

TREATMENT OF DRINKING WATER IN THE RURAL VILLAGES IN MALAWI

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1. INTRODUCTION

With inefficient water allocation and lack of water supply, much attention should be focused on the usage of drinking water in villages in Malawi. It is well known that unequal water source allocation is one of the difficult problems to control in villages. The dissatisfaction has been continually discussed among the people, but it has been an unchangeable issue for years.¹⁾ Needless to say, lack of water supply brings serious problems to the life of human beings.²⁾ The villagers have two choices – to make a simple water source in their village and obtain water from it, or travel to find a better quality water source, which would be far away from their house, cost more to get the water and be burdensome to women and girls. Under the status quo, villagers make an “open water source,”

1) One of the obstacles to progress in the water and sanitation sector in Malawi is that at the local level, powerful people may affect sustainability by abusing their power. For example, leaders allocate water points for political purposes, not according to need. (Water For People 2006: 3)

2) People who cannot access a safe water source might be infected with pathogens and bacteria that can cause severe illness and death (UNDP 2006: 33)

which is just a shallow hole in the ground and the water is easily contaminated.³⁾ It is prone to collapsing from rain and animals because it is not protected or supported.⁴⁾ Using this type of water source, the question is *why do people drink contaminated water without doing any treatment*. This question has been of growing concern and hence, it is the topic of this study.⁵⁾

Lots of studies about basic water treatment focusing on various methods⁶⁾ have been undertaken, and their benefits or effectiveness have also been supported through empirical case studies.⁷⁾ However, such process of water treatment is not always useful for developing countries because it is costly and difficult to implement. "Clean water and sanitation are among the most powerful drivers for human development" (UNDP 2006: 5), and "without basic sanitation the benefit of access to clean water are diminished-and the health, gender and other inequalities associated with the sanitation deficit systematically undermine progress in education, poverty reduction and wealth creation." "Sanitation improvements can broaden the real choices and substantive freedoms that people enjoy, acting as a catalyst for a wide range of human development benefits" (UNDP 2006: 111). It has also been found that the provision of water and sanitation is not always positively associated with wealth according to *Human Development Report, 2006*.

On the other hand, recent studies are focusing on the process of water treatment itself. "Although the treatment is necessary to improve the quality of drinking water, the process also creates its own pollution problems" (Elsevier 2005: 94). To prevent the recontamination of drinking water and combat waterborne disease at the household level, WHO promotes "Household Water Treatment and Safe Storage." WHO's project in developing countries has two major goals: establishing a cost-effective solution to water treatment and improving the access to water for those whose supplies are unsafe.⁸⁾ The additional issue of recontamination is discussed in a case study by Mintz (1995) and Thomas (2003).

Based on the problems, the objective of this study is to find out reasons why so many people who use open water do not treating drinking water. The study will clarify these reasons by comparing two groups of people in Mwadzama: those who treat their drinking water and those who do not.

3) There are six kinds of water sources, of which three (borehole, protected well and open water) are commonly used in the research area. The safest water source is the borehole, which 63% of the households can access. Protected wells are the second safest source of water, and 12% of the households have access to these. Open water sources are the most unsafe water sources, which 23% of the households can access.

4) In rural Sub-Saharan Africa millions of people share their domestic water sources with animals or rely on unprotected wells that are breeding grounds for pathogens (UNDP 2006: 33).

5) The survey for the study shows that as much as 63% of households among 23% from all targets households that use open water sources do not do any treatment to their drinking water, and this is one of the main reasons they are at higher risks for suffer from water-borne diseases.

6) Not only primitive methods such as boiling but also chemical treatment including ozone and hydrogen peroxide.

7) The treatment techniques such as filtration and chlorination and other chemical treatments are introduced as important processes for preventing the spread of water borne disease. See, for example, McClure, M.S. & P.B. Lang (1989) and Spellman, Frank, R. (2003). William H., Joon-Wun and Douglas H., (1987) introduce chemistry water treatment processes.

8) http://www.who.int/household_water/advocacy/wash_forum/en/

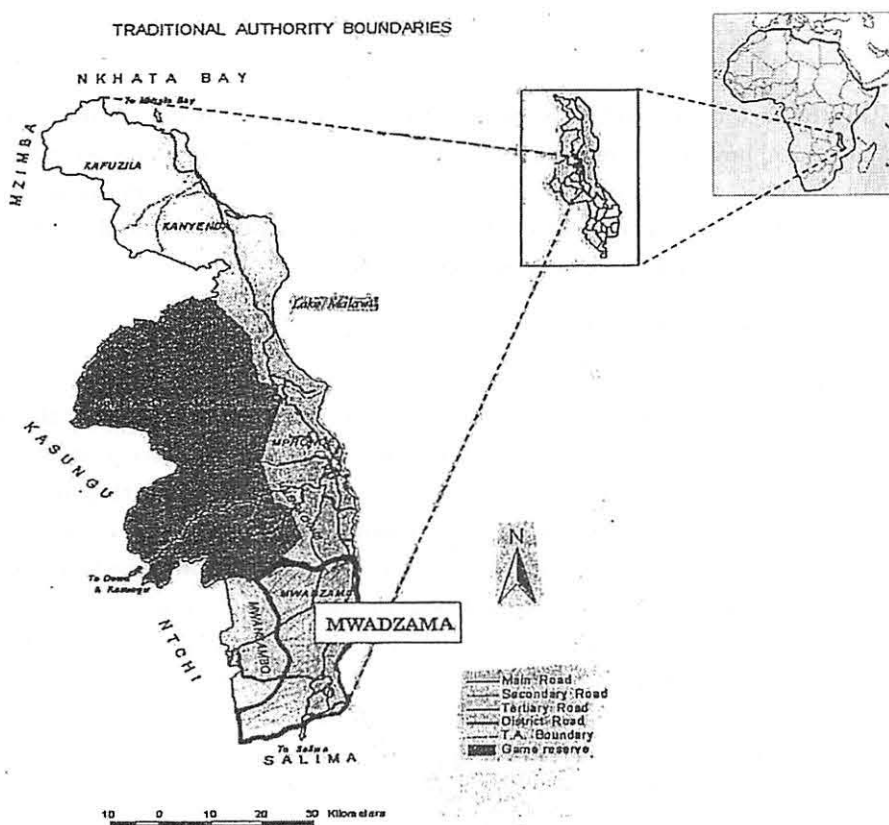
2. RESEARCH SETTING AND DATA COLLECTION

2.1. Research Setting

TA Mwadzama is one of the six Traditional Authorities (TAs)⁹⁾ in Nkhotakota district. In 1998, the total population of TA Mwadzama was 45,997 and the number of households was 10,226 (National Statistical Office 2002: 13). TA Mwadzama is divided into 4 centers; Mdzwazama, Chigwe, Mnyanje, and Suluwi. Under the centers there are villages which are the smallest administrative units. Some of villages combine together, and form group villages. TA Mwadzama has 24 group villages and the survey was conducted with 1,255 households (5,823 people) in 60 villages from those group villages.¹⁰⁾

