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People's Perception on Ecological Sanitation and Health Risks Associated in Central Nepal

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Abstract

In 2015, it was estimated that 2.4 billion people globally still use unimproved sanitation facilities, among which 40% live in Southern Asia (WHO 2015). Ecological sanitation could be the best alternative to solve the problem of sanitation and to improve livelihood. The study was conducted in one of the Village Development Committee (VDC) of Bhaktapur district where ecosan toilet was constructed for the households with the financial and technical help from Environment and Public Health Organization (ENPHO). The present study investigated ecosan users' and non-users' attitudes towards ecosan toilet through questionnaire survey. Fifteen ecosan users and 15 non-users were interviewed. Five ecosan users were selected from abovementioned 15 users for microbial contamination. Fecal contamination on hands, shoes back, soil sample and ecosan manure sample was measured by monitoring *Echerichia coli* as a fecal indicator bacteria. The results from the questionnaire survey suggested that all ecosan user farmers agreed with the positive effects of ecosan manure in terms of fertilizer use and have not mentioned any problems on use of ecosan toilet. Although majority of the non-ecosan users are aware of the benefits of ecosan toilet but only few are willing to install ecosan toilet due to its drawbacks such as need of ash, user unfriendly and unsuitability for large size family (> 5 family members). Need of proper management of ecosan toilet and awareness campaign on self-hygiene was found to be necessary to promote effective use of ecosan toilet. The *E. coli* tests suggested that only ecosan manure is not the source for fecal transmission. However urine and ecosan manure from ecosan toilet might get contaminated by fecal microorganisms through other sources. Proper attention is necessary to reduce such contamination which is generally neglected by the users.

Keywords: ecosan, fertilizer use, households, questionnaire survey

Introduction

In low- and middle-income countries, 38% of health care facilities do not have an improved water source, 19% do not have improved sanitation, 35% do not have water and soap for handwashing (WHO 2015). About 663 million people lack access to improved drinking water sources, among which 34 million falls under Southern Asia (WHO 2015). In 2015, it was estimated that 2.4 billion people globally still used unimproved sanitation facilities, 40% of whom lived in Southern Asia (WHO 2015). To overcome this situation, ecological sanitation (ecosan) could play an important role. Ecosan is the practice of converting human urine and excreta into liquid fertilizer and compost for beneficial reuse of the nutrients contained in the urine and excreta. Materials such as ash, sawdust, and rice husks are used to cover fecal material, to eliminate odors and to absorb moisture from the excreta. Combination reuse of the fecal compost and stored urine can supply nutrients to vegetables as well as chemical fertilizers (Hijikata et al. 2014). As one type of ecosan toilet, urine diverting dry toilets (UDDT), which can separately treat human excreta and urine, have advantages for saving flushing water and sewer pipe networks (Winblad and Simpson-Hebert

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2004). The wastewater reuses would be an attractive option for rural areas in developing countries where poverty, poor infrastructure, low efficiency, government/political instability, and severe environmental condition are challenges (Ushijima et al. 2015). Many advantages such as water conservation, recycling of nutrients, affordable sanitation are associated with ecosan toilet. Ecosan practices is effective at reducing the fecal contamination of the surrounding water environment, thereby liming the health risk from unavoidable accidental ingestion of water (Harada and Fujii 2020). Yet, there is a risk of transmission of bacteria during handling of ecosan manure for which better treatment and management is necessary. These resources potentially contain microbial pathogens that mainly cause gastrointestinal infections (WHO 2006). Fecal contamination of incompletely treated excreta and other frequently contacted objects (i.e., handheld tools, toilet pits) strongly influenced hand contamination, and influenced ingested dose of fecal microorganisms, governed by hand-to-mouth contact frequencies (Julian et al. 2018). Further, overapplication of untreated wastewater and excreta can also lead to runoff and overflow after rainfall events, which can result in the contamination of surface water.

Improvement of water and sanitation in Southern Asia has been one of the most critical issues, especially in rural areas. Improving the sustainability of water and sanitation supplies has potential for both gains in health and economic development (Montgomery et al. 2009). Social attitudes and perceptions towards excreta vary with age, sex, religion, education, employment, region and physical capacity (Mariwah and Drangert 2011). Also, people's behavior towards the urine-diverting toilet and in utilizing human excreta as fertilizer is guided by their perception towards it. The respondents' attitudes and perceptions toward excreta and their decision to use excreta for agricultural purpose, however, differ to their socioeconomic characteristics (Nimoh et al. 2014). The study conducted by Andersson (2015) in Uganda reported that the supportive attitude of farmers for urine fertilization was due to its ability to ensure food and economic security given that they have few other options for soil nutrient management. The study conducted by Lienert et al. (2003) to analyze the perception of Swiss farmers indicated that 57% liked the idea of using urine based fertilizers with 42% stating their willingness to buy such products.

The main factors that motivated farmers to respond positively to reuse of urine were improved soil quality and potential of cost savings with reduced use of chemical fertilizers (Simha et al. 2017). However, limited studies on socio-technological perspective on farmers and consumers attitudes about the design and use of urine diverting toilets have been conducted till date. The re-use of human excreta and organic waste as fertilizer is not new in Nepal. Many communities have developed systems for collecting waste and using it in their fields. In mountainous regions where open defecation is difficult due to the very cold weather condition, toilets are made inside the house, generally in the ground floor which is connected with the pig shelter in the basement (Poudel and Adhikari 2015). Similarly, knowledge on using urine and feces as agriculture fertilizer is not new for Newar community in Nepal. However, these traditional practices are slowly diminishing as the younger generations hesitate to adopt it in the name of modernization (Poudel and Adhikari 2015). Those waste and excreta which were being used as fertilizer are now disposed off through sewer systems.

The concept of ecosan in its modern sense was first introduced in Nepal in year 2002 by the Department of Water Supply and Sewerage and WHO (ENPHO 2006). Since its introduction in Nepal, there are several modifications in ecosan toilet pans in terms of materials and types in order to suit local culture and ecology and have been constructed in difference parts of the country. There were 36 toilets in 2003 with rapid increment upto 517 toilets in 2006 (ENPHO 2006). Majority of ecosan toilets have been built in the peri-urban areas of Kathmandu valley, with few constructed outside the Kathmandu valley. A total of 2,095 ecosan toilets till 2014 have been installed in 19 districts in different regions showing potential for scaling up in diverse socio-cultural setting and geography (Aryal et al. 2015). Nepal is a potential area for ecosan approach as its numerous areas are reported lack of enough water for sanitation and under supply of chemical fertilizer for agriculture. Nepalese economy is still dominated

by agriculture sector and agro-based industries. More than 80% of people (4.2 million) depend on agriculture and agriculture provides net employment to 60% of people (FAO 2017). Development of improved technologies like improved seeds, fertilizer pesticides, farming techniques and use of agricultural tools and instruments and trained human resource have contributed largely to the agriculture production (MoF 2016).

The studies to understand ecosan users perceptions after installation of an ecosan toilet is unclear. To fully utilize hygienic human excreta, UDDT projects are also being introduced in Nepal. And most of the projects currently launched are in communities with long-standing traditions of using human waste on crops and UDDT acceptance reported is 71% (WaterAid Nepal 2008). In order to extend an ecosan toilet and to identify the target group for dissemination, perception of both ecosan users and non-ecosan users should be incorporated. Ecosan users perception will help to understand the drawbacks associated with ecosan toilet and to minimize those drawbacks in future. Non-ecosan users perception will help to understand their concept towards ecosan technology, willingness to install such technology and to have modification in the system as per needed.

This study also tried to evaluate the risk of excreta reuse due to handling of ecosan manure. *Escherichia coli* is a member of the fecal coliform group and is a more specific indicator of fecal pollution than other fecal coliforms. To understand the fecal transmission, only *E. coli* tests was conducted in this study due to limitation of resource. Generally, due to the long tradition of urine and excreta reuse in Nepal, most of the users think that it is safe to use urine and excreta in agriculture. However, studies showed that the waste produced from those ecosan toilets is unsafe for use in agriculture and increases the health risks to the communities (Morgan and Mekonnen 2013). The addition of ash and lime reduces smell, covers the excreted material which in turn reduces the risk for flies and improves the aesthetical condition, decreases moisture content and promotes pathogen die-off through the elevated pH effect (Schonning and Stenstrom 2004). But, if an ecosan toilet is not well managed, it may increase the transmission of diseases like diarrhea and helminthis in the community (Jimenez et al. 2007; Schonning et al. 2007). The risk of fecal matter to the ecosan users varies depending upon the handling behavior or the application practices. The use of human excreta in agriculture is beneficial if it is composted well and did not associate risks with the use of composted excreta if it was dry and lacked odour (Jensen et al. 2008). Hence in this study, risk perception of users and *E. coli* tests were combined so as to understand the handling behaviours and fecal contamination associated due to such practices.

1. Methodology

1.1. Study Area

The study was conducted in a village (21.39° North and 85.25° East) of Bhaktapur district in October 2018. The district is surrounded by Kathmandu (Capital city of Nepal) in the west and North. The population of the district is 304,651 (The total population of the village is about 5,689 with households 1,257) (CBS 2011) with an annual population growth rate of 2.96%. About 54% area of the district belongs to urban areas due to the access of road, transportation, health, education facilities and due to boundary with Kathmandu. The district is an ancient agrarian town with a predominantly Newar population. The houses are traditionally made of clay and bricks. The traditional houses were well adapted to the local climate with the use of local building materials (Gautam et al. 2019). However, traditional houses are being replaced by the contemporary ways of construction, modern design and technology including artificial materials (Rijal 2012). Agriculture is the primary occupation of the households in the district and is considered as the pocket areas for wheat crops, commercial vegetable production, cereal production, and organic agriculture. Livestock is one of the primary sources of income for the rural areas in the district and is associated with agricultural farm. Ecosan toilets for 60 households were installed in the village

by the financial and technical help from Environment and Public Health Organization (ENPHO) in 2007/2008. During that time, ecosan was the new term in the study area. ENPHO informed the households with no toilets about the benefits and use of ecosan toilet. The main aim of ENPHO was to motivate to use toilet and to help households technically and financially to construct toilet was to meet the country's agenda to make a country open defecation free (ODF). There was no hard and fast rule for the households to choose and construct ecosan toilet. The households were given options of biogas toilet, normal pit latrine and ecosan toilet. The decision to choose the type of toilet was with the households head (some might discuss with the households members). Depending upon the land availability, households preferences, ecosan toilet was constructed for 60 households. After several years, a sanitation campaign was started in 2011 to declare the district ODF and became the first ODF district in Kathmandu valley. This village was chosen as a study area because the area represented an example of both ecosan and non-ecosan toilet and hence the perception of ecosan users and non-ecosan users would be well understood.

1.2. Population sampling, data collection and compliance

This study was based on questionnaire survey and *E. coli* tests. Ecosan toilet users' in the community of the study area were listed from the data of ENPHO. The respondents were randomly selected for questionnaire survey from the list mentioned above. Interviewing and sampling for *E. coli* tests were conducted only after people's consent with explanation of study objectives, anonymous data handling, and a publication way.

The total number of respondents was 30 comprising 15 households (25% of ecosan toilet installed) with ecosan toilet in their house and 15 households (same number as ecosan users') from 1,193 households with toilet other than ecosan. As this study tried to focus on perception of households about ecosan use, the number of interviewed households was limited because many of the ecosan users gave up ecosan at the time of survey. The major reasons for giving up ecosan were building of new house with flush toilet, destruction of house and toilet due to earthquake of 2015, difficulty to get ash and inconvenience to use by new members. All interviewed households (except one) belonged to the Newar communities, who in ancient days used toilet wastes collected from several households outside of their village. The questionnaire for the study was comprised of three main sections. The purpose of section I was to establish the socio-economic and cultural profile of the respondents, section II sought details of their farms and the type of farming they pursued, livestock reared, section III looked for insights into the respondents' perceptions, attitudes, inclinations, and willingness to shift towards use of ecosan toilet and human excreta based fertilizers.

Five households with ecosan toilet were selected to conduct *E. coli* tests. The sample was taken from both hands and both shoes back of the member handling ecosan manure. The samples were collected two times by using a swab test kit (ST-25 PBS; ELMEX, Japan). The first sample was collected before touching ecosan manure, i.e. before ecosan manure was applied in the field. The second sample was collected from the washed hand after the application was completed. Similarly, the soil before and after the application of ecosan manure was tested to understand the difference in presence of *E. coli* on soil before and after application. Urine samples were not collected for *E. coli* tests because in the study area very few households (13.3%) were found collecting urine separately for agricultural use.

1.3. Microbiological analysis

The collected soil samples and ecosan manure samples were analyzed for fecal indicator (*E. coli*). In this study, *E. coli* was considered to be the faecal indicator bacterium to infer the presence of fecal microorganisms, potentially including fecal pathogens. *E. coli* has been widely applied in risk assessment studies in the form of faecal indicator ratio. *E. coli* were cultured following a method 9215A in Standard Methods (Clesceri et al. 1998)

using XM-G Agar (Nissui, Japan). This is one of the essential indicators when evaluating microbial risk from various fertilizer products including faeces (Feachem et al. 1983; Sidhu and Toze 2009). Soil sample (10 g) and ecosan manure sample (10 g) were homogenized using a minishaker separately in 100 ml of buffer phosphate solution. After this 10-fold dilution series with buffer solution was prepared as extract liquid. The extracts were filtered through a membrane filter with pore size of 0.47 μm , upon which the bacteria were trapped. The filter was then placed on petri dish with XM-G Agar and incubated at 37°C for 24 h. According to the color profile of colonies, the number of *E. coli* colonies on each petri dish were counted and the results were expressed as colony-forming units per gram of sample (CFU/g) according to FAO (2001).

The sample in the swab test kit was mixed properly before pouring into the membrane filter with pore size of 0.47 μm . The filter was placed on petri dish with XM-G Agar and incubated at 37°C for 24 h. According to the color profile of colonies, the number of *E. coli* colonies on each petri dish were counted and the results were expressed as colony-forming units (CFU/hand or CFU/shoes' back).

1.4. Calculation and statistical analysis

E. coli concentration data were normalized by log transformation before analysis of variance (ANOVA). Statistical analysis was conducted using IBM SPSS Statistics 20.0 (IBM, USA), where a significant difference was reported at a 5% significance level.

2. Results and discussion

2.1. Socio-economic characteristics of respondents

The results of the socio-economic characteristics of respondents for ecosan users and non-ecosan users are presented in Table 1. During the questionnaire survey, 53% respondents were female in the households with ecosan toilet and 47% respondents were female in the households with no ecosan toilet. The average age of respondents was 46.6 years and 40.1 years in ecosan users and non-ecosan users respectively. The average household size was 5.5 and 4.9 in ecosan users' and non-ecosan users, respectively. The average size of family in Nepal is 4.6 with 17.1% nuclear households (family size 1–2) (CBS 2014). The transition from joint family to nuclear family is found increasing in the study area. The average farm size was similar (0.10 ha) in both types of households. The largest amount of vegetable producer among three districts in Kathmandu valley is Bhaktapur with an average landholding size of 0.15 ha for crop farming (MoAC 2006). Land holding size per family and field size have both decreased markedly in recent years (Deshar 2013). All households in the study area were found using LPG for cooking purpose. The study area in previous days used to use firewood for cooking purpose but gradually shifted from traditional cooking practice to use LPG due to lack of firewood and high availability of LPG with additional benefits such as its convenience, smoke free and time saving nature. All non ecosan users have pour flush toilet facilities in their house. Poor households are less likely to use the improved sanitation facility whereas most of the rich households have access to improved pour/flush toilet (MoH et al. 2017). The study conducted in Nepal by Budhathoki (2019) reported that poor households are less likely to have piped water connection in their home which limits access to the improved flush toilet. The principal occupation of both households was farming where rice, green vegetables, cauliflower were cultivated. Less than 7% of the farmers belonged to the age category < 30 years, showing consistency with the result from Sharma (2007) and Rajan (2003), reflecting the ongoing demographic crisis in Indian agriculture in which young people are increasingly less inclined to look to farming for their livelihood. Nepal's agriculture is also facing labor crisis, resulting in barren lands due to youth's migration either to the city or to abroad in search of quality living and to earn money. In Nepal, the proportion

Table 1. Socio-economic characteristics of respondents.

Variable		Frequency (%)	
		Ecosan users	Non-ecosan users
Gender	Male	8 (53.3)	7 (47.0)
	Female	7 (47.0)	8 (53.3)
Age	20–29	1 (6.6)	1 (6.6)
	30–39	3 (20.0)	7 (46.6)
	40–49	6 (40.0)	5 (33.3)
	50–59	3 (20.0)	2 (13.3)
	60 and above	2 (13.3)	0 (0.0)
Household size	5 and below	10 (66.6)	9 (60.0)
	6 and more	5 (33.3)	6 (40.0)
Source of income	Farming only	2 (13.3)	1 (6.6)
	Farming + service	10 (66.6)	10 (66.6)
	Farming + casual labor	3 (20.0)	2 (13.3)
	Farming + family business	0 (0.0)	1 (6.6)
	Farming + remittance	0 (0.0)	2 (13.3)
Landholding size	Below 0.1 ha	9 (60.0)	10 (66.6)
	0.1–0.5 ha	6 (40.0)	5 (33.3)
Livestock	Cow	3 (20)	2 (13)
	Goat	11 (73)	9 (60)
	Chicken	8 (53)	10 (67)
	No livestock	0 (0)	3 (20)

of economically active population depending on agriculture had fallen from 81 percent in 1991 to 60% in 2011 with significant drop in GDP (CBS 2014). Most of the household members of rural Nepal have been abroad for foreign employment. Remittance has become the major part of the national economy as it shares 26.9% in GDP in 2016/17 (Sapkota 2018). After returning home, only a few of them have been engaging in agriculture (Chaudhary 2018). Almost all respondents surveyed did not wish to disclose their income whereas most of them mentioned no savings from their income.

