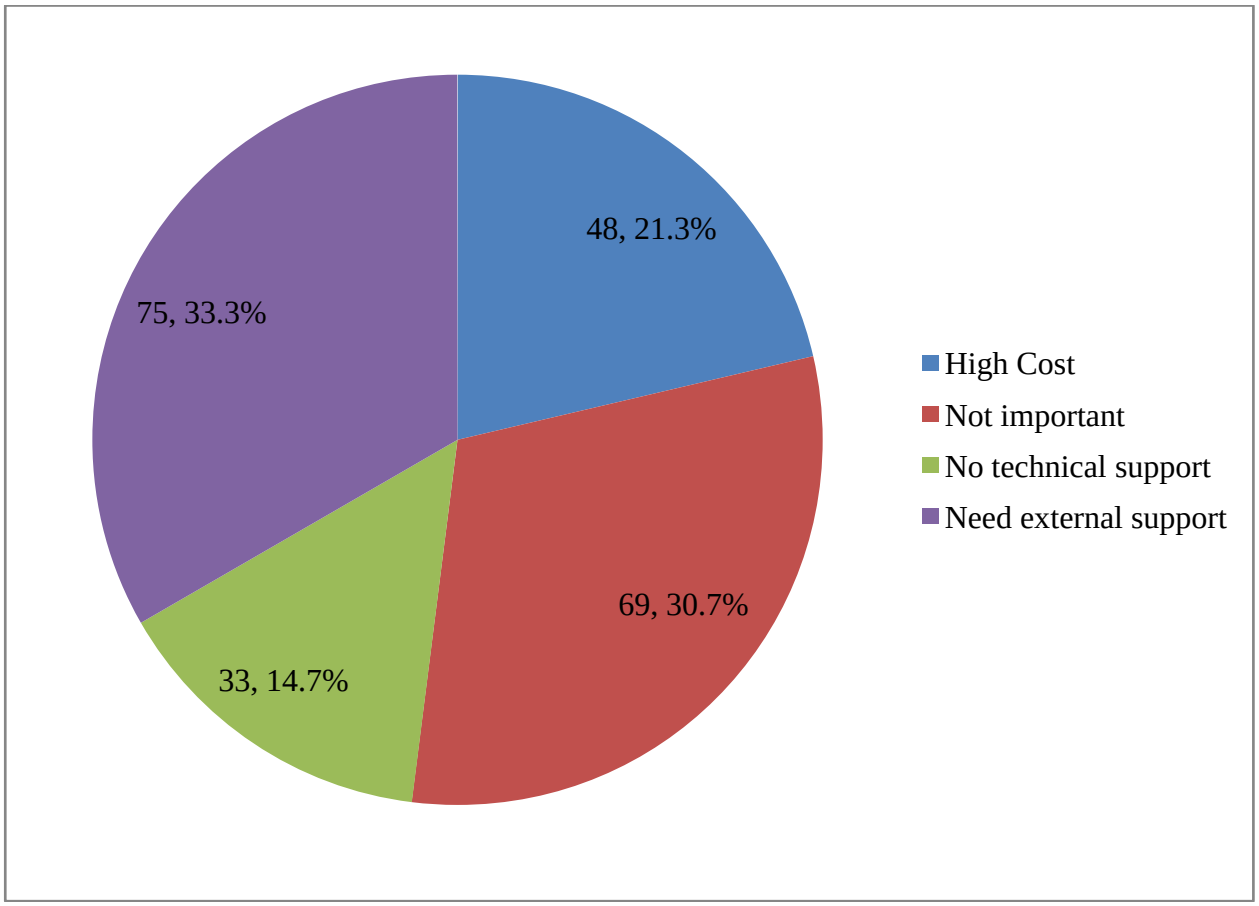

Figure 8: Reasons for not having toilet in the household, Source: Field Survey, 2020

This finding is similar to the finding of Barnard et al., (2013). Their study revealed that 72% of households had toilet which was increased by 10% when compared with control villages in India. According to Barnard et al. (2013), the main reasons for households not using toilet was that they prefer open defecation (29%). Also 20% said the toilets were inconvenient to them because of its smell, 23% said the toilets lack privacy, 17% said their toilets were blocked and 22% of the respondents use their toilets for storage purposes.

The survey looked at the availability of hand washing facilities and it was revealed that 73.4 percent of the respondents have hand washing facility for household members to wash their hands after defecating. The survey revealed that 62.2 percent of the respondents had hand washing facilities with soap for people who use their toilets to wash their hands. This implies that people will be protected from carrying diseases from their toilets to their food or for further transmission to other people in the community.

i) Source of Water for Households

The source of water for household is always a concern in the Mion district. The study showed that, most (31.5%) of respondents depend on dugouts for water, 22.2 percent of the respondents depend on river as a source of water for the household, 26.7 percent of the respondents depend on boreholes as source of water for the household, and 19.6 percent of the respondents depend on well as a source water for their household as shown in figure 7 below.