Map 1. Map of Nkhotakota District and TA Boundary of Mwadzama

(Source: Nkhotakota District Socio Economic Profile n.d.: 8)



9) TA (Traditional Authority) is a division of rural area, administered by a chief.

10) The project site of Nippon International Cooperation for Community Development (NICCO), which is an international NGO based in Kyoto; Japan, consists of these 60 villages. Due to the fact that I was able to participate in their baseline survey as an intern (January 22 to March 25, 2008 and September 26 to October 16 in 2008), this site was decided as targets of this study.

2.2. The Process of Survey and Data Collection

This study includes a main survey, a follow-up survey as well as two different levels of analyses using statistics. The levels of analysis are the village-level (AVL) and the household-level (AHL). The major part of the main survey (baseline survey) consisted of interviews of every household (1,255 households) in the research area using a questionnaire to gain the necessary quantitative data. The questions reflected basic but important issues about the lifestyle in the villages. In addition, interviews, group discussions, and mapping were done to cover some qualitative data. After the main survey, the AVL was conducted choosing 287 households, which use open water source, out of the original 1,255 households, and the causal model of the AVL was constructed.

The follow-up survey was conducted to deepen the understanding of the internal condition of a village (Chapota), which cannot be known from the quantitative research alone. To define the research content of the follow-up survey, first the AHL and then additional qualitative interviews of 47 households were carried out. These 47 households were chosen from the 287 households for the AHL. Then, the causal model of this analysis was constructed. The whole process of this study is shown in Figure 2.1.

2.3. Analysis Method

To identify the factors that relate to the treatment of drinking water, Pearson's correlation analysis and the chi-square test were used as the two main statistical methods for a two variables association. In the case of continuous variables and ordinal variables, Pearson's correlation coefficients were used and chi-square was used for non-ordinal or nominal variables. To deepen the understanding of this study, qualitative methods were also used.

2.4. Data Structure for Quantitative Data

2.4.1. Analysis Target

At the AVL, the target group consists of 287 households (32 villages). Following the objective of this study, these households were selected for three reasons: (1) they do not have proper water sources and/or the water sources they make by themselves are of poor quality; (2) they have bad water sanitation because most of them do not treat their drinking water; and (3) their lack of a sanitary water supply promotes water-borne diseases that have a serious impact on the whole research area. In order to enable the people to live in better conditions in their given environment, the clear reasons of why they are not changing their behavior should be understood. At the AHL, the target group consists of 47 households in Chapota village. The primary reason why this village was selected is because the percentage of the households treating and not treating drinking water is almost equal (no treatment, 55%; and with treatment, 45%). A second factor in its selection was that the village had a large enough number of households to make interviews possible.

2.4.2. Data Structure

There are 51 questions and in total, 83 variables were constructed. These variables represent 8 conceptual categories. These are 1) Water and sanitation, 2) Occupation, 3) Education, 4) Health/ Mosquito net, 5) Agriculture, 6) Food and Cooking, 7) Household assets/ Lifestyle, and 8) Other.