Higher number of households (11 ecosan users, 13 non-ecosan users) have land less than 0.1 ha. The study conducted by Maltsoğlu and Taniguchi (2004) in Nepal concluded that the households that have the average largest herd size (3.5 Tropical Livestock Unit (TLU)) are located in the mountains compared to rural hills (3.1 TLU), Terai (2.7 TLU), urban areas in Kathmandu (1.0 TLU) and in other urban areas (1.5 TLU). Fewer households own livestock in the urban areas in Kathmandu and in other urban areas (FAO 2004). The higher number of livestock in the households with ecosan toilet (0.85 TLU) might reflect the need of manure to use in their farm no matter through any source, chemical fertilizer or cattle manure or ecosan manure. Farm size and livestock number reared were related to each other among non-ecosan users (higher the landholding size higher is the livestock number, $r = 0.988$ ($p < 0.01$)) as in other parts of the country but the result was contrast in the households with ecosan users with low land holding size (Figure 1).

Landholding size and TLU was negatively correlated among ecosan users with low landholding size. Ecosan user households with low landholding size prefer to have more cattles in order to fulfill fertilizer demand for their land. Because the available land size is small, ecosan manure in addition to cattle manure is preferred as a substitute to chemical fertilizer. This is the reason that even after the collapsing of the house due to devastating earthquake of 2015, households would like to keep their ecosan toilet by repairing the damage. In contrast, the non-ecosan user households whose house was collapsed by the earthquake of 2015 built new houses and did

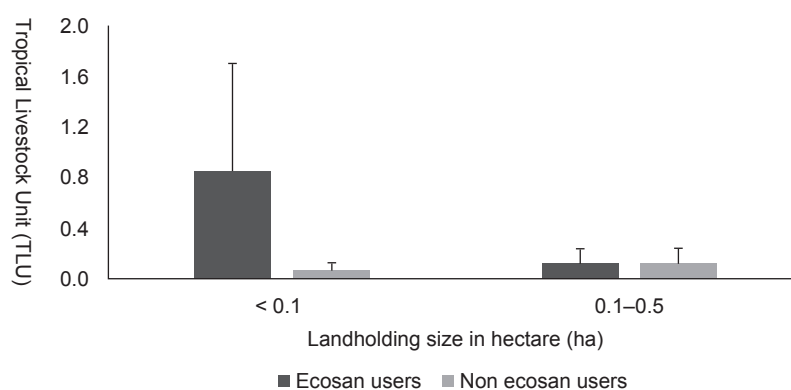


Figure 1. Relationship between landholding size and number of livestock of each household in the study area.

not want to keep cattles because of their thought that livestock decrease the aesthetic value of modern house. Non-ecosan users more likely depend upon chemical fertilizer to fulfill the fertilizer demand. Recently, people are selling land in the high price and interested to construct so called modern building or sophisticated house. The young generations do not want to engage in the activities like farming and livestock rearing. Most commonly used chemical fertilizers in the study area are urea, di-ammonium phosphate and murate of potash. The price of these fertilizer are NPR 18, 45, and 32 per kg (100 NPR = 0.83 USD as of 2020/08/09) respectively (MoAD 2016). In addition, sea freight, port clearance and the cost of transportation can account for as much as 20% of the cost of delivered fertilizer. Being the study area is not far from the Kathmandu valley, there is no constraint of chemical fertilizer as in other rural hilly areas. The households involved in agriculture does not have pressure to seek for the alternatives of chemical fertilizers in terms of availability. These might be the reasons of having lesser livestock number in the households.

2.2. Ecosan toilet in the study area and users perception

Table 2 presents the results of the facts in today's scenario of ecosan toilet in the study area. All interviewed ecosan users mentioned that the motivating factor in installing ecosan toilet in their house was the campaign started by ENPHO during 2007/08. The financial and technical help from ENPHO was the attraction to install ecosan toilet in their house at that time. The decision to construct either pit latrine, ecosan toilet or biogas toilet was decided by the family members depending upon the choice and need. Cultural and social norms play an essential role in deciding which type of sanitation system to use. According to Harada and Fujii (2020), even without cultural background of human excreta use, a high demand for feces use could be successfully created through association with a perception of the value of feces in agriculture.

There are many traditional examples of wastewater and excreta management in several parts of Nepal. Sherpas in mountainous regions still feed their feces to pigs, Newar of Kathmandu valley still use feces in producing vegetables, a farmer in middle hill still uses greywater in their kitchen garden (Poudel 2015). Local people are worried about the use of chemical fertilizers, as they believe that these fertilizers cause soil compaction, which hinders other farming operations (Poudel 2015). Human excreta are considered to be the richest manure and are collected in a special dry latrine pit. Such systems are accepted in those communities not only because people are poor but because of the long traditions of using human waste in crops. However, these traditional practices are slowly diminishing as the younger generations hesitate to adopt it in the name of modernization. Thapa and Kattel

Table 2. The facts associated with ecosan users.

Variable	Level of agreement (%)	
	Yes	No
ENPHO as a motivator to install ecosan toilet	100	0
Continuous use of urine and excreta as fertilizer till date	100	0
Urine is collected separately to use as a fertilizer	13.3	86.6
Use protective measure while handling urine and excreta	46.6	53.3

(2019) mentioned modernization as a regular process of change that happens by adopting new tools and technology. It provides opportunities for people to leave the village and joint family system and shift to the industrial areas. It has affected the family structure, marriage system, prevailing social norms, values and cultures in Nepal. The study also reported that in the rural areas of Nepal where the impact of modernization is less, the joint family is practiced whereas in the cities and urban dwellings, nuclear family system is in existence. A similar culture of using human waste in farm was adopted in ancient days in the study area. The use of human excreta as a fertilizer has a history of more than 200 years in Nepal (Ho and Mathew 2002). They mentioned in their book that sanitation systems in cities, where night soil was collected door to door and taken to surrounding farms for crop fertilization can be dated as far back or further.

According to the ENPHO personnel, because of the long tradition of using human waste, 60 households agreed to construct ecosan toilet in their house in 2007/08. All ecosan users interviewed during this study were using ecosan toilet continuously till date. All users were found using urine and excreta as a source of fertilizer. After years, majority of the households (86.6%) (Table 2) changed the habit of urine collection. Although similar result of using urine by lesser households compared to the households using feces was reported in Malawi in the study by Harada and Fujii (2020) the reason for not using urine is different. According to Harada and Fujii (2020), no use of human urine from ecosan toilet in Malawi was related with no use of animal urine leading to psychological constraint for use of human urine. In contrast, in this study the respondents mentioned that they do not collect the urine from the ecosan toilet separately but use them by mixing with the kitchen waste and cattle manure. Although the respondents are aware of the positive effects of urine as fertilizer value, the reason for not collecting urine is related to the fast filling of the collecting tank, problem associated with storage of urine and difficulty to carry out urine in the field because of its large volume after dilution. The study area is located in the hilly region and terrace farming is common practice. Because majority of the farms are located farther from the house, the family members found it difficult to carry the urine jar to the field. Instead, to recover the fertilizer value of urine, the households mix urine with the households' manure (kitchen waste and cattle manure collected outside of the house). They believe that the urine accelerates the manure decomposition rate and manure could be utilized whenever necessary. It also solved the problem of storage, carrying urine to the field and need of water for dilution.

It was found from the survey that after defecation, ash was used as an additive to sanitize fecal matter. All interviewed households mentioned that they wait for six months to use excreta as a fertilizer. The ash had a higher effect on the operational parameter (increase pH and decrease moisture content) during storage compared to the sawdust (Niwagaba et al. 2009). Demonstration on urine and feces use for agriculture enables the participants to recognize the effects of human waste on agriculture (Harada and Fujii 2020). However the perception of people on agricultural value of urine and feces is associated to the continuous use. In this survey we found that the ecosan users are not much conscious about health risk, which was justified by the result that 53.3% respondents were found not using any protective measures while handling ecosan manure (Table 2). All interviewed respondents agreed on the positive effect of ecosan toilet in terms of fertilizer use of urine and excreta. Eighty percent of the

respondents mentioned that they do not have any problem caused by ecosan toilet and is the reflection of positive side of ecosan toilet. Majority of the respondents mentioned that they could harvest 220–250 kg of ecosan manure in one year (half in six months period). Being majority of households have land less than 0.1 ha, the amount of ecosan manure harvested is enough if cattle manure incorporated with urine is applied together with ecosan manure. In the case if number of cattle reared is small or zero, the farmers need to supply chemical fertilizers to meet the fertilizer demand. Among 15 respondents, 2 household (13.3%) had 6 members in the family and 13.3% had more than 6 members in the family. No complaints or burdens regarding emptying pit was explained by the respondents during the survey. Despite of awareness about the use of ecosan manure, construction of modern house, interest on employment activities other than farming, less availability of land size, water availability, and easy accessibility of chemical fertilizers were observed as factors that distract households to adopt or to continue ecosan toilets.

2.3. Perception of non-ecosan users toward excreta reuse for agricultural purpose

This section presents the results on the respondent's (non-ecosan users) perceptions and knowledge towards using urine and excreta for agricultural purpose, their willingness to construct ecosan toilet and their attitude towards the products grown by using ecosan manure (Table 3). Among the respondents, it was found that although these non-ecosan users are using either pit latrine or flush toilet, 87% of the interviewed respondents had experience of ecosan toilet use (Table 3). Twenty-seven percent respondents (4 households) mentioned that they had used ecosan toilet in their previous house (old ecosan users') and 60% (9 households) respondents replied that they had used ecosan toilet in their neighbors' house. Among 15 respondents, only 13% (2 households) respondents were found who has not used ecosan toilet till date. It was understood from the survey that during the devastating earthquake in 2015, 3 households lost their houses along with their ecosan toilets. Once the house was recovered after earthquake, the households switched from ecosan toilet to the ordinary or flush toilet. The reason for not constructing an ecosan toilet in the new house is due to the perception that such ecosan toilet is suitable only for old and traditional house. Availability of large space around the house, use of firewood for cooking in those houses making ash available to use in ecosan toilet and engagement of household members in agriculture best suited to ecosan toilet in traditional houses. In contrast, lack of space in the newly constructed house as a result of increased land price, family members wish to install toilet inside the house, gradual decrement of agricultural land tended to make the ecosan toilet unsuitable for modern houses (Table 4). Construction of a new house with modern toilet is the necessity of new generation. One of the previous users among the interviewed respondent mentioned that they shifted from ecosan toilet to modern toilet due to the wish of the younger family members. The respondents also mentioned that people gradually started nuclear family and seek other income generating sources giving up farming.

Among the total respondents, 83% replied that they had tasted the products grown from ecosan manure which represented that the respondent consumers do not mind consuming products grown from ecosan manure. They got those products from their neighbours who had an ecosan toilet in their house and raised the crops or vegetables using ecosan manure. It is common mostly in the village of Nepal to share or exchange newly grown vegetables among the neighbours. Among those respondents who tasted products from ecosan manure, 60% mentioned better taste of product grown compared to the one grown from chemical fertilizer while 33% mentioned no difference on taste in the product grown from ecosan manure and other fertilizer. This result showed the possibility of ecosan toilets still exists if toilet could be served with some modification and if it could be adjusted to modern toilets. The market for organic vegetable is gradually growing in Kathmandu valley but not all the farmers have the access to that market. Since the vegetables grown in this study area are

Table 3. Non-ecosan users' knowledge on ecosan and products grown from ecosan manure.

Statement	Yes	No	Need to think
Willing to install ecosan toilet at home	20	67	13
Tasted products grown from ecosan manure	93	7	
Aware of positive effect of human waste	74	26	
Ever used ecosan toilet	87	13	
Knowledge of ecosan toilet	93	7	

Table 4. Non-ecosan users statement to no interest for ecosan toilet construction.

Reasons for not having willingness to construct ecosan toilet	Respondents No (%)
No space/ No ash	6 (40)
Not user-friendly	1 (6.6)
Already have toilet	3 (20.0)
No idea	2 (13.3)

less in amount, the farmers sell the vegetables together with the vegetables grown by using chemical fertilizers. It would be an advantage for the farmers if the market for the products grown from ecosan manure worth more monetary value based on the taste and quality. It is also interesting to note from this study that even though the respondents did not have ecosan toilet in their house, they were seen irrigating their farms with sewage and greywater, pipes linked from their toilet to farm. They would like to use it as an agricultural value on their farm. This will save their money necessary to pay for the disposal of toilet waste and add nutrients to their field. Generally, in the Kathmandu valley with pour flush toilet, the toilet waste is collected in a septic tank. Once the tank is filled, the designated authority will visit the house to remove the toilet waste after paying the specified amount (money). They have mentioned that the authority charges around NPR 5,000 (100 NPR = 0.83 USD as of 2020/08/09) to remove the waste from their toilet.

In Nepal, farmers take raw (fresh) excreta from latrines to their vegetable gardens and grow good quality vegetables, which are tasty and are in high demand (Mishra 2003). In Siddhipur village of Nepal, most of the farmers use animal manure and raw human excreta as fertilizer for crops and vegetables. They have been doing this practice since ancient days, although it was considered unhygienic by the villagers (Mishra 2003). In our study area, although the respondents are aware of positive effect of ecosan toilet and do not hesitate to consume products grown from ecosan manure, the willingness to construct an ecosan toilet is less (20%) (Table 3). Ishii and Boyer (2016) also mentioned that 84% of students in the university of Southeastern region of United States would demand source separation systems to be installed in their halls of residence although their demand declined significantly when the respondents were asked their willingness to pay for it by themselves. In contrast, Lamichhane and Babcock (2013) reported that more than 60% of their test sample of 132 people from the University of Hawaii indicated their willingness to pay an extra \$50 to install a urine diverting toilet. One reason that discourages interviewed respondents (40%) from constructing an ecosan toilet is the need of ash to sprinkle after defecation. People living in the outskirts of Kathmandu valley shifted from firewood to gas stove to cook their food. It became challenging to manage ash for ecosan toilet. Only few people (6.6%) mentioned that such type of toilet is suitable for the family with 4–5 members in their house. They mentioned that if the household size is large, the toilet pit fills earlier before six months' time frame, storage time will be less, and

frequent emptying of vault would be additional work. Building an ecosan toilet for a family of 5–7 members is ideal but in case that household members are more, the faeces collection chamber should be designed to accommodate higher number of users (UNICEF 2011). The number of pathogens in fecal material during storage will be reduced with time due to natural die off, without further treatment (Schonning and Stenstrom 2004). Less storage time of excreta than recommended (six months) increase health risks for farmers due to the incomplete sanitization of feces.

2.4. Microbial risk assessment and existence in collected samples

Farmers and consumers exposure to ecosan manure was analyzed for risk assessment and are presented in Table 5. Majority of the farmers who planted crops three times in a year refers to the fact that they deal with ecosan manure for at least three times in a year (Table 5). Compost amending, plowing, seeding, weeding and harvesting are the major works that have direct or indirect contact with ecosan manure. Some farmers were found irrigating their field with the greywater using the pipe linked from their toilet to the farm. During irrigation, farmers did not wear protective clothing and were in direct contact with the irrigation water. Accidental ingestion of irrigation water and consumption of irrigated vegetables are the exposure paths. According to Julian et al. (2018), *E. coli* contamination of excreta and other frequently contacted objects strongly influence hand contamination and *E. coli* contamination of excreta and hand-to-mouth contact frequency influence ingested dose. The effects of contaminated soil on health were lower than direct handling of greywater and compost (Hijikata et al. 2017). Mostly Nepalese people consume green vegetables or other crops after cooking. The risks and existence of fecal microorganisms might be lower if consumed cooked, compared to vegetables consumed raw. Regarding the risks in compost reuse, it is recommended to store human manure for 6–12 months for adequate handling of UDDT (Schonning et al. 2007). The ecosan user households in the study area were found adopting a similar storage period of at least six months before applying to the farm as instructed by ENPHO. All interviewed ecosan user used ash as an additive after defecation. The ash or lime is added after each defecation to lower the moisture content and raise the pH to 9 or higher thus creating dryness (Winblad and Simpson-Hebert 2004).