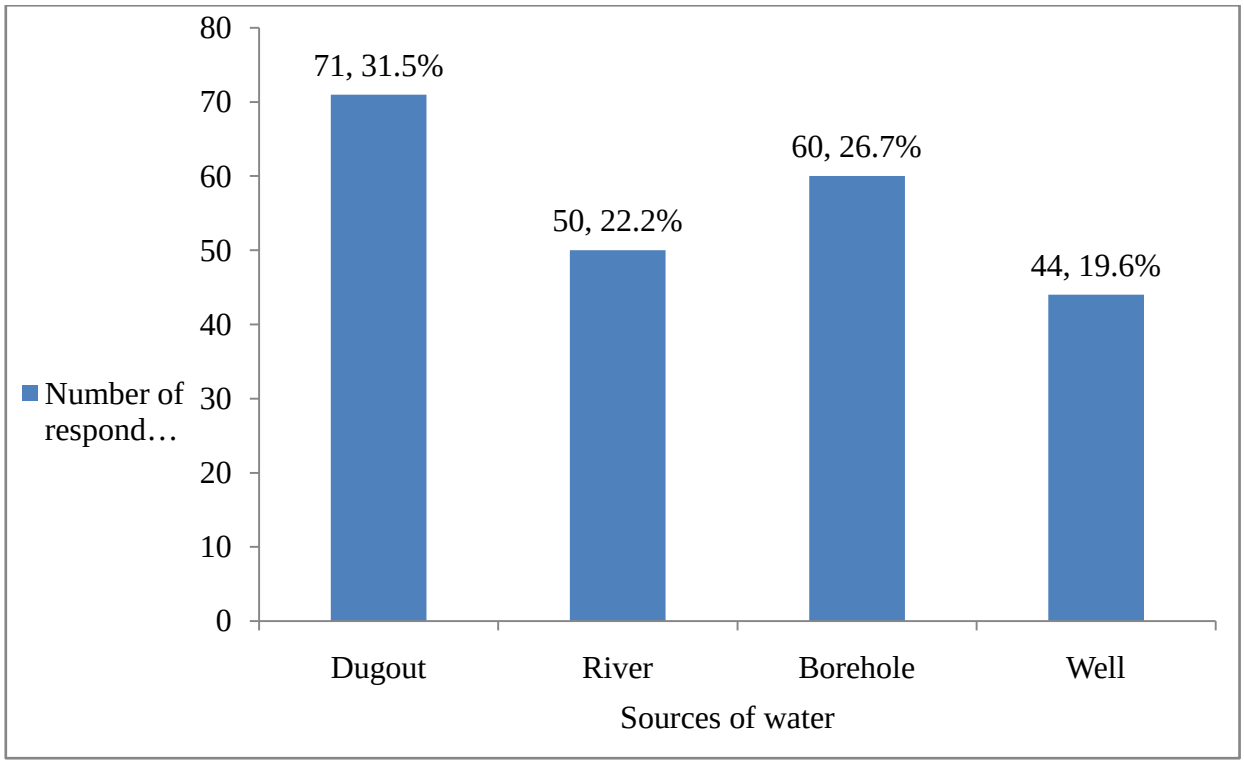

Figure 7: Source of Water for Households. Source; Field survey, 2020

The study showed that, the sources of water in the district are not safe. According to Pickut (2015), clean water is water that is safe enough to drink by humans because it is protected at source and free of mineral and biological pollutants, and so cannot cause harm. However, majority of the respondents depends on river water and boreholes which could be contaminated with pathogenic bacterial and heavy metals due to human activities and mineralization of underlying rocks. Water is a limited resource all over the world and increasing amounts of organic waste threaten water resources quality and availability. Research in the Densu River basin by Karikari and Ansa-Asare (2006), concluded in their study that microbial presence in the river was due to contamination caused by human activities such as intensive agriculture and livestock. Groundwater resource is generally good except for some cases of localized pollution and areas with high levels of iron, fluoride and other minerals (USAID, 2011). This is worsened by climate change; a phenomenon caused by increasing emissions of Carbon dioxide and other greenhouse gases (Nitrous Oxide, Nitric acid, Methane, Chlorofluorocarbons, etc) and subsequently increasing temperatures in the atmosphere (Asumadu-Sarkodie & Owusu, 2016). The impact of climate change in Mion District is felt on water resources with research showing that there is increased evaporation, decreased and highly variable rainfall pattern, and frequent pronounced flood and drought situations (Asumadu-Sarkodie et al., 2015a; Asumadu-Sarkodie et al., 2015b). The impacts of the rising temperature are felt in the dry season (December–March) (Asumadu-Sarkodie et al., 2015b). In Mion District, the felling of trees for firewood, charcoal production farming and development contribute to deforestation.

j) Relationship between socio-demographic characteristics and indicators of open defecation free communities

The research sought to find out whether there was a relationship between household sizes and the communities within the study area. The column percentages show that there was a remarkable difference in the communities in terms of household sizes. Household size between1-5 was likely to be found at Montolo with 26.9% as compared to other communities (Appendix I). A household size of 6-10 and 11-15 were likely to be found at Jibilago with 23.2% and 24.3% respectively. The finding of household size of 11-15 at Jibilago was similar to Bungbali which all had 24.5%. A household size of 16-20 was likely to be found at Nkwanta with 40.0%. In addition, a household size of 21-25 was more likely to be found at Wasambo with 22.6%. Furthermore a household size of over 26 persons was likely to be found at Binagmando with 66.7%. The differences in the percentages show that there was a relationship between the household size and he communities. A Pearson Chi-square of p=0.00 (Table 3) indicated that there was a strong relationship between household size and the communities.

Table 3: Pearson Chi-square between household size and open defecation free communities

	Value	d	Asymp. Sig. (2-sided)
Pearson Chi-Square	224.610[a]	65	.000
Likelihood Ratio	230.239	65	.000
Linear-by-Linear Association	.466	1	.495
N of Valid Cases	225		

a. 72 cells (85.7%) have expected count less than 5. The minimum expected count is .07.

The findings agreed with Osumanu et al., (2016) that household size was a determinant of open defecation in the Wa Municipality of the Upper West Region of Ghana. This is because when the household size is large, not all household members will have the patience to wait especially during the early hours of the day when they have to free themselves and get to work. Again large household size put pressure on the household toilets leading to a reduction in their life span. Next, the study investigated the relationship between the ages of respondents and the communities of residents. Respondents who were less than 26-years were most likely to be found in Wasambo with 26.5% while those between 26 and 30 were found at Binagmando with 29.7% (Appendix II). Respondents who were between 31- 35 years and 36-40 years were mostly found at Namoni with 38.5% and 42.9% respectively. The ages of those with 41-45 years were mostly found at Nayinku with 38.9% and those within 46-50 years were mostly found at Bungbali with 37.5%. Respondents aged between51-55 years were largely found at Kubbagmado with 29.4%. Respondents aged between 55 and 60-yeas were mostly found at Nayinku with21.4% and those above 60 were largely found at Motondo with 25.0%. The variation in the percentages shows that there was a relationship between the ages of respondents and the communities they reside. The Chi-square analysis suggest that there was a strong relationship between the ages of respondents and the communities they reside at a Pearson Chi-square of p=0.00 (Table 4).