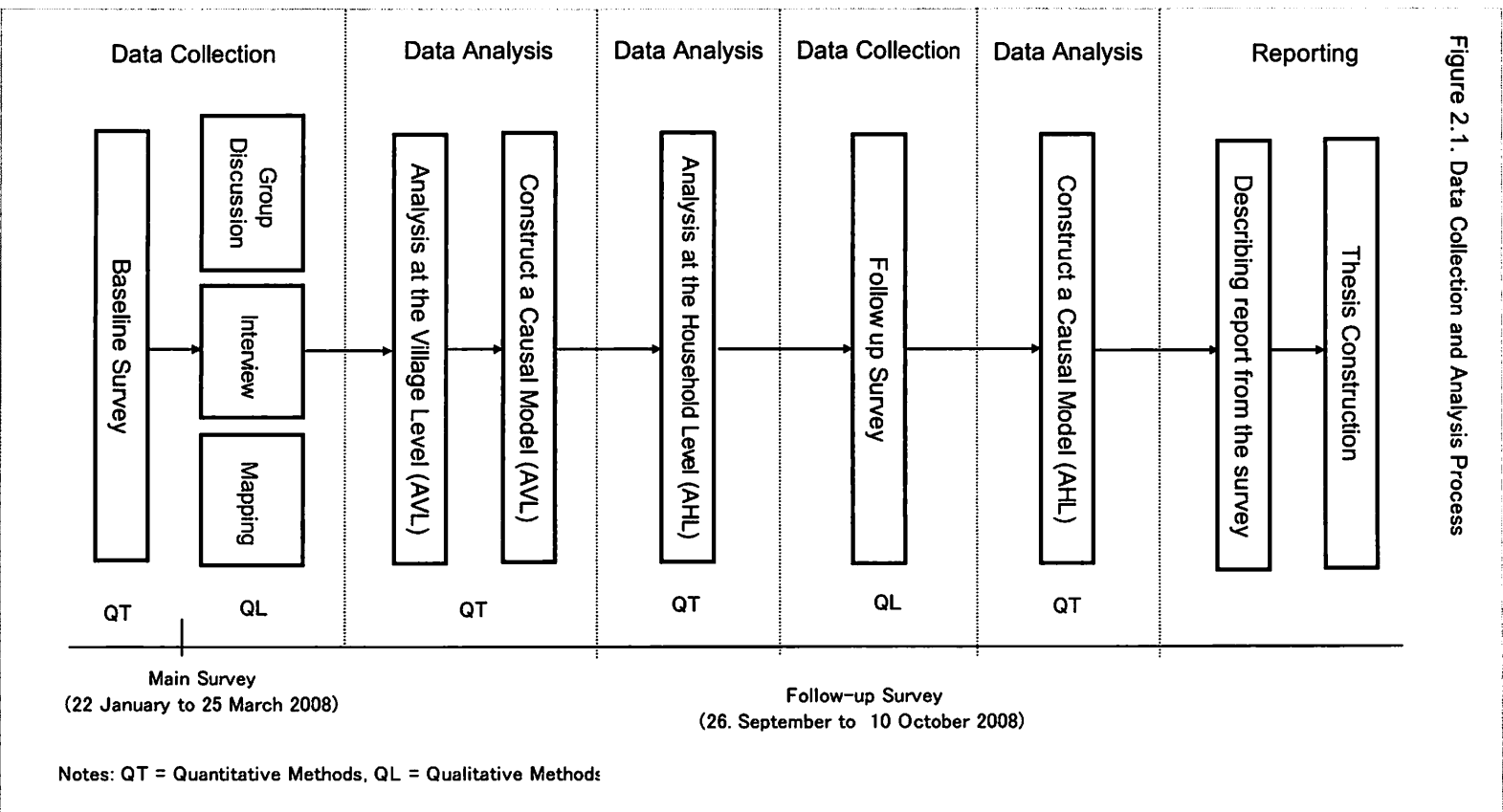
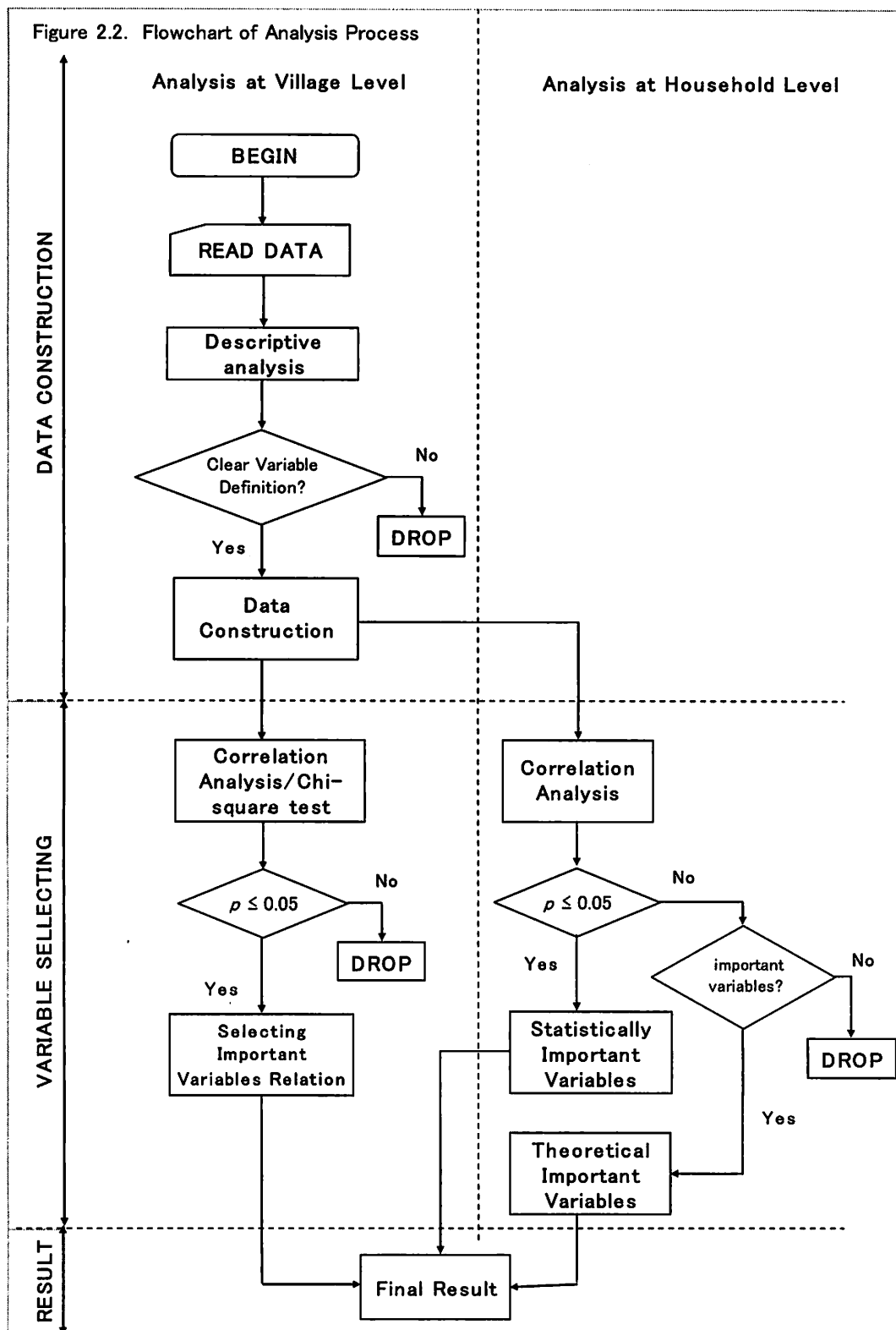