Regarding the use of personal protective equipment (PPE), it was confirmed from the ENPHO staffs that during the installation of ecosan toilets in the study area they had instructed to use gloves and masks while taking out the ecosan manure from the filled pit and while using ecosan manure as a fertilizer. Though proper instruction was delivered, from the questionnaire survey result it was observed that more than 50% respondents (Table 2) did not use any precautions like gloves or masks while dealing with ecosan manure. It reflects the respondents are less concerned about health risks due to handling of ecosan manure or do not want to invest money on those precautions. As reported in Knudsen et al. (2008), personal protective equipment, although perceived to be beneficial, is often neglected due to costs and/or perceived convenience. The households did not hesitate to touch the ecosan manure with the bare hands. It was also observed that after finishing their work on the farm, they are conscious of washing hand but not conscious of washing legs or shoes. From the survey, it was found that ecosan users in the study area believe that it is safe to use human urine and ecosan manure as a fertilizer and did not show more concerns for health risk. This perception about ecosan manure came from older generations who used to use these products in their farm. In rural India, farmers have been observed to rely on the advice of people they know, family members, and in many cases, helpful neighbouring farmers rather than expert advice (Simha et al. 2017). Proper guidance and knowledge about possible health risk due to mishandling and improper management of ecosan toilet and ecosan manure should be delivered to the locals so as to minimize the health risks.

Table 5. Exposure scenario of farmers and consumers for risk assessment.

Target	Event	Ingestion means	Ingestion scenario	Event no. /year	
Farmers	Compost amending	Direct contact with compost	Handling of compost with bare hands	3	
	Plowing	Soil contaminated by compost	Soil touching after applying compost	3	
	Seeding	Soil contaminated by compost	Soil touching after plowing	3	
	Irrigation	Greywater		Handling of a watering can or bucket or pipes running through greywater	6
		Soil contaminated by compost and greywater		Soil touch twice or thrice for weeding	
	Weeding	Greywater on leaves and stems		Touching of plant leaves containing greywater	3
		Soil contaminated by compost and greywater		Soil touching for removing vegetables	
	Harvesting	Greywater on leaves and stems		Touching of plants	3
Consumers	Eating	Raw eating vegetables	Eating vegetables raw or not properly washed		

Microbial contamination in soil and ecosan manure

For soil samples collected from five households before and after application of ecosan manure, *E.coli* concentration (CFU/g) was measured. *E.coli* was detected in all the soil samples. Presence of *E. coli* in soil in the initial state before applying ecosan manure suggested that the source of fecal microorganisms in the soil was not only the ecosan manure (Figure 2). Besides ecosan manure, other sources such as irrigating water, cattle manure, chicken manure might be the contaminating source of fecal microorganisms, including *E. coli*, in soil. Several factors such as temperature, moisture, nutrients either alone or in combination with soil organisms influence the growth and survival of *E. coli* in soil (Ishii et al. 2010).

Among 5 ecosan manure samples collected, *E. coli* (CFU/g) was detected in samples of 3 households (HH 1, 4, 5) whereas no *E. coli* was detected in ecosan manure samples of 2 households (HH 2, 3) (Figure 2). No *E. coli* detection on 2 households might suggest that proper management of an ecosan toilet could play a role to sanitize the excreta, lowering the health risks of using excreta.

Microbial contamination in hands and shoes back

For all 5 households, 10 hand samples (5 right hand, 5 left hand) and 10 shoes back samples (5 right shoes, 5 left shoes), *E. coli* concentrations were measured. Although the households are concerned of washing hands after dealing with ecosan manure, higher concentration of *E. coli* (\log_{10} CFU/hand) even after washing hand (Figure 3) was observed. Although there was no significant change in *E. coli* concentration in hand before and after handling among the households, no *E. coli* concentration in hand samples was found in HHs 2 and 4. Higher concentrations of *E. coli* on hand before handling ecosan manure might also indicate that only ecosan manure is not the source for fecal contamination on hand. *E. coli* counts in the faeces with ash decreased with decreasing moisture content and gradual increase in pH during the storage period (Niwabaga et al. 2009). No change in *E. coli* concentration even after washing hand suggests that the concentration could be affected by water used for washing hand and the way of washing.

Among 5 shoes back samples, in HHs 3, 4, and 5, no *E.coli* (\log_{10} CFU/shoes) was detected on shoe sample even before and after dealing with ecosan manure (Figure 4). Significant difference in *E. coli* concentration on shoe back before and after washing was observed with high concentration of *E. coli* in shoes back after dealing with

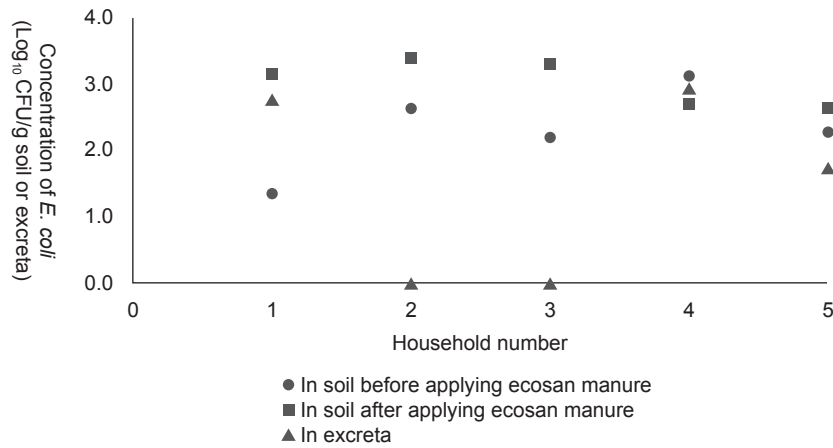


Figure 2. Concentration of *E. coli* in soil and excreta due to ecosan manure among five households.

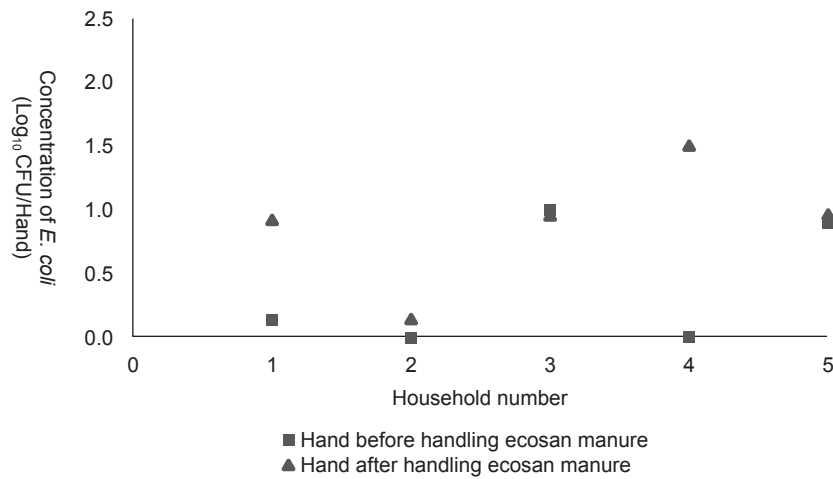


Figure 3. Concentration of *E. coli* on hand before and after using ecosan manure among five households.

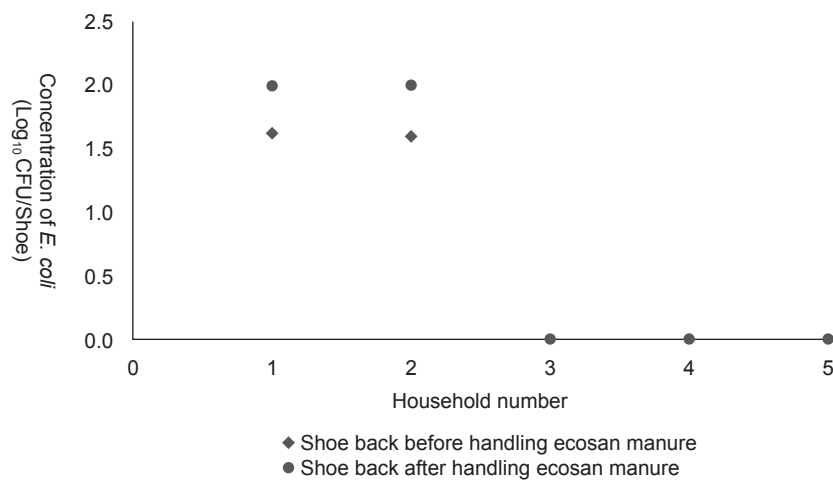


Figure 4. Concentration of *E. coli* on shoe before and after using ecosan manure among five households.

ecosan manure or after coming back to home from outside. It is related with the facts that household members were conscious on washing hand but not for washing legs and shoes after finishing their work. It also reflects to the fact that if we give proper attention to the washing not only while dealing with the ecosan manure but during other households activities, it might have positive effects on reducing fecal contamination on hands, leading less fecal exposure and better human health. Along with sanitation, proper hygiene management training and provision of clean drinking water might be the components necessary to achieve the health improvement in the area. Farmers need to be educated on precautionary measures to avoid health hazard from excreta reuse (Cofie et al. 2010). The current situation about locals' perception might help to address health risk issues associated with ecological sanitation technology and can play a role in dissemination and expansion of such technology. Simha et al. (2017) indicated that for farmers in India to adopt human waste as a fertilizer, they must know someone who uses/used it and/or must be convinced of its crop productivity potential.

Conclusion

This study investigated both ecosan user and non user households' attitudes, and perceptions toward human excreta reuse for agricultural purpose in the study village of Bhaktapur district in Nepal. Farming is the predominant occupation in the study area, and ecosan toilet was disseminated for several households by the financial and technical help from ENPHO. The study found that majority of the respondents in the study community disagreed that excreta is the waste. However, some households were found continuing ecosan toilet till date while some previous users already shifted from ecosan to other toilets due to the choice of younger generation to build modern toilet. This result reflects that though non-ecosan users are also motivated to use products from ecosan manure as an fertilizer amendment, the desire of the new family members in the house and concept that ecosan toilet is not suitable in modern house is the factor that disable users to continue it. To minimize the rate of discontinuation after the dissemination of new technology, it is necessary to monitor the condition of toilet and provide suggestions for the betterment of the toilet, to increase ecosan users and to promote excreta reuse in farming. Open discussions on the benefits and risks associated with excreta reuse in agriculture could enrich farmer's knowledge on the handling and appropriate use of excreta as fertilizer. The study concluded that ecosan manure is not only the source of fecal microorganisms. Ecosan manure might get contaminated by fecal microorganisms through other sources if handled inappropriately. Proper attention should be done to reduce such contamination which is generally neglected by most users. Further research on the factors that influence farmers decision on excreta reuse for agricultural purpose and perceptions on health risks is recommended to avoid contamination of ecosan manure and associated negative health impact by fecal microorganisms. Time to time and door to door supervision on toilet management and modification to meet the need of younger generation is also recommended for the long-term sustainability of the ecosan.

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Latrine Development in Thailand

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Abstract

Millions of people in developing countries are still using open spaces for defecation. Such practice often leads to the spread of infectious diseases and risk of death. Despite much effort to change this unsanitary practice by governments and international agencies, challenges remain in many parts of the developing world today. Although there is no one model for latrine development that fits all, lessons from successful cases can be learned by countries currently striving to increase latrine coverage. This study focuses on how a developing country such as Thailand has come to succeed in latrine development. The analysis is based on documentary data supplemented with interviews of purposively selected key informants. Results of the analysis reveal that the success of latrine development in Thailand is facilitated by a number of key factors including: (1) Strong policies through which resources, man power and materials needed for latrine development can be provided; (2) Integration of latrine development into the overall health and sanitation development process, which makes the campaign meaningful among the target people; (3) Appropriate approach and strategies for implementing the project; (4) Adequate health facilities needed for effective execution of latrine development; and (5) The people's willingness to participate as a result of changing knowledge and attitude about the health benefits of using latrines. With the goal of universal latrine coverage achieved, Thailand is now moving forward to improve latrine quality in all sectors and the proper management of fecal sludge. Based on Thailand's experience some recommendations are provided for countries currently striving to achieve universal latrine coverage.

Keywords: community development, revolving fund, universal latrine coverage, management of fecal sludge

Introduction

According to the Global Burden of Disease study 775,000 people died prematurely in 2017 as a result of poor sanitation (GBDCN 2018); one of the problems noted is limited access to safe latrines. Although the share of the global population who do not have access to safe latrines has fallen to about 9% in 2017 (Ritchie and Roser 2020), millions still depend on open spaces for defecation. For example, in Togo about 72% of the rural population still use open spaces to defecate while 53% in Cambodia and 47% in India still do the same (WSSCC 2019; McCarthy 2019). Another sanitation problem is the lack of proper management of human waste which leads to environmental pollution and transmission of various infectious diseases (CDC 2015).

Providing proper sanitation for all remains one of the challenges for many developing countries. Without improved sanitation, and as long as most people in the country do not have access to safe latrines, the country's health development is difficult to achieve. Furthermore, in the absence of good sanitation and access to safe latrines by all people, development of other economic and social aspects is also difficult to realize. This is why attention needs to be given to latrine development.

In mainland Southeast Asia, where the site for this study is located, most people in rural areas had limited

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access to basic human needs until after the Indochina Wars in 1989. The region has now become an economically dynamic area. It is worth noting that in the period from 1990 to 2015 availability of improved sanitation increased substantially in some countries, particularly Myanmar, Thailand and Vietnam. Latrine coverage in these countries is recently reported as 96%, 100% and 99% respectively (Koottatep et al. 2018).

Thailand, the focus of this study, is unique in terms of its social and economic development. In the recent decades the country has experienced rapid economic growth, and economic crisis, due to the bubble economy of the time. However, by 2011 it was considered a country in the upper-middle income group (Jitsuchon 2012). The Thai government has been working actively to improved access to latrines for the people along with development in other economic and social aspects since the middle of 20th century, and more so since the 1960s when a series of five-year National Economic and Social Development Plans were launched. In 1986, about half of the households in the country had safe latrines and by 2016 the percentage increased to 98.9% (Luong and Arphacharus 2016). Recently much emphasis has been given on further improvement of public latrines. In 2005, for example, a senior officer of the Ministry of Public Health stated, “[Public] latrines are very important for the country’s image in the eyes of visitors.” This was stressed by the Deputy Minister of Public Health; he said, “Health officials would inspect public latrines at schools, restaurants and tourist venues to ensure that they met international sanitary standards” (thePlumber.com 2005).

To date Thailand has been successful in developing its sanitation systems. As a developing country with improved sanitation facilities, particularly availability of safe latrines for the households and the public, Thailand can be considered a success case. Its experience in this respect could provide valuable lessons for many developing countries currently working toward increasing safe latrine access for their populations.

The main purpose of this study is to understand how Thailand has come to achieve latrine development. Our focus is on how the country has managed to increase latrine facilities in the context of household, community, and the wider public arena. This paper begins with a descriptive account of Thailand’s latrine development and from this descriptive account identifies what may be regarded as facilitating factors of the success, drawing upon the data from existing documents and qualitative data from interviews of selected key informants. The paper concludes with some recommendations for developing countries that are striving toward increasing safe latrines among their populations.

In this paper, “latrine” refers to facilities for human defecation which may be built within or physically close to the house or public building. “Latrine development” indicates provision of safe latrines at the household level and in public places; this term also includes proper management of fecal sludge and wastewater from latrines. “Sanitation development” is used specifically to refer to facilities and services for safe disposal of human excreta which involves treatment and separation of human excreta hygienically from human contact (NSO 2013; WHO 2016; Van Minh and Nguyen-Viet 2011).

1. Methodology

1.1. The Study Country

This study was based on fieldwork conducted in Bangkok, Thailand (Figure 1). Thailand has an area of 513,120 km² with a population of about 66.5 million people in 2019, of which 65.5 % live in the rural area (NHA 2019). The country has 21.6 million households, out of these 53.4% are in the rural area (NSO 2019). Administratively the country is divided into four main regions of North, Northeast, Central, and South, with Bangkok being regarded as a separate region. The country experienced an economic crisis in 1997. By 2005 it recovered with a GDP of 189,318 million US dollars. Although the country’s economy is affected by the global economic crisis,

it continues to grow. In 2018, GDP of the country was 504,993 million US dollars and its' annual growth rate was 4.1% (World Bank 2019). At present every household in Thailand has access to safe latrines with sanitation development considered at a moderate level (Koottatep et al. 2018).

1.2 Data Collection

Data collection was carried out from January 8 to February 4, 2020. Documentary data were collected from existing documents available in libraries and online sources. In-depth interviews were also conducted with 14 key informants. The data collection was done in collaboration with the researchers at the Institute for Population and Social Research (IPSR), Mahidol University. The key informants for in-depth interviews were selected purposively to reflect experiences with, and/or responsibility for, latrine development at different levels of the campaign/execution. The selected key informants include community leaders as well as people who had direct experience with latrine development at the policy level. A list of topics to be covered in the interview was prepared beforehand; all key informants were asked about the same topics, allowing for flexibility to suit experience of each interviewee. Besides interview with the key-informant at the policy and community levels, an interview was conducted with the Chief Executive Officer of a well-known non-governmental organization (NGO) dealing with population and community development. A senior officer of the public company dealing with petroleum in Thailand which is widely known for maintaining quality latrines for its customers in the gas stations was also interviewed.