Table 4: Pearson Chi-square between ages of respondents and open defecation free indicators in communities

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	385.739[a]	104	.000
Likelihood Ratio	372.038	104	.000
Linear-by-Linear Association	.040	1	.841
N of Valid Cases	225		

a. 125 cells (99.2%) have expected count less than 5. The minimum expected count is .31.

The findings indicate that age was a determinant of open defecation in the Mion District. This is because household heads that are old are not financially sound to construct household toilets.

Furthermore, the study investigated the relationship between sex and the communities of residents. The percentages for male and female were the highest at Motondo with 14.7% and 14.5% respectively (Appendix III). However, a Pearson Chi-square of p>0.00 (Table 5) shows that, there was no relationship between sex and open defecation free communities.

Table 5: Pearson Chi-square between sex of respondents and open defecation free indicators in communities

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3.352[a]	13	.996
Likelihood Ratio	3.455	13	.996
Linear-by-Linear Associatior	.212	1	.645
N of Valid Cases	225		

a. 13 cells (46.4%) have expected count less than 5. The minimum expected count is 1.22.

The findings suggest that open defecation is not gender base. Both male and female engage in open defecation.

In addition, the study investigated the relationship between religion and open defecation free communitie. Majority of the respondents were Muslims (30.0%) at Jibilago and majority of Christians (23.1%) at Motondo. (Appendix IV) The percentage of Traditional believers at Jibilago was similar to those at Motondo with12.8%. The differences in percentage of the religious beliefs of the residents in the communities show that there was a relationship between religion and the study communities. The study demonstrated that there was a relationship between religion and the communities of residents with a Pearson Chi-square of p=0.0 (Table 6).

Table 6: Pearson Chi-square between religion of respondents and open defecation free indicators in communities

	Value	Asymp. Sig. (2-sided)
Pearson Chi-Square	77.687[a]	.000
Likelihood Ratio	87.663	.000
Linear-by-Linear Association	12.106	.001
N of Valid Cases	225	

a. 21 cells (50.0%) have expected count less than 5. The minimum expected count is .89.

The study suggests that open defecation and religion are highly related. This finding agreed with Osumanu et al., (2016) that religion and belief systems determine open defecation. For example, among Moslems male and female do not share a common toilet. This means every household must have a minimum of two toilets in a Muslim community.

The study showed that 94.5% of the respondents were engaged in farming. Other sectors of the economy of Mion District were the service and the sales sector. There was no relationship between the occupation of respondents and their community of residents as far as sanitation was concerned (Appendix V). The Pearson Chi-sqaure results indicated a probability $p>0.05$ (Table 7) and so the null hypothesis that there was no relationship between the occupation of respondents and the community they reside was accepted. The result suggested that sanitation related activity is not based on one's occupation.

Table 7: Pearson Chi-square between occupation of respondents and open defecation free communities

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	17.597[a]	26	.890
Likelihood Ratio	14.165	26	.971
Linear-by-Linear Association	1.475	1	.225
N of Valid Cases	225		

a. 29 cells (69.0%) have expected count less than 5. The minimum expected count is .04.

Open defecation is not a determinant on the type or form of livelihood or occupation. However, Osumanu et al., (2016) have observed thatthose who are employed are able to mobilize money to construct household toilets.Osumanu and Kosoe (2013) argued that financial constraints present inhibits house owners from the provision of household toilets, and fees charged by public toilet operators.

Furthermore the study looked at the presence of water for washing hands at the household toilets. Most people (13.8%) at Motondo and Jibilago had water for washing their hands. Also 16.2% of the residents of Motondo had no water for hand washing at their toilets. The differences in percentages show that there was a relationship between water presence at household toilets and the communities (Appendix IX). The Pearson Chi-square shows a $p<0.05$ (Table 11) and indicate a relationship.

Table 11: Pearson Chi-square between water presence at latrines and open defecation free communities

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	26.010[a]	13	.017
Likelihood Ratio	28.723	13	.007
Linear-by-Linear Association	.393	1	.531
N of Valid Cases	225		

a. 7 cells (25.0%) have expected count less than 5. The minimum expected count is 1.78.

The result is in sync with Osuman et al., (2016) that toilet ownership and the presence of water at the toilets were a determinant of open defecation. Toilets which have water provide opportunity for users to wash their hands after defecation. Water presence at toilet facilities is therefore a motivation for people to use the toilets.

In addition Jibilago and Motondo both had the highest percentage (12.3%) of toilets with soap and Motondo had most (19.7%) of household toilets without soap. The cross tabulation showed there was a relationship (Appendix X). However, The Pearson Chi-square indicates $p=0.052$ (Table 12) and hence there was no relationship between household toilets with soap and the communities of residents.

Table 12: Pearson Chi-square between toilets with soap and open defecation free communities

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	22.225[a]	13	.052
Likelihood Ratio	21.579	13	.062
Linear-by-Linear Association	1.862	1	.172
N of Valid Cases	225		

a. 9 cells (32.1%) have expected count less than 5. The minimum expected count is 1.58.

The presence of soap according to the study did not matter so much to the users of toilets. As long as there was water to wash their hands after defecation they were content with that. As a result of nonuse of soap after using the toilet, 200,000 children under the age of five die from diarrhoea annually in Sub-Saharan Africa, while the numbers dying from cholera within the region are similarly high because of poor sanitation, hygiene practices, and unsafe water supplies (WHO, 2014).

The sources of water in the communities were stream, boreholes and dugouts. It was indicated that most people (18.4%) of households in Motondo depends on stream water, 17.9% of households in Jibilago depends on boreholes and the percentage of those who depends on dugouts at Jibilago and Motondo were similar (12.7%) (Appendiix XI). This show that while most people in Jibilago depends on boreholes and dugouts most households in Motondo depended on stream and dugouts for water. The Pearson Chi-square $p>0.05$ (Table 13) showed that that there was no relationship between sources of water and the communities of residents.

Table 13: Pearson Chi-square between sources of water soap and open defecation free communities

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	20.787[a]	26	.753
Likelihood Ratio	21.617	26	.709
Linear-by-Linear Association	4.010	1	.045
N of Valid Cases	225		

a. 21 cells (50.0%) have expected count less than 5. The minimum expected count is 1.49.