Figure 2.2. Flowchart of Analysis Process



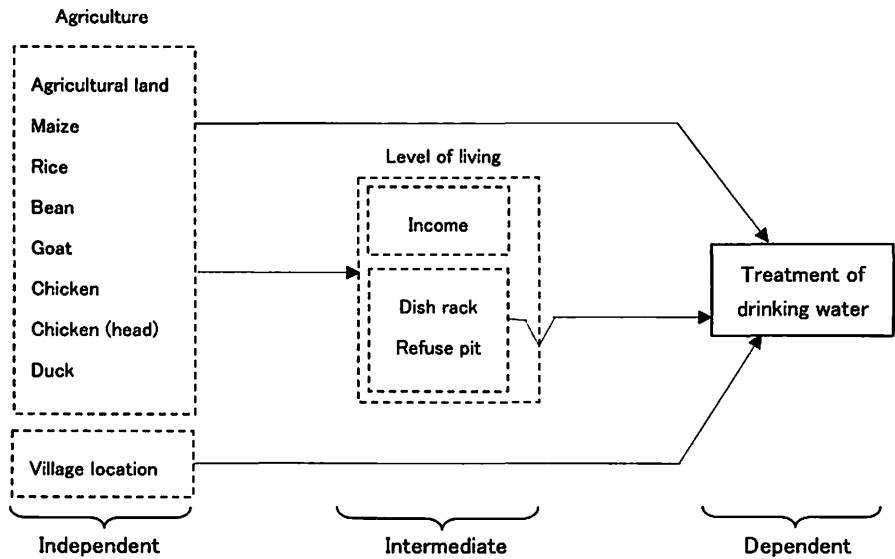
The objective of the statistical analysis is to identify the factors that relate to the treatment of drinking water. The treatment of drinking water (TDW) is the dependent variable, and all other variables are independent and intermediate variables. The following flowchart shows the overall methodological procedure for analyzing at village and household levels (Figure 2.2.).

3. DETERMINING FACTORS OF DRINKING WATER PROBLEMS (1) :
ANALYSIS AT VILLAGE LEVEL

This chapter presents the structure of a causal model for the treatment of drinking water. The model was constructed from the results of the statistical analysis at the village level of including 287 households.

3.1. Causal Model for Treatment of Drinking Water

Figure 3. A Causal Model Constructed from Village Level Data (AVL)



Notes:

1. An arrow shows a causal relationship, based on a statistically significant relationship between two variables.
2. A dotted line shows a conceptual, important relationship, which creates categories.

Dependent variable: The treatment of drinking water (TDW) was measured by a two-point scale where "no treatment" = 0 and "with treatment" = 1.¹¹⁾ Intermediate variables consist of 1) Annual household income, 2) Dish rack, and 3) Refuse pit. Variables two and three belong to the category of sanitation facilities. Together, all three of these variables indicate the level of living as a conceptually

11) The score or value assigned to each household was obtained from a multiple choice question with the response options of: "boiling," "filtering," "precipitation," "using water guard,"¹⁾ and "as it is." A score of 0 means that drinking water is not treated at all, and a score of 1 means that the drinking water is being treated in some way. (The survey of 287 households, 63% of them drink water as it is and 27% of them boil water.)

important category. As shown on Figure 3, eight independent variables belong to the category of agriculture and correlate with one another, as well as with the level of living and the treatment of drinking water. The variable of the geographical location of the village houses also correlates with the treatment of drinking water.

3.2. Analysis at Village Level (AVL)

3.2.1. Correlation Analysis of Factors Associated with the Treatment of Drinking Water at the Village Level

Table 3.1. Result of the Correlation Analysis of Village Level Factors (AVL)

	TDW	Agricultural land	Maize (bag)	Rice (0,1)	Bean (bag)	Goat (0,1)	Chicken (0,1)	Chicken (head)	Duck (0,1)	Dish rack (0,1)	Refuse pit (0,1)
T Pearson	1	.188 (**)	.116 (*)	.131 (*)	.142 (*)	.146 (*)	.127 (*)	.208 (**)	.124 (*)	.263 (**)	.194 (**)
D Correlation											
W Sig. (2-tailed)		0.002	0.050	0.027	0.016	0.013	0.032	0.000	0.035	0.000	0.001
N	287	276	287	287	287	287	287	287	287	287	287

Note: **indicates statistically significant at the significance level of 0.01 * at the significance level of 0.05.

Table 3.1 shows the results of the correlation analysis. Ten independent and intermediate variables among a total of 78 independent variables are statistically correlated with the TDW. The other 68 variables had positive but weak, not statistically significant relationships to the dependent variable of TDW.

3.2.2. Statistically Important Variables

(i) Treatment of Drinking Water and Agricultural Production

The following tables illustrate the concrete relationship between the TDW and some of the independent variables from the Table 3.1.

Table 3.2. Rice Production by Water Treatment

Rice	Not planting	Planting	Total
With treatment	29 (28.4%)	77 (41.6%)	106 (36.9%)
No treatment	73 (71.6%)	108 (58.4%)	181 (63.1%)
Total	102 (100.0%)	185 (100.0%)	287 (100.0%)

Farmer is the main occupation in the villages, with an agriculture that highly depends on rain. After maize, rice is the second largest product, produced on own land. Mainly, those products are important cash crops but they are also used for self-consumption.

Table 3.2 shows that majority of the households in the research group are rice farmers (185 households compared to the 102 households who do not plant rice.). Further, the proportion of rice farmers doing treatment (41.6%) is a little lower than the rice farmers who do not treat their water (58.4%). However, the number of rice farmers doing treatment (77 households) is higher than non rice

farmer who treat their water (29 households). On the other hand, the proportion of “no treatment” among those who do not plant rice was great (71.6%) compared to those who treat their rice (28.4%). Therefore, as can be seen, a lower percentage of non rice famers do not treat their drinking water. The similar relation can be found in the case of households having chickens, goats, and ducks and doing treatment.

Table 3.3. Average Number of Chickens (head) by Water Treatment

Number of chicken	Average (head)	Total
With treatment	8	106 (36.9%)
No treatment	5	181 (63.1%)
Total		287 (100.0) %

There are eight kinds of livestock in the villages: chicken, goat, duck, guinea fowl, cow, sheep, pigeon, and pig. Livestock possession has two essential meanings in the villages: breeding and food and the other are for commercial purposes.

Table 3.3 shows that the majority of the households (69%) do not raise chickens. The average number of chickens in the “with treatment” households is eight, and in the “no treatment” households five. Keeping a large number of chickens indicates a higher guarantee for the household’s daily life. In the villages, chickens are the most common livestock, and they have more importance for commercial purposes rather than for household consumption for eggs or as meat. Even the households who have many chickens do not often consume them, but sell them to purchase other types of food when the household is suffering from lack of food. It seems that “with treatment” households can better manage the husbandry of their livestock and supply their households with food.

(ii) Agricultural Production and Level of Living

Table 3.4 shows the correlation of seven independent variables in the agricultural category with household income.