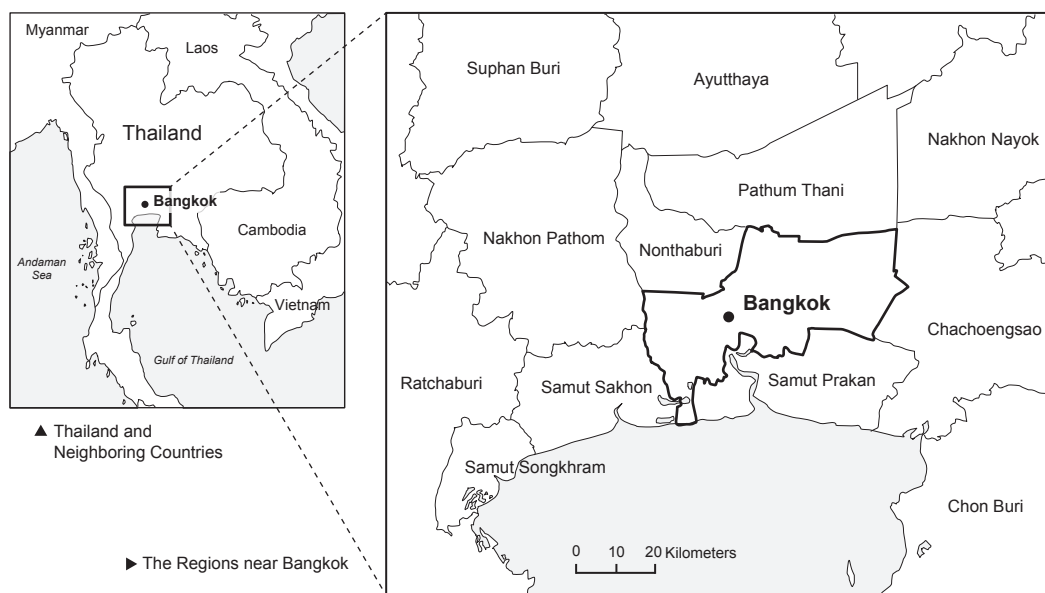


Figure 1. Location of study site.

2. Findings

This section presents results of descriptive analysis of latrine development in Thailand at both national and local levels. It is divided into four parts. Part 1 gives an account of latrine development in three successive historical periods conveniently referred to as the premodern period, the early modern period, and the late modern period. Part 2 looks at the success of latrine development in Thailand. Parts 3 and 4 reflect respectively on the factors facilitating success and the remaining challenges for Thailand's latrine development.

2.1. Latrine Development: A historical sketch

Latrine development in Thailand may be best understood in three successive historical periods. This section gives details of the development in each of these periods based on existing documents and interview data.

The Premodern Period

The premodern period in Thailand's history lasts about 700 years from 1200 to 1900; it covers the largest part of the country's history since the emergence of the first Thai nation state. This long period is characterized by low social and economic development; people lived close to nature with simple technology. Evidence of the people's use of latrines in this period is rare, let alone its development. The oldest archaeological evidence of a stone slab found in this period is believed to be part of a latrine. It is dated back to the time of the Sukhothai Kingdom (1238–1438), the first administrative and political center of the Thai nation. This evidence suggests that the type of latrine used in that time was a squatting pit privy. However, use of latrines is believed to be limited to members of the ruling class and perhaps the Buddhist monks of that time. Among most ordinary people defecation was not done in a man-made latrine but in natural places such as bushes, canals, rivers, and open spaces. The use of such natural places as a "latrine" is believed to be common among most ordinary people not only in the time of the Sukhothai Kingdom but also in subsequent Thai kingdoms of Ayutthaya (1350–1767), Thonburi (1767–1782) and much of Bangkok (1782–present) as well.

Other types of latrine, believed to be in use around the end of this period, is a bucket latrine where a bucket is used as a container of excreta and frequently taken out for fecal disposal and cleaning before being put back in for reuse. However, regardless of the type, use of it was limited to the urban communities where population density was higher. Most of the people, particularly in the rural areas, still relied on natural spaces. Defecation in natural space was so common in the past that when people in those days referred to daily defecation, they used an indirect word of "*pai paa*" (lit., going to the bush) or "*pai thung*" (lit., going to the open field). These words were believed to be "more polite," probably comparable to "going to toilet" or "going to rest room" in the present time expression. It is worth noting that the word "*pai paa*" and "*pai thung*" are still familiar to most people of the older generation today especially in the rural areas. This suggests that the practice of defecation in natural spaces existed up to the recent past when it has been replaced with defecation in a latrine (Sanitation Division 1987).

Toward the end of this period there was a concern about poor sanitation and lack of proper management of human excreta which caused various infectious diseases including diarrhea, cholera, cryptosporidiosis and parasites particularly hookworm and liver fluke. It is believed that such concern and awareness in part of the government must have been influenced by the contact with the western medicine since late 19th century, if not earlier. This concern is reflected in a government announcement in 1897 regarding garbage management and the provision of pit latrines for the general public. This is probably the first time that the government had a clear policy on sanitation and latrine. However, this announcement was for the city of Bangkok where population density was higher than in other areas (Department of Health and UNICEF 1988; Sanitation Division 1987, Hfocus 2018). This policy paved the way toward sanitation development in the early modern period.

Early Modern Period: Beginning of organized efforts for latrine development

Thailand entered the first chapter of socio-economic development around the turn of the 20th century. This period covers the time from 1900 to 1950. It is marked by two important events. The first event is the political revolution in 1932 from the system of absolute monarchy to democracy. Although this change in political system had no direct impact on latrine development, it provided a favorable context within which national development in all aspects operated. The second event was the establishment of the Ministry of Public Health (MOPH) in 1942 which significantly enhanced health development in general and latrine development in particular.

Following the government's announcement in 1897 mentioned above, more organized efforts were made for sanitation and latrine development in this period. The first of these efforts appeared in 1918 when the Royal Thai Government launched a pilot project for hookworm eradication in the Chiang Mai region. This pilot project was carried out by the Department of Public Protection, Ministry of Interior, in cooperation with the International Health Council of the Rockefeller Foundation.

Prior to the beginning of this project a survey of 30,000 people found that about 80% of them had hookworm in their excreta. To fight this problem the hookworm eradication project arranged sanitation education and latrine campaign. According to a document from the Sanitation Division of the Department of Health, the project helped install a large number of latrines in the project area. In 1921 a survey of more than 100,000 people found that 68% of them had hookworm in excreta comparing to 80% in the initial survey. This encouraging result led to expansion of the project to 44 provinces in the country with help from the International Health Council of the Rockefeller Foundation. Meanwhile, in 1926 the Ministry of Interior also issued an order banning defecation in rivers and canals. From this project the government learned that improving environmental sanitation was essential not only for eradication of hookworm but for reducing other infectious diseases as well (Sanitation Division 1987; Department of Health and UNICEF 1988).

Another concern of the government at that time was the management of human excreta, especially those from the home and public latrines in Bangkok. Initially, a Chinese private company was granted permission to collect and dispose excreta. However, this work was later taken over by the government. A plan was also developed to construct sewage pipes for draining human excrement and wastewater from households to the nearby waterway, i.e., canal and river, so that they were carried away by water into the sea. However, the project was not implemented due to lack of budget (Luong and Arphacharus 2016). Instead, the Department of Capital Administration purchased two boats to collect excreta and dispose of it in the sea, about 25 kilometers to the south of Bangkok. All households were required to have excreta ready in buckets to be collected by the workers after midnight. Each household paid a monthly service fee of 1.50 baht (0.05 USD, current rate). This project, however, was not successful because most of the excreta dumped into the sea was often pushed back up the river by the wind and high tide (Sanitation Division 1987).

Up to this time there was no evidence about the type of latrine recommended for use in the country. What seems to be obvious, however, is the concern about the lack of appropriate latrine models that could be introduced to the people. Responsible officials in the administrative system were aware that, if the people were to use latrines, there must be an appropriate type; otherwise sanitation development and the hookworm eradication project would not be successful. The invention of an appropriate latrine for the Thai people was then encouraged. Ideally the latrine would be convenient for use and maintenance, and acceptable in terms of the users' value and practice. It also would be affordable for the average household in the countryside to install.

In 1924, the first model latrine was invented by the governor of Sukhothai province. The new invention, however, was not satisfactory. The inventor continued to improve it through field tests until it was officially accepted. This was a pour-flush water-sealed squatting type of latrine made to prevent the spread of parasites, flies and odor. The

new latrine did not need much water to flush and was considered safe and appropriate. This invention was a small but important step in the process of hookworm eradication and sanitation development in Thailand. The remaining task was to have it accepted and installed by the people.

In the later part of this period people in many rural areas had at least some exposure to knowledge and use of latrine. Yet, it is still premature to say that safe latrines were already common and widely used in those areas. In fact, where it was used, the common type of latrine was a pit privy that was not effective in terms of preventing odor and flies. Otherwise, traditional practice of defecation in the open spaces still widely existed in the rural areas. Moreover, availability of latrines at home, where it existed, did not necessarily mean that it was regularly used. In many cases the people installed latrines simply because they were instructed to do so by the project officials, which had to be respected in the people's view, and not because they really needed it. As a result, many people who had latrines still did not use it regularly partly because they did not appreciate it so much and partly because of limited access to water which was essential for use of safe latrines. It was, therefore, quite common that many home latrines were left unused for a good part of the year; according to key informants some latrines were even turned into storage areas for farm equipment.

Establishment of the Ministry of Public Health (MOPH) in 1942, mentioned above, brought a significant change to the health infrastructure which greatly facilitated not only health development in general, but in particular the development of latrines as well. This new ministry brought together all agencies dealing with various aspects of health development in other departments, thus making the administration more efficient. Under the MOPH the environmental sanitation, of which latrines were a part, has been integrated into the overall health development. Mobilization of foreign aid also increased, making the campaign for controlling significant communicable diseases related to human excreta more effective (Luong and Arphacharus 2016; Department of Health and UNICEF 1988). Indeed, the emergence of the MOPH paved the way for comprehensive health development which had a positive impact on latrine development in the subsequent period.

In short, latrine development in the early modern period was driven by the government concern about environmental sanitation and infectious diseases. This concern was translated into the hookworm eradication project. It is through this project that more intensive latrine development has taken shape in Thailand.

Late Modern Period: Extensive development and success

The late modern period refers to the time from 1950 to 2000 and beyond. Overall, this period is characterized by extensive national development in all aspects—social, economic, transportation, and health. With respect to health development, during the initial two decades (1950s and 1960s) several changes have been made to restructure, reorganize or reorient some units within the MOPH; all of these were made to facilitate the unified work under the new approach of “community development.” Some new units/projects were also initiated, for example, the Regional Health Division, the Rural Health Project and the Regional Health Development Project. These units involved directly or indirectly with sanitation and latrine development mainly in the rural areas. The most important change, that has significantly altered the socio-economic profile of the country in general and latrine development in particular, happened in 1961 and continued up to the present. This was the emergence of the five-year National Economic and Social Development Plans (NESDP)¹. The descriptions given below focus on key activities related to latrine development in this period.

In 1953, the Department of Health launched a pilot project for rural health development in Chiang Mai with

1) Currently the 12th Plan (2017–2021) is under way. Except for the first plan which operated for six years, the rest are all run for the period of five years.

support from the United States Operation Mission - USOM (Sanitation Division 1987). In 1960 this pilot project was officially included under the Department of Health and was known as Community Health Development Project. It focused on sanitation and health development in the rural areas using a community development approach (Sanitation Division 1987; Luong and Arphacharus 2016). At its completion, the project was evaluated as having achieved its goal (Department of Health and UNICEF 1988). Since then, the MOPH carried out various projects which contributed directly or indirectly to latrine development at the community level. It is no doubt that the inclusion of sanitation issue in the community development is an outcome of change in public health knowledge being cumulated over time well before establishment of the MOPH in 1942.

Within the Ministry of Public Health the Village Health and Sanitation Project (VHS) was initiated in 1960 to combat the prevalence of water/filth-borne diseases. This project gave impetus to expanding the sanitation programs nation-wide. In 1961 the Rural Environmental Sanitation Program (RES), as a component of the MOPH's National Health Development Plan, was incorporated into the successive five-year National Economic and Social Development Plans starting from the First to the Eighth Plan ending in 2001 (Luong et al. 2000). With these structural changes the budget was allocated annually and several strategies and projects were initiated for sanitation development. Substantial budget was also available for capacity building of existing health facilities. More rural health centers were established in all *tambon* (sub-districts) and health personnel were trained to work at these *tambon* health centers².

In parallel with the MOPH's work on sanitation development in the rural areas, the Ministry of Interior also carried out community development projects focusing on providing infrastructure such as building roads, constructing water reservoirs, and assisting individual households to build large containers to store rain water for home consumption.

In the period between 1950 and 1990, seven schools/institutes were established in all regions of the country for training of public health personnel to work at the rural health outlets. The training programs were specifically designed to provide knowledge and skills needed for providing basic health services including handling of non-complicated health problems, working with people in rural communities, and making latrine equipment such as the toilet bowl, toilet slab and tank. Each *tambon* health center was staffed with 2–3 officers; one of them was assigned to take responsibility for latrine development. These health officers worked closely with the people. They gained trust and due respect from the villagers who often referred to them with respect as “*môr anamai*” (lit., doctors at the health center, although they are not trained as medical doctors). Our key informants at the Bureau of Environmental Sanitation recalled that these “*môr anamai*” were regarded as “the frontline warriors” because of their important role in the primary health development at the grass root level. It is fair to say that, with trust and respect they gain while working with the people in local communities, these “*môr anamai*” were able to gain cooperation and willingness of the people to participate not only in the latrine development work but in the larger sanitation project as well.

To support the work of *tambon* health centers local government provided necessary supplies, such as the molds for making the water-sealed latrine bowl, cement slab and tank. Selected people from each village in the *tambon* were also trained to make these latrine parts. As a result, there were craftsmen who had sufficient skills in latrine construction in the villages. Proper vehicles were also provided to the health officers to transport equipment as well as to follow up the progress of the latrine promotion in the villages. Local government also arranged mobile units to provide the villagers with knowledge about the health benefits of sanitation and latrines as well as the technique for construction of safe latrines.

2) A *tambon* health center was responsible for the population of 4,000–5,000 people, or 700–1,000 households. Usually a *tambon* (sub-district) has one health center, but two centers may also be found in one *tambon* if number of populations is larger and geographical landscape is difficult for commuting.

In 1977, the Ministry of Public Health initiated the program for all villages to have “village health volunteers” (VHV). These volunteers were selected by the villagers to coordinate regarding health matters between people in the village and the *tambon* health officers. Each VHV received training on hygiene and sanitation needed for supervising their neighbors regarding health matters. During the years when latrine development was the main issue (roughly 1960–2000) VHVs provided valuable assistance to the health officers as well as their neighbors. In addition to VHVs there were also local community leaders (village headmen, village committee, and Buddhist monks) who also cooperated with the health officers in sanitation work and latrine development. These people were change agents at the local level. To date these change agents are still active in the rural areas.

Despite increasing investment in health infrastructure, facilities and training of personnel, the latrine development in rural areas during the period of 1977–1986 progressed slowly. During this time the proportion of rural households with latrines changed from 39% to 50% (Sanitation Division 1987). Obviously, some difficulties remained. To overcome these difficulties some innovative strategies were introduced.

First, around the mid-1980s a “revolving fund project” was initiated in all villages to support the households that needed latrine installation. According to our key informants, the money for the revolving fund was drawn from different sources. In some villages it was from the rural development projects of the government such as the Rural Employment Project and the Health Card Project. Part of the money for these projects was allocated to the revolving fund for development purpose within the village. In other place the money was from part of the income of the village cooperative store. In a small number of villages, the money was advanced by the NGO working on community development. Thus, the amount of fund money varied from village to village, but on average it was about 10,000 to 15,000 baht (323–486 USD, current rate). The fund was managed by the village committee which gave interest-free credit of about 500 baht (16 USD, current rate) to the villagers who needed it for latrine construction. The money taken for this purpose was expected to be returned to the fund within three months or so, so that it was available for other villagers to use.

Second, in 1987, the “100% latrine strategy” was initiated by the Ministry of Public Health in cooperation with the Ministry of Interior (Luong and Arphacharus 2016). This strategy was initiated to comply with the WHO’s goal of “health for all by the year 2000” (WHO 1981). Under the “100% latrine strategy” each province was encouraged to set its goal for universal latrine coverage and put in place efforts to achieve it. Governors of the provinces that achieved this goal would be awarded with gold rings as an incentive and recognition of their success. One of our key informants reported that the strategy worked well for many provinces, but it put substantial pressure on health officers at some *tambon* health centers where latrine coverage was still low. To increase the coverage, and also to relieve the pressure, some officers used their own savings as loans to villagers who needed the money for latrine construction.

In 1989, the Ministry of Interior issued a regulation, based on the law for building control, which required a new residence building must have a proper latrine if it wanted to be registered for a house number which was required for its official recognition. On the other hand, the Electricity Authority also had a regulation requiring that connection of the house to power line could not be done unless it had an officially registered house number (Luong and Arphacharus 2016).

Data from the 2000 census revealed that Thailand reached near universal latrine coverage with 96% of the households having latrines (Figure 2). The rest (about 4%) consisted of those who shared latrines with other households and those who used unsafe areas for defecation such as bushes (NSO 2002). Most of the latter were households of indigenous populations in the hard-to-reach areas especially in the hills; some of them were mobile groups living along the coast of the Andaman Sea. However, by 2015 latrine coverage in Thailand had reached 100% of the households (Koottatep et al. 2018).