The source of water was not a determinant of open defecation and so there was no relation. Any water could be used to wash hands after defecation.

k) Sustaining CLTS in the Mion District

According to Water Aid(2008) identified negative attitudes involving carelessness, disrespect for traditional authority, and community norms as determinants of open defecation. It is therefore important that bylaws and enforcements are put in place in all communities to check open defecation. Also, Jenkins and Scott [11], identified behavioural patterns such as preference, intention, and choice as the determinants of open defecation in poor communities. Continuous education and sensitization are important to ensure that communities that have attained open defecation free status do not relapse into open defecation status.

Building local capacity and engaging local leaders has been reported as an enabling factor for other WaSH behaviors, such as sustainability of household-water treatment and storage (HWTS) practices (Ojomo et al., 2015). The local leaders and the youth are trained by the district environmental health officers. Trained local actors influence the behavior of their peers with diffusion theory, in which, among other factors, peer-communication and opinion leaders influence the adoption of a new behavior (Rogers, 2003).

Water management in Ghana is regulated by the Water Resources Commission (WRC). The WRC of Ghana was established by an Act of Parliament (Act 522 of 1996) to regulate and mange Ghana's water resources and co-ordinate government policies in relation to them. Act 522 of 1996 has vested ownership and control of all water sources in the President on behalf of the people (WRC Ghana, 2015). Ensuring adequate quality supply of water availability for human use is essential(Oki & Kanae, 2006). Water management is divided into three classifications: managing the resource, managing water services, and ensuring a balance between supply and demand (United Nations, 2015).

Rainwater harvesting is common in the Mion District and has a great potential to increase water availability in certain localized areas (WRC Ghana, 2015). According to Anokye and Gupta (2012), Integrated Water Resources Management (IWRM) is an integrated approach that ensures public participation, the role of gender and recognizing the economic value of water. IWRM also advocate awareness creation of the importance of water among policy-makers and the public (Lonergan & Brooks, 1994) and involves users of water in the planning and implementation of water projects. IWRM ensures that, the management, operation and maintenance of water resources are placed in the hands of community members (Anokye & Gupta, 2012; WRC Ghana, 2015).

IV. Conclusions and Recommendations

Achieving total sanitation (100.0% open defecation free) status in the Mion District will be a mirage since the aged cannot construct household toilets and household toilets that were constructed since 2017 are collapsing and needs replacement. The cost of constructing new toilets is rising and not all can afford to own household toilet. Some households who are willing to own toilets complained of poverty and lack of technical support. Soap for washing their hands after defecation is almost absent because they do not see the importance of washing hands with soap. A larger household size that depends on only one toilet is likely to practice open defecation because there are no public toilets. The aged, children and the sick are most likely to practice open defecation if there are no household toilets and they cannot visit their neighbors' homes because they are weak and cannot walk. Religion and the belief systems are keyto open defecation because the mallams and the pastors take part in advocacies and education on sanitation and open defecation. The district depends on surface and ground water sources which are not treated and often dry up during the dry season. However, the source of water for the washing of hands and maintaining good sanitation was important in sanitation and hygiene management. The study recommends that, materials needed for toilet construction be subsidized even though this will defeat the purpose of CLTS. Above all, the sick, the aged and the poor must be supported by community members, the government and benevolent organizations to enable them own household toilets. Continuous education and sensitization on sustaining open defecation free (ODF) status. Collaboration between governmental, nongovernmental agencies and traditional leaders is important to achieve total sanitation in the Mion District.

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Appendices

Appendix I: Relationship between household size and open defecation free communities

			Household size						Total
			1-5	6-10	11-15	16-20	21-25	26 and above	
Community	Jilma	Count	6_a	$5_{a,b}$	0_b	$0_{a,b}$	0_b	$0_{a,b}$	11
		% within HHsize	11.5%	6.1%	0.0%	0.0%	0.0%	0.0%	4.9%
	Jibilago	Count	0_a	19_b	9_b	$1_{a,b}$	0_a	$0_{a,b}$	29
		% within HHsize	0.0%	**23.2%**	**24.3%**	5.0%	0.0%	0.0%	12.9%
	Nkwanta	Count	0_a	7_b	$0_{a,b}$	8_c	$0_{a,b}$	$0_{a,b,c}$	15
		% within HHsize	0.0%	8.5%	0.0%	**40.0%**	0.0%	0.0%	6.7%
	Kpumale	Count	8_a	2_b	0_b	$1_{a,b}$	0_b	$0_{a,b}$	11
		% within HHsize	15.4%	2.4%	0.0%	5.0%	0.0%	0.0%	4.9%
	Wasambo	Count	0_a	8_b	0_a	3_b	7_b	$0_{a,b}$	18
		% within HHsize	0.0%	9.8%	0.0%	15.0%	**22.6%**	0.0%	8.0%
	Macheliyili	Count	4_a	1_a	0_a	0_a	0_a	0_a	5
		% within HHsize	7.7%	1.2%	0.0%	0.0%	0.0%	0.0%	2.2%
	Kubbagmado	Count	5_a	5_a	2_a	0_a	4_a	0_a	16
		% within HHsize	9.6%	6.1%	5.4%	0.0%	12.9%	0.0%	7.1%
	Frigmagdo	Count	$3_{a,b}$	$6_{a,b}$	$2_{a,b}$	0_b	6_a	$0_{a,b}$	17
		% within HHsize	5.8%	7.3%	5.4%	0.0%	19.4%	0.0%	7.6%
	Tuya	Count	0_a	$4_{a,b}$	$0_{a,b}$	$0_{a,b}$	3_b	$0_{a,b}$	7
		% within HHsize	0.0%	4.9%	0.0%	0.0%	9.7%	0.0%	3.1%
	Namoni	Count	0_a	$12_{b,c}$	$1_{a,c}$	$0_{a,c}$	6_b	1_b	20
		% within HHsize	0.0%	14.6%	2.7%	0.0%	19.4%	33.3%	8.9%
	Binagmando	Count	4_a	4_a	3_a	0_a	2_a	2_b	15
		% within HHsize	7.7%	4.9%	8.1%	0.0%	6.5%	**66.7%**	6.7%
	Motondo	Count	14_a	4_b	$6_{a,c}$	7_a	$2_{b,c}$	$0_{a,b,c}$	33
		% within HHsize	**26.9%**	4.9%	16.2%	35.0%	6.5%	0.0%	14.7%
	Nanyinku	Count	6_a	0_b	5_a	$0_{a,b}$	$1_{a,b}$	$0_{a,b}$	12
		% within HHsize	11.5%	0.0%	13.5%	0.0%	3.2%	0.0%	5.3%
	Bungbali	Count	2_a	5_a	9_b	0_a	0_a	$0_{a,b}$	16
		% within HHsize	3.8%	6.1%	**24.3%**	0.0%	0.0%	0.0%	7.1%
Total		Count	52	82	37	20	31	3	225
		% within HHsize	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Each subscript letter denotes a subset of HHsize categories whose column proportions do not differ significantly from each other at the .05 level.