Table 3.4. Correlation with Income with and Independent Variables in the Agricultural Category

	Agricultural land	Maize (bag)	Rice (0,1)	Bean (bag)	Goat (0,1)	Chicken (head)	Duck (0,1)
Income	.453 (**) 0.000	.405 (**) 0.000	.208 (*) 0.003	.513 (*) 0.000	.252 (*) 0.000	.253 (*) 0.000	.165 (*) 0.021
N	276	196	196	196	196	196	196

Note: **indicates statistically significant at the significance level of 0.01 * at the significance level of 0.05.

The value of r for each of the seven correlations shows a relatively strong association between income and the independent variables of the agricultural category. These seven variables are the most important sources for household income for most of the households in the villages.¹²⁾ Livestock also

12) According to the interviews, beans command the highest price: 3000/pail, compared to maize at 600/pail, and rice at 690/pail on the average. (Currency: MWK) 1 (MKW) =0.00716 (USD), 2009 <http://www.oanda.com/>

plays an important role for the household's revenue through the commercial sales. The higher average number of chickens owned by "with treatment" households (Table 3.3) indicates a higher income.¹³⁾ For this reason, such households keep more chickens than lower income households.¹⁴⁾ Therefore, the households producing more crops and having a large amount of livestock are in a better economical situation and it can be confirmed that the income is one of the most important indices for the level of living in the villages.

Table 3.5 shows the correlation of two variables regarding sanitation facilities and selected independent agricultural variables.

Table 3.5. Correlation of Dish Rack, Refuse Pit and Independent Variables in the Agricultural Category

	Agricultural land	Maize (bag)	Rice	Bean (bag)	Goat	Chicken	Chicken (head)	Duck
Dish rack	.243 (**) 0.000	.205 (**) 0.000	.167 (**) 0.005	.151 (*) 0.010	.220 (**) 0.000	.121 (*) 0.041	.128 (*) 0.030	.239 (**) 0.000
N	276	287	287	287	287	287	287	287
Refuse pit	.171 (**) 0.004	.139 (*) 0.018	.188 (**) 0.001	.154 (**) 0.009	.248 (**) 0.000	.167 (**) 0.005	0.098 0.098	.117 (*) 0.048
N	276	287	287	287	287	287	287	287

Note: **indicates statistically significant at the significance level of 0.01, * at the significance level of 0.05.

As can be seen in the table above, all of the correlations between the eight independent agricultural variables and the dependent sanitation variables of dish rack and refuse pit are statistically significant except for the correlation between refuse pit and the number of chickens a household possesses. While high values on each of the agricultural variables are undoubtedly associated with increased wealth, the two sanitation measures are not correlated with it. They are also not expensive items to create or to maintain. The explanation likely lies more in the household women's attitudes towards sanitation, because they are the ones who choose and use them, than in the level of income. It can be further speculated that better management of the production and selling crops and keeping animals influences the possession of sanitation facilities in a positive way.¹⁵⁾

In summary, the variables belonging to the category of agriculture are positively correlated with income and the use and/or possession of sanitation facilities and thereby give an understanding of the level of living of villagers.

(iii) Treatment of Drinking Water and Sanitation Facilities

Table 3.6 shows the relationship between the intermediate variable "refuse pit" with the dependent variable of whether water treatment is done by a household.

[channels/products/products.shtml](#)

- 13) The price for chickens is about 450/head; for ducks, 500/head; and for goats, 3000/head. (Currency: MKW)
- 14) Most of the variables belonging to the category of agriculture are also positively correlated with the variables of having a radio and/or a lamp. These variables are some of the indicators for a household economy.
- 15) Management of crops includes many several processes such as making field, harvesting and selling periods, and fertilizer. Also, that of livestock includes breeding, selling, and making hutches for keeping animals.

Table 3.6. Having Refuse Pit by Water Treatment

Refuse pit	Not having	Having	Total
With treatment	45 (28.5%)	61 (47.3%)	106 (36.9%)
No treatment	113 (71.5%)	68 (52.7%)	181 (63.1%)
Total	158 (100.0%)	129 (100.0%)	287 (100.0) %

There are 6 kinds of sanitation facilities as important and basic tools for the villagers in their daily life. These are traditional pit latrine (42% of the households use it),¹⁶⁾ bathroom (67%),¹⁷⁾ a hand wash facility (20%),¹⁸⁾ dish rack (33%), and a refuse pit.¹⁹⁾

Dish racks and refuse pits are two of the basic sanitation facilities in the villages and possessing these facilities indicates a woman's consciousness of the importance of sanitation for the health of her household. As can be seen in the table, the majority of the 287 households do not possess refuse pits (55.1%). However, the clear positive relationship between the usage of refuse pits and treatment of drinking water can be seen. For refuse pit use, the proportion of not treat their drinking water (71.5%) is 43% greater than treat their drinking water among those who do not having refuse pit. The main reason for the low use of refuse pits is that women need to do the extra work required to maintain the pits. Extra work also falls upon women to undertake the treatment of water. Among the sample households, treating drinking water tends to also be associated with the possession of sanitation facilities for assuring good hygiene and health within a household.

In the villages, a higher income and having sanitation facilities, resulting from agricultural activities, provides important indices for level of living. However, income itself does not directly affect whether people treat drinking water or not, but the possession of sanitation facilities does so.

Based on the data present above, it appears that in understanding how people such as those in the research area make the decision of whether to treat their water is an important factor in their level of living and is affected by attitudes and knowledge about sanitation measures and their use of available sanitation facilities, but income does not seem to have a direct impact on whether people treat their drinking water.

3.2.3. Chi-Square Test of Factors Associated with the Treatment of Drinking Water

The village location is a significant variable for the TDW according to the chi-square test. The result of the test tells that the proportion of "with" and "no treatment" of drinking water is not equally distributed by center. According to Table 3.7, in Mwadzama center only 9% of the households treat

16) Traditional toilet is only a hole, fenced by reeds and bad for hygiene. Another toilet used in villages is the EcoSan toilet (Ecological Sanitation toilet). This type of toilet has been constructed through the support of NICCO. Only 6% of household uses it, but in several houses they are under construction during the survey period.

17) If people do not have a bathroom or toilet, they bathe in the river or go into the bush. The river water is also used for washing clothes, but in villages where there is no water source, people use the river for drinking. Every family uses the river in many different ways.