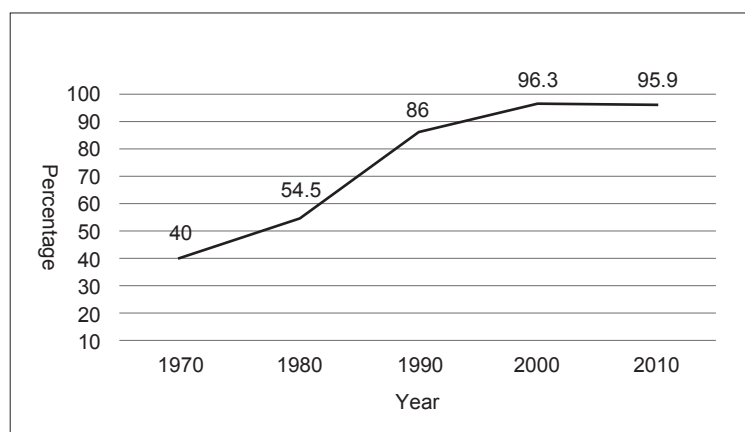


Figure 2. Percentage of households in Thailand with latrines in the past five decades.

2.2. Further Development

With universal access to safe latrines for all households, more attention has now turned from quantity to quality of latrines in both the home and public sectors. The policy is to gradually replace water-sealed squatting latrines, currently widely used in the country, with sitting latrines which are regarded as more comfortable for people of all ages. Considering that the population in the country is getting older, shifting from squatting to sitting latrines is the best choice although this will take some time for most households in rural areas.

In the public sector, the aim of further development is to improve three main aspects conveniently referred to as the “HAS standard” recommended by the Department of Health. According to the HAS standard, public latrines must be (i) healthy, i.e. clean and without smells, (ii) accessible, i.e. available in all categories of public places and convenient for people to access, and (iii) safe for all users (Department of Health and UNICEF 1988). The public latrines targeted for improvement are in 12 sectors including schools, religious places, markets, tourist places, public offices, hospitals, parks, sidewalks, department stores, transportation terminals, restaurants, and gas stations. The Bureau of Environmental Sanitation at the Department of Health as well as at the Bangkok Metropolitan Administration (BMA) is responsible for implementing the HAS standard for public latrines. The HAS guideline in Thai and foreign languages such as Burmese, Chinese and English are distributed to concerned sectors; it is also available online. To enhance improvement of public latrines, annual awards have been given to the sectors with best latrines according to the HAS standards.

According to the officers at the Bureau of Environmental Sanitation, Department of Health, in the past the owners of public latrines did not pay much attention to cleanliness. But today most of them are motivated and the public latrines are much improved. An example is the public latrines at the gas stations of a petroleum company which are widely regarded as clean and hygienic. The clean latrine attracts more customers, and hence more success for the company’s business (Box 1). Many gas stations of other companies now have adopted the same strategy to attract more customers.

Quality of latrines often suffers from labor constraint due to relatively high turnover rate among the cleaners. However, this constraint has been relieved to some extent by the services offered by private cleaning companies. Workers in these companies are trained to be specialized in latrine cleaning. Many public latrines also provide instructions about the proper use of the facility and place it on the latrine door. As a result, use of public latrines has been improved.

Box 1. Clean latrine and business of gas stations.

The *PTT Public Company Limited (PTT)* is one of the largest public companies dealing with energy. In 2019 the Company has 1,700 gas stations located on the main roads all over the country. In addition to latrines for free use by customers, other businesses included in the compound of most PTT gas stations include a café, restaurant, and convenience store.

In 1997 the Company initiated a strategy called “PTT clean latrine.” This strategy is employed to attract customers (i.e., drivers of vehicles) to its gas stations. Drivers like to stop at PTT gas stations to use the clean rest room as well as for food and drink or things they need from the convenience store.

To maintain the latrine standard PTT has technical teams to supervise cleaners and evaluate the quality of the latrines regularly. The company has its own standards for evaluation. To enhance clean public latrines PTT also gives awards annually to the best cleaners and station dealers. Recently, the company has started an environment project of “zero-waste” by which wastewater from latrines is treated and recycled for use in growing plants. This is seen as an innovative way to enhance the Company’s image and maintain its top rank in the business.

Source: Interview, Manager, PTT Public Company, February 3, 2020

2.3. Factors Contributing to Success

What are the factors behind success of the latrine development in Thailand? From the analysis presented above we can identify the following contributing factors:

- Strong policy;
- Integration of latrine into health and sanitation development;
- Effective approach and strategy;
- Adequate facilities for project execution; and
- Participation of the people.

These factors are highlighted below based on our analysis in the previous sections.

Strong policy

Needless to say, policy is the fundamental factor that sets the stage for any large-scale development. Strong policy makes it possible for provision of elements needed for execution of development projects (money, materials and man power).

Thailand’s first policy on latrines appeared in the sanitation law issued in 1897, i.e. near the end of the premodern period (early 1200–1900). The aim of this law was to prevent infectious diseases through management of garbage and human wastes in the Bangkok area. We do not know much about the impact of this policy on latrine development. Presumably, it had limited impact on development of latrine and sanitation since it was intended only for Bangkok rather than for the entire country.

In the early modern period (1900–1950) latrine development was carried out under the policy for eradication of the hookworm. Through this policy people in the rural areas were advised to have and use latrines as a means to control the spread of hookworm and other parasites. Latrines constructed in this period were simple pit privies. Although water-sealed latrines were mentioned, they were not widely accepted until the next period. In the late modern period (post-1950) the policy for latrine development became stronger, especially after initiation of the National Economic and Social Development Plans in 1961. Latrine development received increasing support

along with health and sanitation development.

In addition, stronger efforts were made to support latrine development. Around the mid-1980s the Ministry of Interior had a regulation requiring a new house to have a latrine of its own in order to be qualified for registration to get an official house number. Meanwhile, the Electricity Authority also requires that connection of a house to electricity is only possible if it has an official house number. These policies positively contribute to latrine development.

Integration of latrine into health and sanitation development

From its very beginning latrine development in Thailand has been integrated into the overall development of health and sanitation. It was within the health and sanitation sector that latrine promotion made more sense to the target people. Such integration made it less difficult for local health workers to explain to the people why having and using a latrine was beneficial for their health. It was also reasonable to convince them that good environmental sanitation could be realized by proper management of human waste through the use of a latrine. Indeed, integration into health and sanitation is a unique feature of latrine development in Thailand.

Effective approach and strategy

During the late modern period (after 1950), the “community development approach” was adopted. This approach views improvement of the rural communities as its important goal. Many new government departments, units or divisions were established to support community development. Within the Ministry of Public Health significant structural improvement was made which resulted in establishing of new units/divisions while responsibilities of some existing units/projects were modified to support health development in the local areas. For example, establishment of the Division of Local Health in 1953, Village Health Project in 1957, Local Health Development Project in 1960, Division of Health Development in 1962, and Comprehensive Village Health Development in 1966. In addition, the Ministry made two internal modifications in 1973 and 1974 to strengthen the work in different aspects of local health development (Sanitation Division 1987). It was under these new units/projects that latrine development was carried out until it reached the development goal around the end of the 1990s.

Some strategies were developed during this period which also contributed to success of latrine development in many rural areas. Two such strategies were reported by some of our key informants: one is the “100% latrine project,” the other is the “revolving fund project;” both were in place since the 1980s.

Adequate facilities for project execution

After the beginning of the national Economic and Social Development Plans in 1961 Thailand entered the so-called “development era.” More infrastructures and facilities were provided for health and sanitation development in the rural communities. Health centers were established in all sub-districts while a sufficient number of health officers were trained to work at these centers. These officers worked in close cooperation with the village health volunteers and the village administrative leaders to encourage the households to have and use safe latrines. At the same time access to water necessary for use in the safe latrines became convenient for communities in the remote areas through the rural development projects carried out by the Ministry of Interior. These infrastructure and facilities significantly contributed to success of latrine development.

Participation of the people

In its early years the latrine development in Thailand faced difficulties in winning participation of the rural people. However, what we presented above clearly suggests that several activities, facilities and government

strategies contributed to the people participation. To mention just a few important ones, these include government's activities to provide rural people with knowledge and understanding of the latrine benefits, availability of rural health centers with trained health workers, availability of the people-managed revolving fund which provided interest-free credits to the needed households for installing their latrine, and strong government policy. It is after these activities and facilities had been in place that participation of the people was no longer a problem, hence the increase of proportion of the households with safe latrines.

Figure 3 gives a conceptual summary of the factors contributing to the success of latrine development based on Thailand's experience.

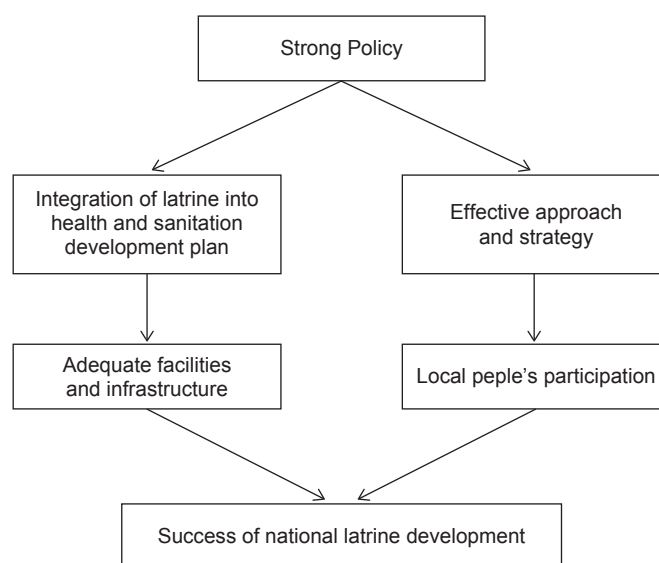


Figure 3. Summary of the factors contributing to the success of latrine development in Thailand.

2.4. The Way Beyond

Although Thailand has achieved the goal of latrine coverage for all households, more efforts remain in order to improve the latrine quality and management of fecal sludge. These are highlighted below.

(i) Improving latrine quality. Although Thailand has succeeded in expanding latrine coverage to all households and public places, its quality needs to be improved. At present most latrines used in the country are water-sealed squatting type; especially this is the case for most households in the rural areas. This water-sealed squatting latrine has proved to be effective in preventing odor and the spread of some infectious diseases. Yet, its quality needs to be improved in terms of general cleanliness and convenience for users who have difficulty squatting. Recently the Ministry of Public Health has a policy to raise the quality of latrines in all sectors by gradually replacing squatting latrines with the sitting type. This policy was made after taking into account increasing numbers of old people and those with disability. However, it is likely to take some time before the goal of this policy is realized; the difficulty lies in the costs of installing a sitting latrine which may be considered unaffordable by most rural households.

(ii) Management of fecal sludge. So far, proper management of the excreta and wastewater from latrines is limited in many areas. A study by researchers at the Asian Institute of Technology in 2013 noted that 80% of the collected fecal sludge in the country is disposed without proper treatment, due to either lack of treatment facilities

or limited function of the treatment plants, or both (AIT 2013). In general, fecal sludge from latrines is removed and disposed by licensed individuals or business companies. According to the local regulations and guidelines the disposal should be done at designated places after proper treatment to prevent unpleasant odor and the spread of diseases. Yet, according to our interviewees, without close supervision and strong control systems fecal sludge has sometimes been dumped at places such as in the bushes, streams or even private paddy fields. Another study in 2015 pointed out that most local administrative organizations and municipalities in Thailand are facing financial constraints to support fecal sludge treatment services. As such, some of these local organizations do not place priority on managing fecal sludge (Taweesan et al. 2015).

Several methods for fecal sludge treatment have been introduced. In some parts of the country anaerobic digestion coupled with sand drying beds is used; in other parts the methods used include disposing in landfills, co-treatment with wastewater, drying beds, activated sludge, stabilization ponds, constructed wetlands and covered lagoons (Kootatep et al. 2018). In 2012 a team of scientists at the Asian Institute of Technology (AIT) invented the “decentralized system” that combines different treatment technologies to meet the required goals of treating human excreta and wastewater from homes and businesses. The project, funded by the Bill and Melinda Gates Foundation, used the “market-driven approach,” to ensure that the innovative products are saleable and affordable to the urban poor. It is also hoped that the decentralized systems have the advantage of saving homeowners the cost of connecting to a sewer, and eliminating the environmental burden of transporting large quantities of wastewater to the treatment plant (AIT 2012). However, innovative as it is, the new technology appears to be too expensive for the target households in both urban and rural areas.

The main issue at present is that the country still lacks proper guidelines for implementation and control of proper treatment of human excreta and wastewater from home and public latrines.

Summary and Recommendation

Latrine development in Thailand has a long history which can be traced back to the time of the Sukhothai Kingdom, the early capital center of the Thai nation. Limited evidence from that time suggests that the latrine was known and used only by members of the ruling class including the Buddhist monks; other people depended on public places such as bushes, canals and open spaces for defecation. It is believed that the squatting pit privy was the only type of latrine used in that time.

Evidence of the government policy regarding the management of excreta and garbage in Thailand first appeared in 1897. But that policy was aimed mainly at Bangkok rather than the entire country. Since the turn of 20th century health projects were initiated aiming to eradicate hookworm through prohibiting defecation into rivers and canals. Following the establishment of the Ministry of Public Health in 1942 more projects were initiated to increase latrine use among the general population with help from the United States Operation Mission (USOM).

Since the emergence of the first five-year National Economic and Social Development Plans in 1961 Thailand has entered a new chapter of development whereby substantial resources were invested in strengthening infrastructure and facilities for rural health development. Health centers, staffed with trained health workers, were established at all sub-district levels. Innovative projects to increase latrine among the rural households, such as the “100% latrine project” and “revolving fund” were launched countrywide. By 2015 all households had access to safe latrines. Yet, work on latrine development still goes on. More still needs to be done in (i) raising the latrine quality standard by replacing squatting with sitting type latrines both in the private households and public sectors, and (ii) proper management of fecal sludge from latrines.

Drawing on Thailand's experience, the following recommendations are provided here.

Firstly, projects designed for increasing coverage of safe latrines should be grounded in strong government policy. It is on the basis of strong policy that provision of resources, materials and manpower needed for the project implementation can be well justified.

Secondly, in the context where poor sanitation causes many infectious diseases, integration of the latrine project with the overall sanitation and health development is one of the key factors contributing to success of the latrine project. It is meaningful for implementation while making it attractive to the people who are recipients of the project outcome.

Thirdly, provision of adequate health infrastructure and facilities is essential if latrine development is to succeed. For this purpose, emphasis should be given not only to the number of facilities but also to strengthening them. It is through these facilities that development will have a direct effect on the people at the grass-root level.

Fourthly, it is important that the latrine project be carried out with appropriate approaches that take into account the social and economic context. Equally important are innovative strategies such as incentives for the project workers and, where possible, interest-free credit for the needed households to install latrines.

Fifthly, participation of the target people is the key to success of the latrine project. While different societies may have different approaches to win people's participation, provision of knowledge and understanding on significant of latrine is essential. Therefore, adequate resources should be allocated for this purpose. In addition, young people who are exposed to education and experience in school and other sources outside the community often bring home positive ideas and values for latrine. They, too, can play important role in household participation in the rural areas. Furthermore, drawing on Thailand's experience, NGOs can also have their part to play in raising participation of the target people.

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A Comparative Report on Health and Water, Sanitation and Hygiene in Malawi, Tanzania and Zambia

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Abstract

The United Nations International Children's Emergency Fund's strategy for WASH 2016 to 2030 indicated water, sanitation and hygiene (WASH) as central to the attainment of the Sustainable Development Goals (SDGs) because of its implications for nutrition, health, education, poverty and economic growth, urban services, gender equality, resilience and climate change. At the SDGs initiation, the United Nations pledged to 'leave no one behind', with special consideration to the least developed countries in sub-Saharan Africa who had performed poorly in accomplishing the just ended Millennium Development Goals (MDGs). It is in this regard that this paper highlights the past and current status, performance and policies of three sub-Saharan countries; Malawi, Tanzania and Zambia in reference to WASH. These countries were selected due to their similarities in a bid to uncover trends, best practices, and means for improvement of WASH towards the attainment of SDG 6: universal, sustainable, and equitable access to WASH, and an end to open defecation by 2030. Only Malawi attained its target for citizen access to safe drinking water at MDG level, whilst all three countries failed to meet targets for sanitation and hygiene. Causes for success and failure in the improvement of WASH across the three countries were linked to the implementation and sustainability of WASH policies and programs. These findings highlight the importance for full stakeholder engagement from the government to the individual in all sections of WASH. It also recommends the engagement to take part in all WASH sectors, from construction to maintenance, for the overall creation of workable WASH structures and frameworks.