Appendix II: Relationship between age groups and open defecation free communities

			Age group								Total
			Less 26	26-30	31-35	36-40	41-45	46-50	51-55	56-60 61 and above	
Com-munity	Jilma	Count	5_a	$2_{a,b,c}$	$3_{a,c}$	$0_{a,b,c}$	$0_{a,b,c}$	$0_{b,c}$	$0_{a,b,c}$	$1_{a,b,c}$ 0_b	11
		% within AgeGp	14.7%	5.4%	11.5%	0.0%	0.0%	0.0%	0.0%	4.3% 0.0%	4.9%
	Jibilago	Count	$4_{a,b}$	$5_{a,b}$	0_b	3_a	3_a	4_a	3_a	$3_{a,b}$ $4_{a,b}$	29
		% within AgeGp	11.8%	13.5%	0.0%	21.4%	16.7%	16.7%	17.6%	13.0% 12.5%	12.9%
	Nkwanta	Count	0_a	$2_{a,b,c}$	$2_{a,b,c}$	3_c	3_c	$3_{b,c}$	$2_{b,c}$	$0_{a,b}$ 0_a	15
		% within AgeGp	0.0%	5.4%	7.7%	21.4%	16.7%	12.5%	11.8%	0.0% 0.0%	6.7%
	Kpumale	Count	$3_{a,b}$	0_b	0_b	$0_{a,b}$	$0_{a,b}$	0_b	$1_{a,b}$	$2_{a,b}$ 5_a	11
		% within AgeGp	8.8%	0.0%	0.0%	0.0%	0.0%	0.0%	5.9%	8.7% 15.6%	4.9%

Wasambo	Count	9_{a}	$3_{b, c}$	0_{c}	$0_{b, c}$	$0_{b, c}$	0_{c}	$0_{b, c}$	0_{c}	$6_{a, b}$	18
	% within AgeGp	**26.5%**	8.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	18.8%	8.0%
Macheliyili	Count	0_{a}	4_{b}	$1_{a, b}$	$0_{a, b}$	$0_{a, b}$	$0_{a, b}$	$0_{a, b}$	$0_{a, b}$	$0_{a, b}$	5
	% within AgeGp	0.0%	10.8%	3.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.2%
Kubbagmado	Count	0_{a}	0_{a}	$2_{a, b, c, d, e, f}$	$0_{a, e, f}$	$0_{a, d, f}$	$4_{b, c, d, e, f}$	5_{c}	$4_{b, c, d, e, f}$	$1_{a, b, d, e, f}$	16
	% within AgeGp	0.0%	0.0%	7.7%	0.0%	0.0%	16.7%	**29.4%**	17.4%	3.1%	7.1%
Frigmagdo	Count	$3_{a, b, c, d, e}$	$0_{d, e}$	$0_{c, e}$	$0_{a, b, c, d, e}$	3_{b}	4_{b}	3_{b}	4_{b}	$0_{a, c, d, e}$	17
	% within AgeGp	8.8%	0.0%	0.0%	0.0%	16.7%	16.7%	17.6%	17.4%	0.0%	7.6%
Tuya	Count	0_{a}	0_{a}	$0_{a, b}$	$0_{a, b, c}$	$0_{a, b, c}$	$0_{a, b}$	3_{c}	$0_{a, b}$	$4_{b, c}$	7
	% within AgeGp	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	17.6%	0.0%	12.5%	3.1%
Namoni	Count	0_{a}	0_{a}	10_{b}	6_{b}	$0_{a, c}$	$0_{a, c}$	$0_{a, c}$	$0_{a, c}$	4_{c}	20
	% within AgeGp	0.0%	0.0%	**38.5%**	**42.9%**	0.0%	0.0%	0.0%	0.0%	12.5%	8.9%
Binagmandoo	Count	0_{a}	11_{b}	$4_{b, c}$	$0_{a, c}$	$0_{a, c}$	0_{a}	$0_{a, c}$	0_{a}	0_{a}	15
	% within AgeGp	0.0%	**29.7%**	15.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	6.7%
Motondo	Count	$5_{a, b, c}$	10_{c}	$4_{a, b, c}$	$2_{a, b, c, d}$	$0_{b, d}$	0_{d}	$0_{b, d}$	$4_{a, b, c}$	$8_{a, c}$	33
	% within AgeGp	14.7%	27.0%	15.4%	14.3%	0.0%	0.0%	0.0%	17.4%	**25.0%**	14.7%
Nanyinku	Count	0_{a}	0_{a}	0_{a}	$0_{a, b}$	7_{c}	0_{a}	0_{a}	$5_{b, c}$	0_{a}	12
	% within AgeGp	0.0%	0.0%	0.0%	0.0%	**38.9%**	0.0%	0.0%	**21.7%**	0.0%	5.3%
Bungbali	Count	5_{a}	0_{b}	$0_{b, c}$	$0_{a, b, c}$	$2_{a, c, d}$	9_{d}	$0_{a, b, c}$	$0_{a, b, c}$	$0_{b, c}$	16
	% within AgeGp	14.7%	0.0%	0.0%	0.0%	11.1%	**37.5%**	0.0%	0.0%	0.0%	7.1%
Total	Count	34	37	26	14	18	24	17	23	32	225
	% within AgeGp	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Each subscript letter denotes a subset of AgeGp categories whose column proportions do not differ significantly from each other at the .05 level.