18) A hand wash facility is a water bottle that hangs next to the toilet.

19) Half of the households have a refuse pit which is a small hole made behind the house for discarding waste and garbage in, and when it becomes full, the rubbish is burned. Sometimes the hole needs to be changed.

water, while almost 90% do not. On the other hand, in Suluwi center, the percentage is nearly the same.

Table 3.7. Cross Tabulation of Water Treatment (TDW) by Center

		Center			Total
TDW	Yes	Mwadzama	Mnyanje	Suluwi	
	No				
	Yes	4 (9.3%)	62 (39.7%)	40 (45.5%)	106 (36.9%)
	No	39 (90.7%)	94 (60.3%)	48 (54.5%)	181 (63.1%)
Total		43 (100.0%)	156 (100.0%)	88 (100.0%)	287 (100.0%)

Note: Pearson Chi-square 17.366, 2 df, p <0.000. Based on the chi-square test, probability is less than significant level of 0.05. The null hypothesis of the relationship between village location and treatment of drinking water is rejected.

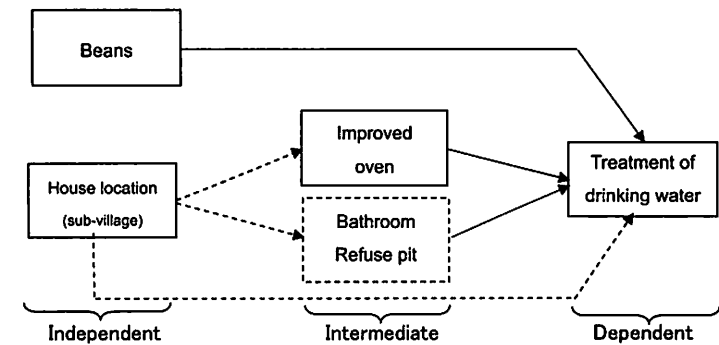
The distribution of households using water treatment also varies from village to village. Some villages have a majority of households treating water. In other villages, the majority of households do not treat water, and another set of villages have almost the same proportion of “with treatment” and “no treatment” households. Though the living environment in one village is the same since they live close to each other, it does not mean that their behavior or attitudes toward water treatment are the same.²⁰⁾

4. DETERMINING FACTORS OF DRINKING WATER PROBLEMS (2) : ANALYSIS AT HOUSEHOLD LEVEL

This chapter presents the structure of a causal model for the treatment of drinking water based on the results of the statistical and qualitative analysis at household level, including 47 households.

4.1. Causal Model for Treatment of Drinking Water

Figure 4. A Causal Model Constructed from Household Level Data (AHL)



Note:
 1. An arrow shows causal relationship, based on a statistically significant relationship between two variables.
 2. A dotted line shows a conceptual, important relationship with two categories and their variables.

20) It might be related to several studies about the heterogeneity of a community with regard to interests, distribution of power and wealth, and traditional norms, etc. (Peter 2006:31) and (Ton, Patrick 2003 56-58).

Intermediate Variables consist of 1) Having an improved oven, 2) Bathroom, and 3) Refuse pit. Variable one belongs to the category of food and cooking and variables two and three belong to the category of sanitation facilities. The two independent variables used in the household level analysis are bean production, from category of agriculture, and house location is a conceptual variable that emerged during the qualitative analysis of the fieldwork survey in Chapota village and are related to the intermediate variables.

4.2. Analysis at Household Level (AHL)

4.2.1. Correlation Analysis of Factors Associated with the Treatment of Drinking Water at the Household Level

Table 4.1. Result of the Correlation Analysis of Household Level Factors (AHL)

TDW		Beans (bag)	Having an improved oven (0,1)	Bathroom (0,1)	Refuse pit (0,1)
TDW	1	.343 (*)	-.340 (*)	.305 (*)	.295 (*)
		0.018	0.019	0.037	0.044
N	47	47	47	47	47

Note: **indicates statistically significant at the significance level of 0.01, * at the significance level of 0.05.

Among the 78 independent variables studied at the household level, four variables were identified as being statistically significant in their relationship to the dependent variable of whether a household treats its drinking water (TDW). The results of the correlation of these four variables with TDW area are shown in Table 4.1. The Pearson *r* for bean production output (number of bags), a bathroom, and a refuse pit have a positive, statistically significant relationship to treating drinking water. There is a statistically significant but negative relationship between having an improved oven and treating drinking water. In other words, those households that treat their drinking water tend not to have an improved oven.

4.2.2. Statistically Important Variables

(i) The Use of an Improved Oven by the Treatment of Drinking

Table 4.2. Number of Households with an Improved Oven by Water Treatment²¹⁾

Improved oven	Not having	Having	Total
With treatment	18 (38.3%)	3 (6.4%)	21 (45.7%)
No treatment	14 (29.8%)	12 (25.5%)	26 (55.3%)
Total	32 (68.1%)	15 (31.9%)	47 (100.0%)

Improved oven was introduced by NGO for sanitation tool for the purpose of decreasing women's

21) The introduction of the improved ovens to the villages was taking place at during the time of the baseline survey. This survey provides the opportunity to observe how and in which place the improved oven prevails in a short period.

work. Its benefit is that women can save cooking time, they use less firewood, and they can use other pans at the same time. As can be seen in Table 4.2, the majority or 68% of the households surveyed do not possess an improved oven compared to 32% who do. The negative correlation shown in Table 4.1 is more clearly seen in Table 4.2. To understand this negative association with the TDW, it is important to look at the geographical features in Chapota village, which can be conceptually divided into three areas as illustrated on Map 4. with the designations a, b, and c.

The three areas marked on the map have different characteristics and as such have contributed to the development of a conceptual typology related to the use of an improved oven and the treatment of drinking water. Four different types have been identified. The simple matrix below shows how the types have been derived.

Use of Improved Oven		
Treatment of Water	Yes	No
Yes	Type I	Type III
No	Type IV	Type II

Type I: With treatment of water and having an improved oven

This type of household representing 6.4% of the houses in the study lies in Area a. The geographical distinction of this area is that the houses stand along and near the main road close to other villages. Most of the houses reflect a higher economical situation, indicated by better or more substantial materials used in the construction of the houses.²²⁾ People in Area a share many things among the houses and villages, including information. For example, 31% of the women living in this area belong to a women’s group²³⁾ interested in introducing the improved oven where they have been provided information about the new type of oven. According to the interviews with people in this area, people can access several information sources about sanitation from a health center,²⁴⁾ school, friends, and the radio.