Keywords: Water, Sanitation and Hygiene (WASH), Millennium Development Goals (MDGs), Sustainable Development Goals (SDGs), policies, Malawi, Tanzania, Zambia

Introduction

The resurgence of planning to tackle the challenges of water and sanitation is both timely and imperative. Principal importance is the recognition that despite the reasonable level of growth during the years of structural reforms, poor water and sanitation remains pervasive. Access to water and sanitation services by all segments of the population and industry is a key component of overall sustainable development and this challenge becomes more important when population growth estimates for 2030 are factored in. Sub-Saharan Africa was given a target to achieve 75% access to water coverage in the period between 1990 and 2015 (United Nations 2015). However, the region remained off-track during the Millennium Development Goals (MDGs) with the highest number of people without access to safe water into the year 2015; only 20 of the 46 countries seemed to be on track (UN-Water 2015). Access to sanitation was even worse due to rapid population increase in urban and peri-urban areas. These problems have often accelerated the prevalence of communicable diseases such as diarrhea and cholera. Consequently, the Africa Infrastructure Country Diagnostic (AICD) was created and commissioned in 2005 at the G8 summit by the Infrastructure Consortium for

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Africa (Banerjee and Morella 2011). The AICD project aimed at monitoring and enforcing infrastructure investments and policy reforms designing in Africa because these were considered the keys to development.

This comparative report will focus on three sub-Saharan countries; Malawi, Tanzania and Zambia respectively (Figure 1). These countries have been selected due to their similarities and the unique differences in their geographical, political, and socioeconomic situations. All three fall in the Great Rift Valley and share fresh water from Lakes Victoria, Tanganyika and Malawi (also known as Nyasa). The three countries are neighbors and former British colonies that gained independence together in the early 1960's. All three countries are also members of the Africa Union and Southern African Development Community (SADC). The countries share similar history, political setup and interests, and their progress is expected to be similar. Water sources and usage, sanitation and hygiene, and water, sanitation and hygiene (WASH) health threats will be discussed in relation to policies and the current Sustainable Development Goals (SDGs). The target for SDG 6 includes achieving universal and equitable access to safe and affordable drinking water, and access to adequate and equitable sanitation and hygiene for all by 2030 (UN-Water 2017). Despite the strong similarities between these countries, their performance in WASH has been very different. This picture corresponds to the views of other researchers that have agreed in the past that there is no single model that guarantees an effective water governance (Rogers and Hall 2003). On the other hand, other researchers suggest that donor aid needs to be increased and believe there is more need for foreign aid to elevate WASH and other problems in Africa (Ndikumana and Pickbourn 2017). However, this report suggests that there is need for more funding, but the most important issue is for the indigenous people to gain knowledge of their situation and take a leading role if development is to be sustainable. The analysis of the three countries and their WASH policies may help to give insight to future research and policies that may effectively help the three and other developing countries to develop their WASH systems and attain the SDGs.

Data referred to in this comparative report has been summarized in three tables: Table 1 gives the countries socioeconomic background; Table 2 summarizes WASH and health statistics from the end of the MDG era to the recent SDGs; and Table 3 gives a summation of national WASH budgets and policies by which these nations are striving for the improvement of national WASH. These tables have been placed at the before the discussion for ease of reference.

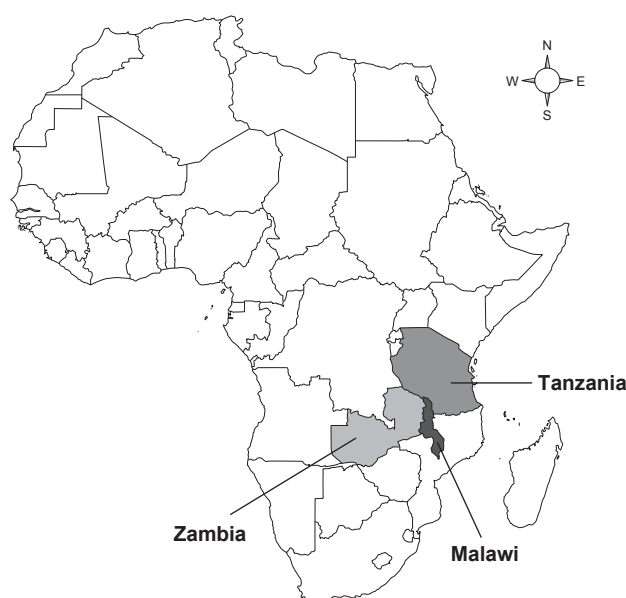


Figure 1. Map of Africa showing Malawi, Tanzania and Zambia.

1. Malawi

1.1. Background

Malawi is a relatively small, landlocked country with a total surface area of 118,480 km², and 28,760 km² (20%) of the total area is covered by water (Laisi 2009). The total national population was estimated to be over 17.5 million in 2018 (NSO 2018). The population percentage based on religion indicated that, Christians 77% and Muslims 13% were the majority. Total National population was over 17.5 million. The population of northern region had over 2.2million, central region had over 7.5million and southern region had over 7.7million (NSO 2018).

Malawi has several fresh water sources. A network of rivers and lakes are supported by Lake Malawi, the biggest surface water resource in the country. As an agricultural economy, most of Malawi's surface water is used for crops, livestock production and hydroelectricity. The groundwater is mainly used for domestic purposes in both rural and urban areas. Malawi successfully surpassed the MDG's water access target. However, Malawi is considered a water-stressed country, and likely to be water scarce by the year 2025 (Government of Malawi 2008; NSO 2018). Malawi's major challenges range from lack of funds for increased service delivery to rapid population growth in urban and peri-urban areas, poor infrastructure management and drastic climate conditions such as persistent droughts and floods.

Regarding sanitation and hygiene, statistics indicated that people in Malawi had basic sanitation which was estimated at 84% in 2005 and 93% in 2009 (Ministry of Economic Planning and Development 2011). However, the availability and usage of toilets seemed to vary depending on location, intervention and pressure from high population density (Ministry of Irrigation and Water Development 2006). In addition, 80% of the sewage from industries and residential areas was directly flowing into the rivers which were also a common source of water for domestic usage. The Malawi Sanitation Policy of 2006 also indicated that household hygiene practice was low, and households that used hand-washing soap were 45% of the 75% of the households that had soap in the house (Ministry of Irrigation and Water Development 2006).

1.2. Review of Past Performance

The proportion of households with sustainable access to improved water resources was 47% at the beginning of the MDG era. In 2013, the population with access to safe and improved water stood at 86.2%, surpassing the 74% target set by the MDGs and was estimated to reach 92% in 2015 despite the prominent challenges at the time (Ministry of Finance, Economic Planning and Development 2014). The United Nations International Children's Emergency Fund (UNICEF) and World Health Organization (WHO) reported that Malawi's water coverage stood at 90% in 2015 (WHO and UNICEF 2015).

Similarly, the country registered an increase in the proportion of the population with access to basic sanitation from about 72% to 95% between 1990 and 2014 (Ministry of Finance, Economic Planning and Development 2014). This positive impact was mainly attributed to interventions in WASH through construction of sanitation facilities in schools and communities, and sensitization campaigns. Areas where sanitation projects were active in promoting sanitation and hygiene were estimated to get up to 95% sanitation coverage, while those without access to such projects were as low as 40% (Ministry of Irrigation and Water Development 2006).

1.3. Policies and Key Reforms

The Ministry of Irrigation and Water Development (MoIWD) and its subsidiary, the Department of Water Resources Development control and manage the country's water resources. They are guided by the Water Resources Act of 1969 (mainly governing ownership and usage of water resources for farming), Water Works Act of 1995

and National Water Policy of 2005 (Chilwe and Nkhata 2014). The National Water Policy of 2005 endorsed the Integrated Water Resources Management and Water Efficiency (IWRM/WE) plan which started in 2008 as the basis for sustainable water and sanitation development in Malawi (Ministry of Irrigation and Water Development 2006). The National Water Policy aimed to address water resource management, water resource development, and water service delivery. The policy emphasized four main areas of water management, i.e., water for food, water for people, water for hydro-electric energy, and water for environment. The strategies to compliment the policy were; providing water in sufficient quantities and acceptable qualities to all, promoting water conservation, developing and expanding raw water sources, incorporating local governments and communities in planning, development and management of water supplies and sanitation services, rehabilitating the existing infrastructure and creating an enabling environment for public-private partnerships in water supply and sanitation activities (Ministry of Irrigation and Water Development 2005).

The National Water Policy is an inclusive plan that engages all stakeholders to take responsibility for their water resources and environment. The Malawi Water Board is responsible for providing piped water to the households and public institutions. Boreholes, water kiosks and wells are very common household water sources in peri-urban areas and rural areas of Malawi. An ambitious move promoting taps instead of boreholes has also been adopted with aid from donors and some NGOs to ensure safe and potable water delivery to all citizens (Figure 2). The Water Board has been supported to build multi-purpose dams and groundwater resources and Private Public Partnerships are also being promoted to ensure equitable delivery of water and sanitation services to the growing population (Ministry of Finance, Economic Planning and Development 2014) (Figure 2).

In addition, the government developed a National Sanitation Policy in 2006 to ensure the population without access to sanitation was halved by 2015, and to achieve sanitation for all by 2020. Some of the strategies put in place involved; establishment of a new Directorate for Sanitation within the Ministry of Irrigation and Water Development, establishment of a National Hygiene and Sanitation Coordination Unit (NHSCU), preparation of enabling Legislation to provide for the implementation of the National Sanitation policy, creating institutional linkages to include organizations concerned with civic education, as well as the private sector through the continuation and expansion of the National Sanitation Policy Steering Committee (Ministry of Irrigation and Water Development 2006).

In 2006, Malawi developed the National Sanitation Policy with a team called Sanitation Core Team (SCT). The team was comprised of senior and junior members from about 10 ministries including ministries of Health, Water development, Child Welfare and Community Development (Ministry of Irrigation and Water Development 2006). The SCT and the policy aimed to work with all stakeholders from government departments and NGOs to households and communities. The aim was to achieve the country's MDG commitment to halve the population without access to basic sanitation by 2015 and achieve universal access to improved sanitation by 2020.

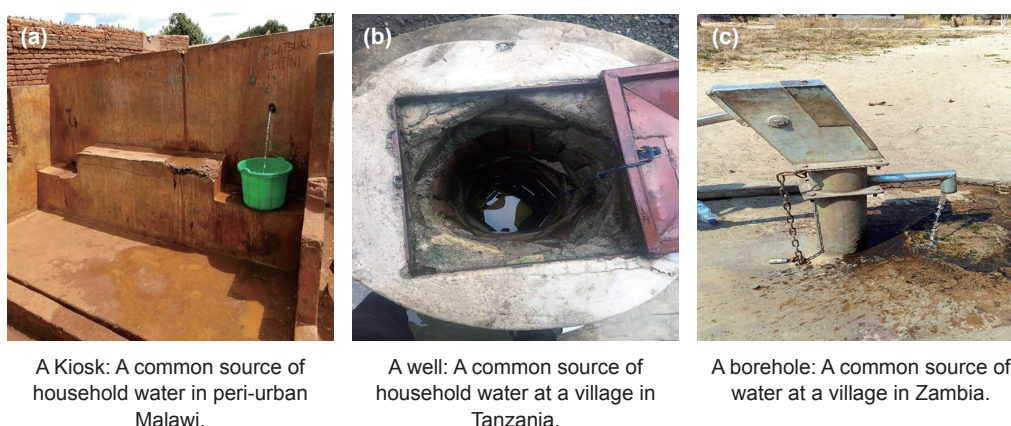


Figure 2. (a), (b) and (c) show some of the common sources of household water used in Malawi, Tanzania and Zambia respectively. (Photos by the author)

1.4. The Current Situation of WASH

In Malawi, poor WASH contributes to 3,000 deaths of under five children every year (UNICEF Malawi 2018). An estimated 1 million people in Malawi are still practicing open defecation. The recent statistics indicate that 6% of the households nationwide are still practicing open defecation, while stunting in children under the age of five is remarkably high at 37% (USAID 2019). The mortality of children under five years of age is 63 deaths per 1,000 live births and Infant mortality rate is at 42 deaths per 1,000 live births. The number of annual cases of cholera recorded recently were 874 between 2017 and 2018. 27 deaths from cholera were reported during the same period 2017–2018, and case fatality rate (CFR) was 3.1% (NSO 2018). The Malawi government with the aid of UNICEF Malawi has partnered with other NGOs and the private sector to support and promote interventions towards usage of improved sanitation and hygiene services. This is an inclusive program that depends on the Community Led Total Sanitation (CLTS) approach. Malawi joined the Open Defecation Free (ODF) campaign under the Community Led Total Sanitation (CLTS) strategy in 2007, as it was a trend in most developing and middle-income countries. The aim is to improve sanitation and hygiene practices in a community. The focus is on behavior change and increasing the demand for toilets and hand washing facilities for households and public institutions in communities.

Malawi has a small and struggling economy. The country registered an increment in GDP from 3.9% in 2017 to 4% in 2018 (UNICEF Malawi 2019a). In 2018/19 national budget was increased from 1.3 trillion Malawi Kwacha (approximately \$1.762 billion USD) in 2017/18 to 1.45 trillion Malawi Kwacha (approximately \$1.966 billion USD) (UNICEF Malawi 2019a). Consequently, 23.1 billion Malawi Kwacha (approximately \$31.3 million USD) was allocated to the WASH sector in 2018/19 representing a 12.3% increase from the 2017/18 budget representing a 27% reduction (UNICEF Malawi 2019b).

However, many Malawians in rural and peri-urban areas still rely on groundwater for household usage; they are not connected to the piped water supplied by the Water Boards due to limited resources (Ministry of Irrigation and Water Development 2007) (Figure 2). In addition, most shallow wells that were used and studied indicated a high level of fecal contamination (Mkwate et al. 2017). Hand hygiene has been neglected in many areas and recent interventions seem to be helping (Figure 4). Consequently, with annual cholera outbreaks, this water exposes people to high risk of disease due to consumption minus water treatment.

2. Tanzania

2.1. Background

Tanzania is the largest country in east Africa with a total geographical area of 940,000 km² and 60,000 km² (6%) covered by water (MoHCDGEC et al. 2016). As of 2012, the total national population was estimated at 44.9 million (NBS and OCGS 2013). The population percentage based on religion suggested that there Christians were 61% and Muslim covered 35% of the total population.

Tanzania's massive land surface is rich in minerals and natural resources including freshwater wetlands estimated to cover 10% of the total land surface (Division of Environment 2015). Despite having a profitable mining sector, the Tanzanian economy is still highly driven by agriculture which was estimated to cover one-quarter of the gross domestic product (GDP) and offers employment to nearly 80% of the population (World Bank 2012). Many people in Tanzania depend on wetland resources for agriculture, fishing, livestock production, hydro-power, and most importantly domestic usage (Division of Environment 2006). Tanzania also shares some of its major water bodies with other countries such as Lake Malawi (also known as Lake Nyasa) with Malawi.

Tanzania was among the 63 countries in the world that failed to meet their water MDG targets and had the second worst sanitation coverage (World Bank 2018). Its key WASH targets were to increase national water supply service coverage from 51% in 2000 to 90% in 2015 and from 68% in 2000 to 95% in 2015 in rural areas and urban water supply service coverage respectively (Kessy and Mahali 2017). The 2014 Tanzania MDG report estimated that 59% of the households in the mainland had access to a clean and safe water source. On the other hand, the proportion of population using an improved sanitation facility stood at only 13% during the same period (Ministry of Finance 2014).

2.2. Review of Past Performance

Economically, Tanzania has managed to constantly reduce poverty since 2007, and has registered an annual GDP growth of 6.5% per year for the past 15 years (World Bank 2018). This economic growth rate has propelled Tanzania to be the second largest economy in East Africa. Despite this remarkable progress since the MDGs era, Tanzania was among the 17 countries that could not meet its water targets to halve its "population without access to safe water" between 1990 and 2015 (World Bank 2018).

The Joint Monitoring Program of 2010 estimated the national water coverage at 54% (African Ministers' Council on Water 2011). Some progress was made towards the end of the MDGs period when the country achieved a 64% coverage for improved drinking water and 31% for improved sanitation by the year 2015 (Division of Environment 2015). The progress, however, was not good enough to meet the MDG targets for water and sanitation. In 2018, the World Bank reported that 24% of rural Tanzanians relied on traditional open-dug wells and 18% on surface water while those in urban areas without access to tap or borehole water depended on informal tanker trucks or water vendors (Figure 2).

2.3. Policies and Key Reforms

The little progress in access to WASH made during the MDGs and the coming of the SDGs resulted in various reforms to government policies and priorities. The National Strategy for Growth and Reduction of Poverty (NSGRP) is the biggest reform being revised several times. The National Water Policy and the National Water Sector Development Strategy (NWSDS) were developed and led to the launch of the Water Sector Development Programme (WSDP) in 2007 (Kessy and Mahali 2017). The program was initiated in two phases, from 2007 to 2014 and the second phase was launched in 2014 (WSDP 2014). The following years saw the Water Resources Management Act No. 11 of 2009 and the Water Supply and Sanitation Act No. 12 of 2009 enacted. The program

aimed at strengthening sector institutions for water resources management and improving access to clean and safe water supply and sanitation services (WSDP 2014). The strategies that were put in place in the water strategy of 2006 included; identifying sector needs at all levels and in all organizations in terms of staffing and skills requirements, implementing a human resources development plan for building staff capacities in integrated water resources management at all levels, developing a framework for strengthening human resource capacities in local and catchment water user organizations and developing appropriate training delivery capacity (Ministry of Water and Irrigation 2008).