Appendix III: Relationship between sex of respondents and open defecation free communities

			Sex of respondents		Total
			Male	Female	
Community	Jilma	Count	7_{a}	4_{a}	11
		% within Sex	4.1%	7.3%	4.9%
	Jibilago	Count	23_{a}	6_{a}	29
		% within Sex	13.5%	10.9%	12.9%
	Nkwanta	Count	12_{a}	3_{a}	15
		% within Sex	7.1%	5.5%	6.7%
	Kpumale	Count	8_{a}	3_{a}	11
		% within Sex	4.7%	5.5%	4.9%
	Wasambo	Count	14_{a}	4_{a}	18
		% within Sex	8.2%	7.3%	8.0%
	Macheliyili	Count	4_{a}	1_{a}	5
		% within Sex	2.4%	1.8%	2.2%
	Kubbagmado	Count	14_{a}	2_{a}	16
		% within Sex	8.2%	3.6%	7.1%
	Frigmagdo	Count	12_{a}	5_{a}	17
		% within Sex	7.1%	9.1%	7.6%
	Tuya	Count	5_{a}	2_{a}	7
		% within Sex	2.9%	3.6%	3.1%
	Namoni	Count	15_{a}	5_{a}	20
		% within Sex	8.8%	9.1%	8.9%

	Binagmando	Count	11_a	4_a	15
		% within Sex	6.5%	7.3%	6.7%
	Motondo	Count	25_a	8_a	33
		% within Sex	**14.7%**	**14.5%**	14.7%
	Nanyinku	Count	9_a	3_a	12
		% within Sex	5.3%	5.5%	5.3%
	Bungbali	Count	11_a	5_a	16
		% within Sex	6.5%	9.1%	7.1%
Total		Count	170	55	225
		% within Sex	100.0%	100.0%	100.0%

Each subscript letter denotes a subset of Sex categories whose column proportions do not differ significantly from each other at the .05 level.

Appendix IV: Relationship between religion of respondents and open defecation free communities

			Religion			Total
			Muslim	Christi	African Traditional Religion	
Community	Jilma	Count	5_a	1_b	$5_{a,b}$	11
		% within Religion	12.5%	1.1%	5.3%	4.9%
	Jibilago	Count	12_a	5_b	12_b	29
		% within Religion	**30.0%**	5.5%	**12.8%**	12.9%
	Nkwanta	Count	8_a	3_b	4_b	15
		% within Religion	20.0%	3.3%	4.3%	6.7%
	Kpumale	Count	3_a	3_a	5_a	11
		% within Religion	7.5%	3.3%	5.3%	4.9%
	Wasambo	Count	6_a	2_b	10_a	18
		% within Religion	15.0%	2.2%	10.6%	8.0%
	Macheliyili	Count	2_a	1_a	2_a	5
		% within Religion	5.0%	1.1%	2.1%	2.2%
	Kubbagmado	Count	2_a	8_a	6_a	16
		% within Religion	5.0%	8.8%	6.4%	7.1%
	Frigmagdo	Count	1_a	6_a	10_a	17
		% within Religion	2.5%	6.6%	10.6%	7.6%
	Tuya	Count	0_a	4_a	3_a	7
		% within Religion	0.0%	4.4%	3.2%	3.1%
	Namoni	Count	1_a	14_b	5_a	20
		% within Religion	2.5%	15.4%	5.3%	8.9%
	Binagmando	Count	0_a	8_a	7_a	15
		% within Religion	0.0%	8.8%	7.4%	6.7%
	Motondo	Count	0_a	21_b	12_b	33
		% within Religion	0.0%	**23.1%**	**12.8%**	14.7%
	Nanyinku	Count	0_a	5_a	7_a	12
		% within Religion	0.0%	5.5%	7.4%	5.3%
	Bungbali	Count	0_a	10_b	$6_{a,b}$	16
		% within Religion	0.0%	11.0%	6.4%	7.1%
Total		Count	40	91	94	225
		% within Religion	100.0%	100.0%	100.0%	100.0%

Each subscript letter denotes a subset of Religion categories whose column proportions do not differ significantly from each other at the .05 level.

Appendix V: Relationship between occupation of respondents and open defecation free communities

			Occupation			Total
			Farming	Trading	Government	
Community	Jilma	Count	10_a	1_a	0_a	11
		% within Occupation	4.7%	10.0%	0.0%	4.9%
	Jibilago	Count	28_a	1_a	0_a	29
		% within Occupation	13.1%	10.0%	0.0%	12.9%
	Nkwanta	Count	15_a	0_a	0_a	15

	% within Occupation	7.0%	0.0%	0.0%	6.7%
Kpumale	Count	10_a	1_a	0_a	11
	% within Occupation	4.7%	10.0%	0.0%	4.9%
Wasambo	Count	18_a	0_a	0_a	18
	% within Occupation	8.5%	0.0%	0.0%	8.0%
Macheliyili	Count	5_a	0_a	0_a	5
	% within Occupation	2.3%	0.0%	0.0%	2.2%
Kubbagmado	Count	15_a	1_a	0_a	16
	% within Occupation	7.0%	10.0%	0.0%	7.1%
Frigmagdo	Count	16_a	1_a	0_a	17
	% within Occupation	7.5%	10.0%	0.0%	7.6%
Tuya	Count	7_a	0_a	0_a	7
	% within Occupation	3.3%	0.0%	0.0%	3.1%
Namoni	Count	18_a	$1_{a, b}$	1_b	20
	% within Occupation	8.5%	10.0%	50.0%	8.9%
Binagmando	Count	14_a	1_a	0_a	15
	% within Occupation	6.6%	10.0%	0.0%	6.7%
Motondo	Count	32_a	1_a	0_a	33
	% within Occupation	15.0%	10.0%	0.0%	14.7%
Nanyinku	Count	10_a	$1_{a, b}$	1_b	12
	% within Occupation	4.7%	10.0%	50.0%	5.3%
Bungbali	Count	15_a	1_a	0_a	16
	% within Occupation	7.0%	10.0%	0.0%	7.1%
Total	Count	213	10	2	225
	% within Occupation	100.0%	100.0%	100.0%	100.0%

Each subscript letter denotes a subset of Occupation categories whose column proportions do not differ significantly from each other at the .05 level.