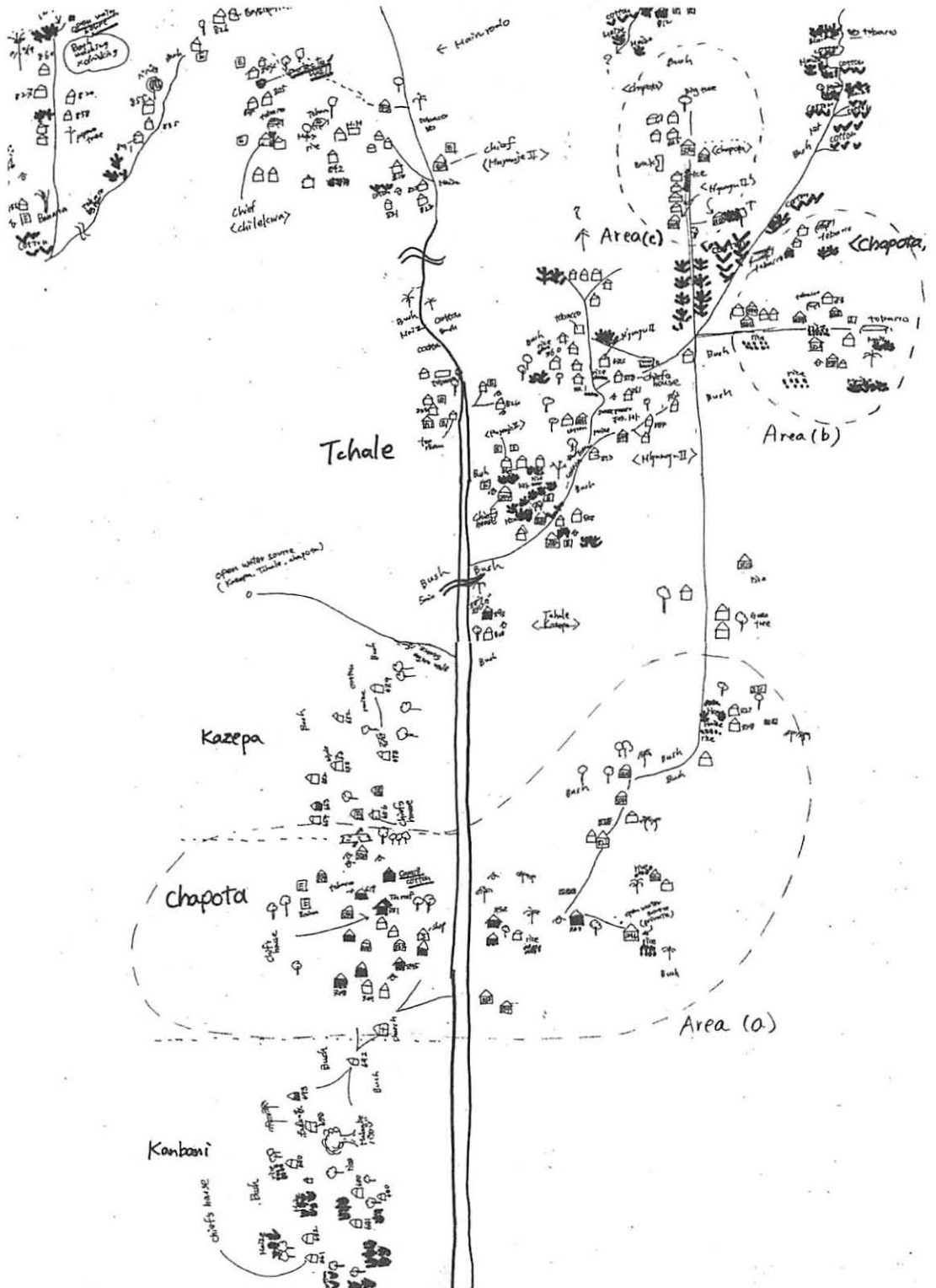
In this area the oven is used because of its proven effectiveness in terms of saving firewood and cooking time. In addition, the women with such an oven have found that they are able to more easily boil water for drinking. Samples of some of the positive responses given during interviews are: “It is possible to cook several dishes at the same time with the oven,” and “The consumption of firewood has

22) Many houses in this area have bricks as the main material for houses. Bricks indicate a better economical situation as it has been shown to be a statistically significant variable in the correlation analysis.

23) Women’s group is important information source in the villages. The women’s group began when women gathered voluntarily, and it became more active through the NGO. The training course is provided and its topics include nutrition, vegetable planting, cooking demonstrations, cooking with an improved oven, and the prevention of malaria. Now there are many women’s groups in the villages.

24) Major information source comes from community health center, where villagers can get medical assistance from a community and a maternity nurse. It was frequently reported during interviews that the health center provides educational information about ways to treat water in order to prevent diarrhea and malaria. Pregnant women are also provided with information about nutrition and sanitation. Medical personnel from the health center also sometimes provide lectures for women.

Map 4. Map of Chapota Village



decreased since using an oven.” As mentioned above, only 6.4% of the households are in such a favorable condition of to using both an oven and water treatment.

Type II: No treatment of water and no improved oven

This type of households represents 29.8% of the households in the study and lies in the Area b. The people living in this area are all related to each other. Geographically, this area is a 10 to 15 minute walk from the Area A. There are no other houses belonging to Chapota village or other villages near the households in this area. These people are not involved in the greater village community and have fewer connections to the other villages. None of the household women participates in the women's group.

Information about water sanitation and the improved oven has been conveyed from the outside. The people seem willing to build an improved oven, and they also understand the benefits of boiling water as well as the process of doing so, but they do not do it. Contrary to their knowledge level, the practice of treating water and building the oven is not carried out undoubtedly of the extra work involved in doing so.²⁵⁾ According to interviews, the women report that it is up to the individual's whim of whether to take on the additional work. It appears that the women in this area have not set sanitation about water and cooking convenience as priorities in their everyday lives. The geographic factor likely plays a big role since they are more isolated from the main road, a higher concentration of non-relatives, and the input from other women such as in the women's group.