The Water and Sanitation Act led to the formulation of the Water and Sanitation program (WSP). WSP partnered with the Ministry of Health in 2008 to initiate CLTS to support households to attain access to improved water and sanitation (WSDP 2014). WSDP was revised in 2010 and National Sanitation Campaign (NSC) was included in the program. The campaigns were initiated as pilot programs in some districts to help speed up the progress to achieve the MDGs target of people with access to Sanitation by 2015 (WSDP 2014). Some of the sanitation strategies that were developed were; identifying sector needs at all levels and in all organizations in terms of staffing and skills requirements, implementation of a human resources development plan for building staff capacities and increasing motivation in the provision of water supply, sewerage and sanitation services at all levels, strengthening the capacity of the Regional and Local Government Authorities, and enhance the capacity of the private sector and Non-government Organizations, to operate water supply, sewerage and sanitation schemes (Ministry of Water and Irrigation 2008).

Tanzania has made a few positive strides through campaigns towards sanitation over the years. Rural sanitation has seen some progress in transitioning households to using improved sanitation facilities thereby reducing open defecation. Initiatives such as the 1973 *Mtu Ni Afya* (Health Man) campaign and some latest campaigns like *Choo Bora* (A Good Toilet is Possible!) have achieved some success in pilot districts (World Bank 2018). In 2016, Tanzania developed a manual for assessing Open Defecation Free status and joined the campaign under the Community Led Total Sanitation (CLTS). These strategies have used behavioral change communication and sanitation marketing approaches to emphasize the importance and promote the usage of improved toilets. Despite these approaches, scaling up of improved sanitation remains a challenge. In Tanzania it is required to also note that the Central government, Ministry of water, the Basins water boards and water offices are the main entities responsible for all water governance.

2.4. The Current Situation of WASH

Despite the positive intervention and policies, the government of Tanzania still faces many challenges. Collection of funds from unwilling citizen users of water who do not feel obliged to pay, monitoring of infrastructure, operation and maintenance costs also seem to be a challenge. WSDP had shown positive results and offered promise during the MDGs with the ability to convince donors and accumulate over 950 million dollars in five years (CSO 2015). However, with a growing population the funding is still little to achieve the SDG water goals.

Tanzania has a stable and the biggest economy in east Africa. Tanzania maintained a stable growth of its economy and the GDP was estimated between 6.5% to 7% (UNICEF Tanzania 2018). The 2017/18 budget was set at 1.087 trillion Tanzania shillings (approximately \$468.7 million USD), indicating a 26% increment from the previous year at 841 billion Tanzania Shillings (approximately \$302.6 million USD) (UNICEF Tanzania 2018). Approved budget allocation to the water sector declined from 957 billion Tanzania Shillings (approximately \$412.6 million USD) in 2016/17, to 702 billion Tanzania Shillings (approximately \$302.7 million USD) in 2018 (UNICEF Tanzania 2018).

Tanzania has not shown significant improvement in access to safe and clean water especially in rural areas of the country. The estimated rural households with access to safe and clean water was at 45% in 2004 and 2005 and was recorded to have risen to 57% in 2012. Conversely, statistics for the same period indicated a decline from 79% to 77% in urban areas and household access to basic sanitation also dropped from 93% in 2007 to 88% in 2011 (Kessy and Mahali 2017). However, most recent data show that almost 75% of households in urban areas, 14% in rural, and 31% nationwide have access to improved sanitation. On the other hand, stunting in children remains high at 35% (MoHCDGEC et al. 2016; World Bank 2018) (Figure 3). Mortality of children under five years of age was 74 deaths per 1,000 live births. Infant mortality rate was 68 per 1,000 live births (Ministry of Health and Social Welfare 2008). Recent cholera statistics indicated 4,636 cases and 95 deaths in 2017, and 4,444 cases and 80 deaths were reported in 2018. CFR was 1.7% on average (MoHCDGEC 2018).

WSDP (2014) estimated that poor WASH accounts for about 5,800 annual cases of cholera, and the death of 18,500 children under the age of five every year from diarrhea with about 90% of these deaths caused by poor WASH conditions. In addition, the 2010 Demographic and Health Survey (DHS) through multiple regression analysis highlighted that rural Tanzanian children were stunted in communities with poor human fecal management, portraying a strong link between sanitation and nutrition (WSDP 2014).

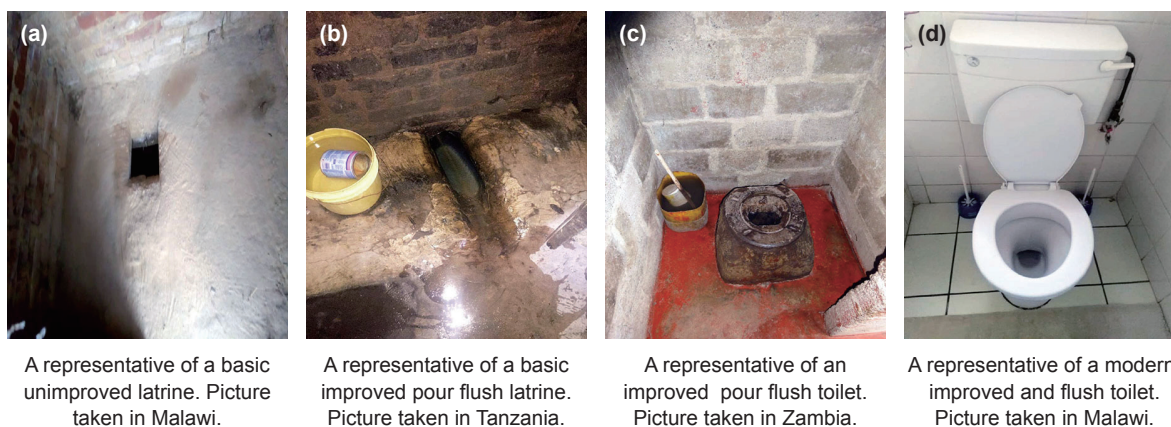


Figure 3. (a), (b), (c) and (d) show representative toilets that are commonly used in peri-urban Malawi, Tanzania and Zambia. (Photos by the author)

3. Zambia

3.1. Background

Zambia has a total geographical area of 752,612 km². About 317,000 km² is covered by water. The population census of 2010 estimated that Zambia would have over 17.9 million people in 2020, with Christians taking 95.5% and Muslim taking 2.7% (Office of International Religious Freedom 2019c). Zambia has vast water resources in form of rivers, streams, lakes and groundwater. However, declining rainfall patterns over the years have had a significant adverse impact on the country's water resources. In terms of groundwater, Zambia has favorable geological conditions for accessing groundwater with regard to depth, storage capacity, available yields and exploitation potential. However, water resource management has not succeeded to substantially improve access to water or prevent the pollution of both surface and groundwater (Republic of Zambia 2006).

Target 7.C of the MDGs was to halve, by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation. Approximately 2 million Zambians had no access to sanitation facilities and open defecation was common (UNDP 2013). In 2015, some 2.4 million people were still using unimproved sanitation facilities, of which a third practiced open defecation; a failure to reach MDG sanitation targets (United Nations 2015).

3.2. Review of Past Performance

Some successes were achieved in the early and late 1990s during the implementation of the drought relief program, upgrading of squatter compounds in peri-urban areas, and the rehabilitation of the urban water supply program, which gave rise to increases in access to safe water supply. The program was targeted at drilling and the rehabilitation of boreholes and wells in drought prone provinces. The rehabilitation of urban water supply systems was concentrated along the rail line, but very little was done for rural district towns.

According to the 2005 MDGs report, halving the proportion without sustainable access to safe drinking water and sanitation was perceived as likely to be achieved by 2015. The proportion of the Zambian population, without access to safe drinking water remained high, estimated at 47%, with rural dwellers being the worst affected. Several deaths each year were attributed to poor WASH. According to UN-Water (2013), WASH factors are responsible for 11.4% of all deaths in Zambia.

3.3. Policies and Key Reforms

In the late 1980s, the government began the formulation of a policy and institutional reform of the water sector which culminated in the development and adoption of the National Water Policy of 1994 which provides the overall framework for the sector (Ministry of Energy and Water Development 2010). It covers water resources management, urban water supply and sanitation, such as water quality and water tariffs, and rural water supply and sanitation. To operationalize water sector policies, strategies were developed. These include: Strategy and Institutional Framework for the Water and Sanitation Sector approved in 1995, National Environmental Sanitation Strategy launched in 1998 and the National Irrigation Plan developed in 2001.

The most significant strategy was the Water, Sanitation and Hygiene Education (WASHE), adopted in 1996 (Ministry of Energy and Water Development 2010). According to the policy, WASHE was to work in the rural areas only with the objective of promoting integrated development of water, sanitation and health education to improve the impact of water supply and sanitation on health and to promote community management so as to ensure sustainability of services through better financial support, operation and maintenance. In 2010 a modern national water policy was developed to include the new principles of water resources management. Some of the strategies were to develop national water resources management plans, water resources regulations and guidelines,

mechanisms for equitable and reasonable allocation of water, a fair and justifiable tariff structure for water use and to develop water allocation plans with the participation of local communities.

The Fifth National Development Plan from 2006 to 2010 explains the plan on Water Supply and Sanitation (WSS), which caters for the provision and maintenance of adequate supply of water for human consumption and domestic use in rural areas (Republic of Zambia 2006). Water supply sources may be from boreholes, shallow water wells or springs. Sanitation aspects include the promotion of hygiene education in rural communities and schools. During the planned period, a new water bill was scheduled to be presented to parliament. The proposed new bill would have provisions for implementation of integrated water resource management. The legal framework for WSS is currently anchored in two main pieces of legislation namely, the Local Government Act No. 22 of 1991 and the WSS Act No. 28 of 1997 (Government of Zambia 1997). Other legislation which has an impact on provision of water includes the Environmental Protection and Pollution Control Act of 1990 whose purpose is protection of the environment and control of pollution, and the Public Health Act of 1995, which has provisions for the management of sanitation and prevention of pollution to water supplies. In 1997 the national environmental sanitation strategy for rural and peri-urban areas in Zambia was developed by the Program Co-ordination Unit. The government realized the need to look at sanitation separately from water. The objective was to meet their MDGs of halving the population without access to sanitation by 2015 and to reduce health risks. Some of the strategies that were put in place were; Identifying and targeting key political and non-political figures, holding national events/workshops at which key figures can contribute and show their support, and which are covered by mass media, to form links to mass media and develop a newsletter to link all those interested in sector progress. Usage of community friendly communication strategies and intersectoral approaches to ensure that the messages being promoted, and how they are promoted, are the same in all sectors of government. In the year 2007 Zambia also joined the Open Defecation Free (ODF) campaign under the Community Led Total Sanitation (CLTS) strategy which was a central part to the sanitation sector wide approach. Community champions such as chiefs took part in monitoring and facilitating behavior change.

3.4. The Current Situation of WASH

According to the 2015 Living Conditions Monitoring Survey (LCMS) Report, analysis by residence shows that 51.6% and 89.2% of households in rural areas and urban areas respectively had access to safe water (CSO 2016). At provincial level however, Lusaka Province had the highest percentage of households with access to safe water at about 96% (CSO 2016). This data shows a significant change in the national access to safe water supply as compared to the situation in 2000 when an estimated 86% of the population in urban areas and 37% of the population in rural areas had safe water access (Figure 2).

In 2015 only, 40% of households in Zambia had access to improved sources of sanitation (CSO 2016); 27% of people in urban areas and 85% in rural areas had no access to improved sources of sanitation. The proportion of households accessing improved sources of drinking water increased from 63% in 2010 to 67.7% in 2015. Households in urban areas had more access to improved sources of drinking water at 89.2% compared to 51.6% of households in rural areas in 2015 (CSO 2016). However, the most recent data in the Zambia country brief reported at the 2019 Sector Ministers' meeting indicated that access to basic drinking water was at 44% in the rural, 86% in the urban, and 61% nationwide (Ministry of Water Development, Sanitation and Environmental Protection 2019). The same report showed the improved access was at 47% in the urban and did not highlight the rural and national figures. The report also highlighted that hand hygiene is even worse with only 5% of the rural households using water and soap for handwashing.

Zambia's economy declined significantly as represented by a GDP of 4% in 2018 to 1.7% in 2019 (World Bank

and IMF 2019). The 2018/19 budget was set at 86.8 billion Zambia Kwacha (approximately \$4.8 billion USD) (UNICEF Zambia 2019). The 2017/18 national budget was set at 71.6 billion Zambia Kwacha (approximately \$3.9 billion USD). Approved budget allocation to the water and sanitation sector was increased from 628 million Zambia Kwacha (approximately \$34.9 million USD) in 2017/18, to 1.9 billion Zambia Kwacha (approximately \$105.7 million USD) in 2018/19 (National Assembly of Zambia 2019).

The mortality of children under five years was 61 deaths per 1,000 live births in 2018. Over the same period, infant mortality was estimated at 42 deaths per 1,000 live births (Zambia Statistics Agency et al. 2019). Recent statistics indicated 5,905 cholera cases between 2017 and 2018, and 112 deaths.



(a) A basic latrine at a village in Malawi with a hand washing station (bottle) installed a few metres from the toilet.



(b) An improved toilet and a hand washing station (bottle) at a village in Tanzania.



(c) An improved toilet in Zambia with a hand washing station installed in the toilet room.



(d) A well: A common water source at a village in Malawi.



(e) An improved toilet and a hand washing station (bucket) at a village in Tanzania.



(f) A common hand washing bottle installed near a latrine at a village in Malawi.



(g) A basic latrine with a hand washing station (bottle) at a village school in Malawi.



(h) A common improved pour flush toilet at a peri-urban area in Zambia.



(i) A basic latrine without a hand washing station at a village school in Zambia.

Figure 4. (a), (b), (c), (d), (e), (f), (g), (h) and (i) show pictures of WASH facilities that are commonly used in Malawi, Tanzania and Zambia. (Photos by the author)

Table 1. Summary of history, geogrpahy, population, economy and finance of Malawi, Tanzania and Zambia.

	Malawi	Tanzania	Zambia
Historical Background			
Colonizer	Britain	Britain	Britain
Independence	1964	1961	1964
Geography			
Land Surface (Laisi 2009)			
Location	Southern sub-Saharan Africa	Southern sub-Saharan Africa	Southern sub-Saharan Africa
Total geographical area	118,480 km ²	940,000 km ²	752,612 km ²
Covered by water	28,760 km ² (20%)	60,000 km ² (6%)	About 317,000 km ²
Water usage and coverage			
Surface water	Agriculture, hydroelectricity	Domestic use, agriculture, hydroelectricity	Hydroelectricity
Ground water	Domestic use	Domestic use	Domestic use
Total coverage (estimate)	67%	47.9%	61%
Population statistics			
National Population*			
As per last official census	17.5 bn (in 2018)	44.9 bn (in 2012)	13.1 bn (in 2010)
2020 Projection	19.1 bn	57.5 bn	17.9 bn
Religion (Population %)**			
Christian	77.3%	61%	95.5%
Muslim	13.8%	35%	2.7%
Traditional	1.1%	-	-
Others	5.6%	4%	1.8%
Non-religious	2.1%	-	-
Economy & Finance***			
International Membership	African Union, SADC, COMESA	African Union, SADC	African Union, SADC, COMESA
Economy	Agriculture	Mining, agriculture	Mining (Copper)
Currency	Malawi Kwacha: MWK	Tanzania Shilling: TZS	Zambian Kwacha: ZMW
Gross Domestic Product (GDP)	3.9–4% (increment: 2017–2018)	6.5–7% (stable: 2003–2018)	4–1.7% (decline: 2018–2019)
National Budget	MWK 1.3 tn (~USD 1.762 bn) (in 2017/18)	TZS 841 bn (~USD 302.6 bn) (in 2016/17)	ZMW 71.6 bn (~USD 3.9 bn) (in 2017/18)
	MWK 1.45 tn (~USD 1.966 bn) (in 2018/19)	TZS 1.087 tn (~USD 468.7 bn) (in 2017/18)	ZMW 86.8 bn (~USD 4.8 bn) (in 2018/19)

*World Bank and IMF 2019; UNICEF Malawi 2019a; NSO 2018; UNICEF Zambia 2019

*Last official census: Malawi (NSO 2018; Trading Economics 2020a), Tanzania (NBS and OCGS 2013; Trading Economics 2020b), Zambia (CSO 2012; Trading Economics 2020c)

**International Religious Freedom Report citations: Malawi (Office of International Religious Freedom 2019a), Tanzania (Office of International Religious Freedom 2019b), Zambia (Office of International Religious Freedom 2019c)

***United States Dollar: USD; Trillion: tn; Billion: bn; Million: mn

Table 2. WASH and health statistics of Malawi, Tanzania and Zambia (MDGs to Current SDGs).