Appendix VI: Relationship between the management of bath water of respondents and open defecation free communities

			Management of bath water		Total
			Yes	No	
Community	Jilma	Count	4_a	7_a	11
		% within MgtBathwater	6.9%	4.2%	4.9%
	Jibilago	Count	9_a	20_a	29
		% within MgtBathwater	15.5%	12.0%	12.9%
	Nkwanta	Count	5_a	10_a	15
		% within MgtBathwater	8.6%	6.0%	6.7%
	Kpumale	Count	2_a	9_a	11
		% within MgtBathwater	3.4%	5.4%	4.9%
	Wasambo	Count	4_a	14_a	18
		% within MgtBathwater	6.9%	8.4%	8.0%
	Macheliyili	Count	1_a	4_a	5
		% within MgtBathwater	1.7%	2.4%	2.2%
	Kubbagmado	Count	5_a	11_a	16
		% within MgtBathwater	8.6%	6.6%	7.1%
	Frigmagdo	Count	4_a	13_a	17
		% within MgtBathwater	6.9%	7.8%	7.6%
	Tuya	Count	1_a	6_a	7
		% within MgtBathwater	1.7%	3.6%	3.1%
	Namoni	Count	6_a	14_a	20
		% within MgtBathwater	10.3%	8.4%	8.9%
	Binagmando	Count	3_a	12_a	15
		% within MgtBathwater	5.2%	7.2%	6.7%
	Motondo	Count	7_a	26_a	33
		% within MgtBathwater	12.1%	15.6%	14.7%
	Nanyinku	Count	3_a	9_a	12
		% within MgtBathwater	5.2%	5.4%	5.3%
		Count	4_a	12_a	16

Bungbali	% within MgtBathwater	6.9%	7.2%	7.1%
Total	Count	58	167	225
	% within MgtBathwater	100.0%	100.0%	100.0%

Each subscript letter denotes a subset of Mgt Bathwater categories whose column proportions do not differ significantly from each other at the .05 level.

Appendix VII: Relationship between Solid waste management and open defecation free communities

			Solid waste management		Total
			Bury	Burn	
Community	Jilma	Count	7_a	4_a	11
		% within solidwastemgt	3.9%	8.5%	4.9%
	Jibilago	Count	23_a	6_a	29
		% within solidwastemgt	12.9%	12.8%	12.9%
	Nkwanta	Count	13_a	2_a	15
		% within solidwastemgt	7.3%	4.3%	6.7%
	Kpumale	Count	8_a	3_a	11
		% within solidwastemgt	4.5%	6.4%	4.9%
	Wasambo	Count	15_a	3_a	18
		% within solidwastemgt	8.4%	6.4%	8.0%
	Macheliyili	Count	5_a	0_a	5
		% within solidwastemgt	2.8%	0.0%	2.2%
	Kubbagmado	Count	11_a	5_a	16
		% within solidwastemgt	6.2%	10.6%	7.1%
	Frigmagdo	Count	14_a	3_a	17
		% within solidwastemgt	7.9%	6.4%	7.6%
	Tuya	Count	5_a	2_a	7
		% within solidwastemgt	2.8%	4.3%	3.1%
	Namoni	Count	16_a	4_a	20
		% within solidwastemgt	9.0%	8.5%	8.9%
	Binagmando	Count	12_a	3_a	15
		% within solidwastemgt	6.7%	6.4%	6.7%
	Motondo	Count	27_a	6_a	33
		% within solidwastemgt	15.2%	12.8%	14.7%
	Nanyinku	Count	10_a	2_a	12
		% within solidwastemgt	5.6%	4.3%	5.3%
	Bungbali	Count	12_a	4_a	16
		% within solidwastemgt	6.7%	8.5%	7.1%
Total		Count	178	47	225
		% within solidwastemgt	100.0%	100.0%	100.0%

Each subscript letter denotes a subset of solid waste mgt categories whose column proportions do not differ significantly from each other at the .05 level.

Appendix VIII: Relationship between latrine cover and open defecation free communities

			Latrine cover		Total
			Yes	No	
Community	Jilma	Count	8_a	3_a	11
		% within LatrineCover	5.1%	4.4%	4.9%
	Jibilago	Count	24_a	5_a	29
		% within LatrineCover	15.3%	7.4%	12.9%
	Nkwanta	Count	12_a	3_a	15
		% within LatrineCover	7.6%	4.4%	6.7%
	Kpumale	Count	7_a	4_a	11
		% within LatrineCover	4.5%	5.9%	4.9%
	Wasambo	Count	14_a	4_a	18
		% within LatrineCover	8.9%	5.9%	8.0%
	Macheliyili	Count	4_a	1_a	5
		% within LatrineCover	2.5%	1.5%	2.2%

Kubbagmado	Count	7_a	9_b	16
	% within LatrineCover	4.5%	13.2%	7.1%
Frigmagdo	Count	11_a	6_a	17
	% within LatrineCover	7.0%	8.8%	7.6%
Tuya	Count	5_a	2_a	7
	% within LatrineCover	3.2%	2.9%	3.1%
Namoni	Count	15_a	5_a	20
	% within LatrineCover	9.6%	7.4%	8.9%
Binagmando	Count	9_a	6_a	15
	% within LatrineCover	5.7%	8.8%	6.7%
Motondo	Count	20_a	13_a	33
	% within LatrineCover	12.7%	19.1%	14.7%
Nanyinku	Count	9_a	3_a	12
	% within LatrineCover	5.7%	4.4%	5.3%
Bungbali	Count	12_a	4_a	16
	% within LatrineCover	7.6%	5.9%	7.1%
Total	Count	157	68	225
	% within LatrineCover	100.0%	100.0%	100.0%

Each subscript letter denotes a subset of Latrine Cover categories whose column proportions do not differ significantly from each other at the .05 level.