Type III: With treatment of water and no improved oven

This type of household account for 38.3% of the research households and lies in the Areas a and c. Those households of Type III who reside in Area a are not interested in an improved oven. Despite holding negative opinions toward the oven, these people care about treating water. Following demonstrations about the treatment of drinking water put on by health center staff, the people have followed the advice given and have implemented water treatment procedures.

The Type III households that are found in Area c are far from Area a and about a 20 minute walk from Area b. The families of these households belong to a single clan, and their homes are isolated from other homes. This isolation does not mean that there is no connection or a bad relationship with the other households in the same or other villages. However, it does mean that they receive less influence from outside their community. Nobody has an improved oven although they know about it. It is difficult for new things to prevail in this area. On the other hand, people seem to be concerned about water sanitation. From an interview with a woman representing Type III, reported that she treats water every two days. She said that when she was a child, her mother never boiled water, and so she never boiled water for her family. However, after learning from the health center the fact that boiling water kills germs, she has started doing it.

The villagers described in Area c have their own, two large water sources. The first one cost 7,500 MKW and its quality is periodically checked by the health center.²⁶⁾ The second one was made

25) Boiling water is tough work for people living in villages. “The traditional emergency prevention measure, boiling the water, is economically and environmentally unsustainable. It takes a kilogram of firewood to bring a liter of water to boil for one minute, and a person requires a minimum of two liters of drinking water per day (Mintz 1995: 2).

26) Based on interviews, whenever the taste of the water is sour, people take bottles of water to the health center

specifically for drinking water, and it cost 6,500 MKW. The holes of both water sources are very deep, but they are not protected by any materials and are only loosely covered by a wooden board.

In summary, Type III people favorite treating water, and they have access to good information. However, in Area a, the women do not have an improved oven, because it is not considered a priority as in other households. They also do not appreciate or recognize that having such an oven could decrease their household work. In Area c, the household women have less involvement with people and influences from outside, and this seems to be the key to their not making or using an improved oven as a practical way of living.

Type IV: No treatment of water and having an improved oven

All of the Type IV households also lie in Area a, and they represent 25.5% of the research group. Each Type IV household has an improved oven but does not undertake treatment of drinking water. The reason given is that the women are too busy doing other housework, and treating water in a hot climate is a hard task that they prefer not to do. However, sometimes women use the ovens to keep water warm, for their husband's bath. There are also some houses that have an oven that does not work because of functional problems such as the wrong height or having been attached at the wrong place. Treating water has a low priority for them, and their oven is not thought of as having a role in sanitation.

The table 4.3 provides a brief summary of the primary characteristics of the households that fall into each of the four types.

Table 4.3. Summary of the Characteristics Associated with Each Household Type		
	Not having an improved oven	Having an improved oven
With treatment	Careful treatment for drinking water.	Area a: Sharing information with neighbors.
	Area a: No interest in an improved oven.	Effective usage of improved oven and good management of drinking water.
	Area c: Less influence from outside.	
No treatment		Area a: Low priority given to water treatment.
	Area b: Less influence from outside.	Ineffective usage of an improved oven.

(ii) Treatment of Drinking Water and Sanitation Facilities

The two variables indicating the sanitary facilities and practices of a household that are also related to whether drinking water is treated are having a bathroom and having a refuse pit. The next two tables show the relationship of these variables upon the dependent variable of water treatment.

for checking to determine if whether the quality of the water is good. If the water cannot be checked and the people are suspicious about its quality, they do not use the water for drinking, but they still use it for washing their clothes.

Table 4.4. Having refuse Pit by Water Treatment

Refuse pit	Not having	Having	Total
With treatment	2 (18.2%)	19 (52.8%)	21 (44.7%)
No treatment	9 (81.8%)	17 (47.2%)	26 (55.3%)
Total	11 (100.0%)	36 (100.0%)	47 (100.0%)

As can be seen in the table, the majority of the households are possessing this type of sanitation facilities. Table 4.4 shows that the 36 out of the 47 households use a refuse pit and of these, 52.8% also doing treatment of their drinking water.

Although the differences are not large, the fact that having sanitation facilities tend to coexist with the treatment of water. The presence of sanitation facilities and water treatment can be identified by the location of households in Areas a, b, and c on the map.

The households living in the Area c treat water and also have a refuse pit as shown in the table. In the case of Area b, households do not treat water but have the mentioned facility. Perhaps the most important finding is that the people who live in same area tend to have the same practices related to water treatment and sanitary facilities.

As discussed earlier, the relationship between the TDW and the improved oven and sanitation facilities is influenced by the geographic factors as measured by the location of a household, which also influences the villagers' behavior. The location of a house may serve to isolate the villagers, especially the adult females' access to information, which influences the women's attitude and curiosity about water treatment and the making of an improved oven. Therefore, a house's location is a key factor that directly influences behavior about the treatment of drinking water in this village (see the causal model in Figure 4.).

5. CONCLUSION

There are six overall conclusions that emerge from this study as follow:

- 1) Agricultural activities form the indicators of the standard of living in the villages. A lower agricultural activity has a direct, negative impact on whether a household will treat their drinking water. Higher agricultural activities lead to higher household incomes as well as better management of agricultural crops and livestock which lead to more favorable factors for the use of sanitation facilities.
- 2) Not possessing or using sanitation facilities is a factor related to not treating drinking water. The reverse condition is equally true.
- 3) Income has no direct impact on drinking water treatment, but possessing sanitation facilities has. However, there is no relationship between wealth and the use of sanitation facilities.
- 4) A village's location is an important factor in whether drinking water is treated.
- 5) Different geographic situations lead to variations or differences in people's behavior. The communities are heterogeneous in understanding about sanitation facilities, the improved oven and drinking water treatment.

- 6) Finally, the usage of an improved oven and the treatment of drinking water are negatively related. While the oven is the most effective method for treating water, it is not always effectively used and understood as a sanitation dimension.

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- http://www.who.int/household_water/advocacy/wash_forum/en/ (WHO)
- <http://www.oanda.com/channels/products/products.shtml>
- (Trade with OANDA)