Appendix IX: Relationship between water presence at toilets and open defecation free communities

			Water presence at toilet		Total
			Yes	No	
Community	Jilma	Count	8_a	3_a	11
		% within WaterPresence	5.5%	3.8%	4.9%
	Jibilago	Count	20_a	9_a	29
		% within WaterPresence	13.8%	11.2%	12.9%
	Nkwanta	Count	10_a	5_a	15
		% within WaterPresence	6.9%	6.2%	6.7%
	Kpumale	Count	10_a	1_a	11
		% within WaterPresence	6.9%	1.2%	4.9%
	Wasambo	Count	8_a	10_a	18
		% within WaterPresence	5.5%	12.5%	8.0%
	Macheliyili	Count	4_a	1_a	5
		% within WaterPresence	2.8%	1.2%	2.2%
	Kubbagmado	Count	10_a	6_a	16
		% within WaterPresence	6.9%	7.5%	7.1%
	Frigmagdo	Count	14_a	3_a	17
		% within WaterPresence	9.7%	3.8%	7.6%
	Tuya	Count	0_a	7_b	7
		% within WaterPresence	0.0%	8.8%	3.1%
	Namoni	Count	14_a	6_a	20
		% within WaterPresence	9.7%	7.5%	8.9%
	Binagmando	Count	7_a	8_a	15
		% within WaterPresence	4.8%	10.0%	6.7%
	Motondo	Count	20_a	13_a	33
		% within WaterPresence	13.8%	16.2%	14.7%
	Nanyinku	Count	9_a	3_a	12
		% within WaterPresence	6.2%	3.8%	5.3%
	Bungbali	Count	11_a	5_a	16
		% within WaterPresence	7.6%	6.2%	7.1%
Total		Count	145	80	225
		% within WaterPresence	100.0%	100.0%	100.0%

Each subscript letter denotes a subset of Water Presence categories whose column proportions do not differ significantly from each other at the .05 level.

Appendix X: Relationship between the presence of soap at toilets and open defecation free communities

			Soap presence at toilet		Total
			Yes	No	
Community	Jilma	Count	8_a	3_a	11
		% within SoapPresence	5.2%	4.2%	4.9%
	Jibilago	Count	19_a	10_a	29
		% within SoapPresence	**12.3%**	14.1%	12.9%
	Nkwanta	Count	10_a	5_a	15
		% within SoapPresence	6.5%	7.0%	6.7%
	Kpumale	Count	8_a	3_a	11
		% within SoapPresence	5.2%	4.2%	4.9%
	Wasambo	Count	5_a	13_b	18
		% within SoapPresence	3.2%	18.3%	8.0%
	Macheliyili	Count	4_a	1_a	5
		% within SoapPresence	2.6%	1.4%	2.2%
	Kubbagmado	Count	12_a	4_a	16
		% within SoapPresence	7.8%	5.6%	7.1%
	Frigmagdo	Count	13_a	4_a	17
		% within SoapPresence	8.4%	5.6%	7.6%
	Tuya	Count	5_a	2_a	7
		% within SoapPresence	3.2%	2.8%	3.1%
	Namoni	Count	17_a	3_a	20
		% within SoapPresence	11.0%	4.2%	8.9%
	Binagmando	Count	11_a	4_a	15
		% within SoapPresence	7.1%	5.6%	6.7%
	Motondo	Count	19_a	14_a	33
		% within SoapPresence	**12.3%**	**19.7%**	14.7%
	Nanyinku	Count	10_a	2_a	12
		% within SoapPresence	6.5%	2.8%	5.3%
	Bungbali	Count	13_a	3_a	16
		% within SoapPresence	8.4%	4.2%	7.1%
Total		Count	154	71	225
		% within SoapPresence	100.0%	100.0%	100.0%

Each subscript letter denotes a subset of SoapPresence categories whose column proportions do not differ significantly from each other at the .05 level.

Appendix XI: Relationship between water source of respondents and open defecation free communities

			Water source for community members			Total
			Stream	Bore hole	Dugout	
Community	Jilma	Count	1_a	6_b	$4_{a,b}$	11
		% within WaterSource	1.1%	9.0%	5.6%	4.9%
	Jibilago	Count	8_a	12_a	9_a	29
		% within WaterSource	9.2%	**17.9%**	**12.7%**	12.9%
	Nkwanta	Count	6_a	4_a	5_a	15
		% within WaterSource	6.9%	6.0%	7.0%	6.7%
	Kpumale	Count	2_a	3_a	6_a	11
		% within WaterSource	2.3%	4.5%	8.5%	4.9%
	Wasambo	Count	5_a	6_a	7_a	18
		% within WaterSource	5.7%	9.0%	9.9%	8.0%
	Macheliyili	Count	3_a	1_a	1_a	5
		% within WaterSource	3.4%	1.5%	1.4%	2.2%
	Kubbagmado	Count	7_a	6_a	3_a	16
		% within WaterSource	8.0%	9.0%	4.2%	7.1%
	Frigmagdo	Count	6_a	4_a	7_a	17
		% within WaterSource	6.9%	6.0%	9.9%	7.6%
	Tuya	Count	4_a	1_a	2_a	7
		% within WaterSource	4.6%	1.5%	2.8%	3.1%

Namoni	Count	9_a	5_a	6_a	20
	% within WaterSource	10.3%	7.5%	8.5%	8.9%
Binagmando	Count	9_a	2_a	4_a	15
	% within WaterSource	10.3%	3.0%	5.6%	6.7%
Motondo	Count	16_a	8_a	9_a	33
	% within WaterSource	**18.4%**	11.9%	**12.7%**	14.7%
Nanyinku	Count	4_a	4_a	4_a	12
	% within WaterSource	4.6%	6.0%	5.6%	5.3%
Bungbali	Count	7_a	5_a	4_a	16
	% within WaterSource	8.0%	7.5%	5.6%	7.1%
Total	Count	87	67	71	225
	% within WaterSource	100.0%	100.0%	100.0%	100.0%

Each subscript letter denotes a subset of Water Source categories whose column proportions do not differ significantly from each other at the .05 level.