	Malawi		Tanzania		Zambia	
Household WASH Statistics: Pre SDGs = MDG (2015)						
Drinking water access	Improved, MDG (2015)	Basic, SDGs	Improved, MDG (2015)	Basic, SDGs	Improved, MDG (2015)	Basic, SDGs
Rural	89.0%	63.0%	46.0%	34.9%	51.0%	44.0%
Urban	96.0%	87.0%	77.0%	79.0%	86.0%	86.0%
Total	90.0%	67.0%	56.0%	47.9%	65.0%	61.0%
MDG target	Target Met	-	Moderate progress	-	Limited or no progress	-
Improved sanitation access	MDG (2015)	SDGs	MDG (2015)	SDGs	MDG (2015)	SDGs
Rural	40.0%	53.0%	8.0%	13.8%	36.0%	18.5%
Urban	47.0%	44.7%	31.0%	74.9%	56.0%	35.0%
Total	41.0%	51.8%	16.0%	31.7%	44.0%	25.4%
MDG target	Moderate progress	-	Limited or no progress	-	Limited or no progress	-
Unimproved sanitation access	MDG (2015)	SDGs	MDG (2015)	SDGs	MDG (2015)	SDGs
Rural	34.0%	41.0%	71.0%	89.3%	34.0%	85.5%
Urban	15.0%	47.0%	36.0%	57.0%	18.0%	65.0%
Total	31.0%	42.0%	60.0%	79.8%	27.0%	74.6%
Open defecation	MDG (2015)	SDGs	MDG (2015)	SDGs	MDG (2015)	SDGs
Rural	5.0%	7.0%	17.0%	13.8%	22.0%	32.0%
Urban	1.0%	1.0%	2.0%	2.5%	1.0%	3.0%
Total	4.0%	6.0%	12.0%	10.5%	14.0%	19.0%
Handwashing station (water & soap)	Pre SDGs (2010)	SDGs	Pre SDGs	SDGs	Pre SDGs (2013–4)	SDGs
Rural	2.0%	8.0%	-	40.9%	5.0%	5.0%
Urban	7.0%	18.0%	-	61.7%	24.0%	26.0%
Total	3.0%	10.0%	-	47.8%	13.0%	14.0%
Health Statistics						
Child Mortality (deaths/1,000 live births)						
Under 5 y.o.	63 (in 2018)		74 (in 2018)		61 (in 2018)	
Infants	42 (in 2018)		68 (in 2018)		42 (in 2018)	
Child Stunting						
Under 5 y.o.	37% (in 2017)		31.8% (in 2018)		40% (2017)	
Annual cholera outbreaks						
Number	874 cases, 27 deaths (in 2017/18)		4,636 cases, 95 deaths (in 2017) 4,444 cases and 80 deaths (in 2018)		5,905 cases, 112 deaths (in 2017/18)	
Case Fatality Rate (CFR)	3.1% (in 2017/18)		1.7% (on average) (in 2017/18)		1.9% (estimate) (in 2017/18)	

Malawi (WHO and UNICEF 2017; NSO 2017; USAID 2018a), Tanzania (MoHCDGEC et al. 2016; World Bank 2018), Zambia (Min. of Water Development, Sanitation and Environmental Protection 2019); WHO and UNICEF 2015

Table 3. Qualitative comparison of WASH policy, governance and strategies of Malawi, Tanzania and Zambia.

	Malawi	Tanzania	Zambia
WASH Policy & Budget Overview*			
WASH Budget	MWK 23.1 bn (~ USD 31.3 mn) (in 2018/19) Budget increase: +12.3% from 2017/18	TZS 957 bn (~ USD 412.6 mn) (in 2016/17) TZS 702 bn (~ USD 302.7 mn) (in 2018) Budget decline.	ZMW 628 mn (~ USD 34.9 mn) (in 2017/18) ZMW 1.9 bn (~ USD 105.7 mn) (in 2018/19) Budget increase.
WASH Budget Allocation	- No clear breakdown of fund - Focus: Water & sanitation. Implementation: Mainly water	- No clear breakdown of fund - Focus: Mainly water rather than sanitation & hygiene	- No clear breakdown of fund - Focus: Mainly water rather than sanitation & hygiene
WASH in policy	Water and sanitation: Clear, separate approach	Water and sanitation: Combined. No clear separation	Water and sanitation: Combined. No clear separation
Water and Sanitation Governance			
Laws governing the water sector			
Policies	- 2005 National Water Policy - 2006 National Sanitation Policy	- 1991 National Water Policy - 2002 National Water Policy	- 1994 National Water Policy - 2010 National Water Policy
Acts	- Water Resources Act of 1969 - Water Resources Act of 2013 (revised) - Waterworks Act 1995	- Water Supply and Sanitation Act No. 12 of 2009 - The Water Utilization Act No. 42 of 1974 - Amendment Act No. 10 of 1981 - Waterworks Act of 1997	- Local govt Act No. 22 of 1990 - Water Supply & Sanitation Act No. 28 of 1997 - Water Resources Management Act of 2011
Responsible party	Water Governance & Management: - Min. of Agriculture, Irrigation & Water Development - Water Resources Board (1969) Sanitation: - Water Boards: water supply services - Local govt - Min. of Health: Sanitation and Hygiene Education - Water Resources Board (1969)	Water Governance & Management: - Min. of Water and Irrigation - Basin Water Boards and Water Offices (1981)	Water Governance & Management: - Min. of Energy and Water Development - Dept. of Water Affairs (since 1972) - Water Board: demand, utilization, allocation of water & rights (since 1949) - National Water Supply & Sanitation Council (since 1997)
National Strategy (Water and Sanitation)			
Strategies & Plans (Water & Sanitation)	- Community Led Total Sanitation (CLTS 2007–2018) - Sanitation Marketing and Hygiene Promotion - ODF strategy - Establish National Hygiene & Sanitation Coordination Unit (NHSCU): Min. Irrigation & Water Development	- National Strategy for Growth and Reduction of Poverty (NSGRP) - National Water Sector Development Strategy (NWSDS) - Water and Sanitation Program (WSP) - National Sanitation Campaign - Community Led Total Sanitation (CLTS 2016) - ODF strategy	- National Irrigation Plan (2001) - Strategy and Institutional Framework for the Water and Sanitation Sector (1995) - Water, Sanitation and Hygiene Education (WASHE) (1996) - National Environmental Sanitation Strategy (1998) - Community Led Total Sanitation (CLTS 2016) - ODF strategy
Governance	Water: - Create enabling environment: WASH PPPs - Rehabilitate infrastructure for sustained services - Incorporate local govt., communities in planning, development, WASH service management Sanitation: - Structural implementation: National sanitation policy - Establish new sanitation directorate: Min. Irrigation & Water Development - Institutional linkages: Policy Steering Committee	Water: - Strengthen regional and local govt authority capacities: implementation of roles, responsibilities Sanitation: - Strengthen capacity of regional & local govt. authorities - Enhance private sector and NGO capacity	Water: - Develop: • Water resources regulations and guidelines • Fair and justifiable tariff structure for water use • National water resources management plans
Integrated Water Resource Management (Water)	- Water conservation and catchment protection - Develop, expand raw water sources: sustainable water supply	- Capacity development: trans- boundary water management	- Collaborative development of water allocation plans - Designate protected areas with line ministries - Develop mechanisms for equitable water allocation*
Other	Sanitation - Information dissemination: - Mass media: awareness and information spread - Annual sanitation conference	Water & Sanitation - Human Resource (HR): - Implement human resources development plan - Framework: Strengthen HR capacity in water CBOs - Develop appropriate training delivery capacity - Identify sector staffing and skills needs	Sanitation - Information dissemination: - Develop newsletter (highlight sector progress) - Community friendly communication strategies - National events/workshops: Key figures (political & non-political) & mass media coverage - Form links to mass media

Malawi (Min. of Irrigation and Water Development 2005; NSO 2018; UNICEF Malawi 2019b), Tanzania (Min. of Water and Irrigation 2008), Zambia (Min. of Energy and Water Development 2010; UNICEF Zambia 2019); World Bank and IMF 2019

*Malawi Kwacha: MWK, Tanzania Shilling: TZS, Zambian Kwacha: ZMW, United States Dollar: USD, Billion: bn, Million: mn)

4. Discussion: Qualitative and Quantitative Comparison of Malawi, Tanzania and Zambia

A comparison between the three countries is key to understanding the differences and similarities in their performance and perception of WASH. In this regard, it is very important to quantitatively and qualitatively compare the three countries as they have been highlighted in this paper. Quantitatively, basic population statistics, health statistics, and National economy and WASH budget need to be addressed. On the other hand, Qualitative comparison includes; Water and sanitation governance, National strategy, and results.

4.1. Qualitative comparison

Qualitatively, all three countries seem to have taken similar approaches towards management of WASH sector. Primary governance of Water, Sanitation and Hygiene is given to the ministry responsible for water and ministry of health deals with matters of sanitation and health. In all three countries, system of water governance was adopted from the colonial government which gave full control of water and natural resources to the central government. Similarly, with time and rapid population increase post-independence, all three countries saw the need to decentralize their systems for them to work efficiently. Zambia already had a decentralized system with the Department of Water Affairs and the Water Board which were formed in 1948 and 1949 respectively. Malawi followed in 1969 when water management was shared between the ministry and water resources board. In 1995, the Water Board was established. Similarly, Tanzania's central government established nine basins water boards and water offices in 1981. This difference in time of sector reforms may translate in how the governments have outperformed each other in WASH because those that started earlier would be expected to have a more significant progress. This view arguably corresponds to Tanzania being left behind because the reforms came much later. However, in this regard, Zambia is behind Malawi in access to water and sanitation despite having a decentralized system before Malawi. A possible explanation to this would be that the institutions in place were outdated to cover recent needs in the sector.

The three countries also share similar fundamental policies and laws that govern their WASH sector. The most fundamental policy is the National Water Policy. Malawi established its water policy in 1994, revised in 2005 and 2007, while Tanzania and Zambia created their policies much earlier in 1991, revised in 2002 and the latter 1994, revised in 2010 respectively. Similar conception would be that, those that developed their policies much earlier are expected to be leading in that sector. However, in this case it seems to be the opposite. Developing working policies needs to be supported by implementation to be effective. In this regard, Malawi did better because of planning and implementation. The introduction of separate water boards and institution reforms to the Water Resources Board in 1994 relieved the pressure and gave more power to the local government (Ministry of Irrigation and Water Development 2005). This reform and redistribution was very significant to improving services. On the other hand, Tanzania remained behind because the central government remained the sole investor, implementer and manager of the sector. Reforms only came later in 2002 policy to have an inclusive approach as it was the trend in the region (Ministry of Water and Irrigation 2008). Zambia's slow growth in the water sector was mainly due to poor management of the sector. The 2010 National water policy indicated that 1994 water policy lacked development and implementation strategy, and data assessment of available water resources (Ministry of Energy and Water Development 2010).

All the policies that the three countries have put in place over the years have been cemented and governed by the Water and Sanitation Act, and the Waterworks Act.

In all three countries, water has been granted more attention than Sanitation and hygiene. However, the similarity is that, the water and sanitation Acts aimed at recognizing the importance of addressing water and sanitation as separate entities in order to achieve the MDGs and the future SDGs. This was a positive approach as it ensured that

funds can be split towards water or sanitation projects separately. The water works act also known as the Water resources management Act in Zambia aimed at ensuring power redistribution through institution reforms. The ministries shared power with the local government and water boards. Malawi's water works Act was established early in 1995, and this ensured the national water policy of 1994 could be implemented successfully and in time. Tanzania on the other hand developed a national water policy in 1991 and the Waterworks Act came later in 1997. This shows a lack of coordination to effectively guide the reforms. This problem may explain the reason why the policies developed did not work. Zambia's introduction of the Waterworks Act in 2011 indicates the willingness to make positive changes. This gave the water board responsibility to deal with water supplies to entities while the Department of Water Affairs focus on conservation and rights of water resources (Ministry of Energy and Water Development 2010).

In addition, Malawi and Tanzania are very similar in terms of water aspect. This is because both countries depend on agriculture economy which employs over 80% of their population, unlike Zambia which relies mostly on copper mining. This factor may mean that the Ministry of water in Malawi and Tanzania is big and has a robust experience in water governance because they have to strike a balance between agricultural water and domestic water. On the other hand, Zambia's Ministry of water supply would be expected to be better because a lot of effort and funding in their water management has to be directed towards domestic water supply. However, management, policies and implementation are necessary to be successful.

4.2. Strategies

Malawi, Tanzania and Zambia put more effort towards the water development than sanitation and hygiene during the MDGs era. However, in the early 2000, and the fight to attain the MDGs, countries began to focus on sanitation when they realized the significance. Malawi, Tanzania and Zambia engaged the Open Defecation Free campaign through the Community Led Total Sanitation (CLTS) strategy. The campaign aimed at changing behavior with respect to stopping people defecating in the open or in basic latrines and increasing handwashing with soap behavior. Despite all three countries taking the approach, the approach was different. Malawi and Zambia reports indicate that the campaign and strategy was rolled out around the same time in 2007. Tanzania on the other hand, seem to have started later around 2016. Tanzania produced its CLTS guidelines for verification of ODF (MoHCDGEC 2016). In this regard, it is arguable to say Tanzania has mostly been behind because of slow management of WASH institutions as compared to Malawi and Zambia.

In addition, Malawi's strategies seemed to focus more on institutional reforms such as; engaging local communities through the Local government, and creation of the water boards and national Water Resources Authority Council (Ministry of Irrigation and Water Development 2006). Tanzania focused more on capacity building rather than institutional reforms. On the other hand, Zambia combined institutional reforms with WASH education. Despite the differences, all three countries are similar because they follow a sector wide approach of engaging all stakeholders, the ministry of water and local government work together, and employ the Community-Led Total Sanitation.

4.3. Quantitative comparison

Quantitative comparison of the three countries display their similarities and differences. Firstly, the total land surface area of the countries is very different. Malawi is a very small country as compared to Zambia, but Tanzania is far much bigger than both Malawi and Zambia. This can be one of the reasons for Malawi and Zambia's better performance in other WASH aspects, such as access to basic drinking water. This is economically understandable because Tanzania would require a huge investment and resources for infrastructure development and maintenance

in order to cover its large area.

Firstly, the most common and perhaps interesting similarity between the three countries is that they were British colonies. The independence that followed, left the countries with western ideologies and systems of governance. This can be evidenced by the presence of laws which were formulated using the British standard and the presence of over reliance of funding from their colonial masters. This turned into a parasitic relationship where the countries depend heavily on colonial funding. This left many countries in Africa helpless when funding was cut or reduced. A good example is that of the fall of Zimbabwe's WASH. When funding was cut off 24% of Zimbabweans were left lacking access to improved water sources, and 32% of the people practicing open defecation (UNICEF Zimbabwe 2018). Conversely, Malawi's strong governance and leadership from 2004 to 2012 emphasized economic independence. This led to the creation of the famous 'zero deficit budget' which was based on what Malawi had and not on donor funds. Malawi's major reforms and achievements came during this period (World Bank 2016).

Secondly, population of the three countries is of great importance to note because it is logical to assert that the bigger the population, the bigger the budget or investment plan. Malawi and Zambia's population are slightly different, with Malawi having a slightly bigger population than Zambia. Malawi and Zambia population can be estimated at around 20 million, while Tanzania's population is over two times the population of Malawi or Zambia. The small difference between the population of Malawi (67% access to drinking water) and Zambia (61% access to drinking water) may explain the reason behind the small difference in access to drinking water (6% difference) and the huge difference between the two countries to Tanzania (47.9% access to drinking water) which has a huge population.

In addition, the population is also a significant factor in a country's economy as the numbers mean there is need for more productivity and circulation of money to sustain a big nation. Tanzania has the strongest economy among the three countries with a stable average GDP of 6.5% to 7% estimated over the past five years (UNICEF Tanzania 2018). Malawi's GDP has not enjoyed such stability and growth as it was estimated at 3.9% in 2017 and 4% in 2018 (UNICEF Malawi 2019a). Similarly, Zambia has faced major hardships in recent years after attainment of middle-income status in 2011 with a GDP of more than 7%. However, Zambia's economy has declined from 4% GDP in 2018, to 1.7% in 2019 (World Bank and IMF 2019). Persistent natural disasters such as floods and cholera, decline of copper industry and heavy debts have been the major causes of this downfall. It is also important to note that the geographical position of these countries also plays an important role in their economies. Malawi is a small, landlocked country, while Tanzania is a big country open to the sea and with a robust tourism industry. Tanzania's access to the sea, possessing the highest mountain (Kilimanjaro) in Africa, and huge game reserves significantly adds value to their economy. Zambia is also naturally endowed, and tourism is also a huge industry with Victoria Falls as a major tourism area.

Thirdly, expenditures in the countries national budget and WASH is significant having evaluated their economic performance. Malawi's national budget was about \$1.9 billion USD in 2018/19, and WASH was allocated \$31.3 million USD (UNICEF Malawi 2019b). Tanzania had a budget of \$468.7 million USD, with \$302 million USD allocated to the WASH sector (UNICEF Tanzania 2018). Zambia had a \$4.8 billion USD national budget and \$34.9 million USD allocated to WASH (National Assembly of Zambia 2019). From the figures indicated, Tanzania shows that it is taking major steps in WASH sector as it is investing much more than the other two countries despite having a low national budget as compared to Malawi and Zambia. However, despite such allocations on paper, Tanzania is still behind of the two countries in access to basic drinking water and total sanitation coverage. This financial breakdown also indicates that Malawi and Zambia can do much better by increasing WASH investments if they are to meet the SDGs by 2030.

An analysis of the countries in relation to WASH also indicate that all three countries are very similar. Access to drinking water is higher in urban areas unlike rural areas in all the three countries. Current access to drinking water is estimated to be at 87% in urban, and 63% in rural Malawi. Similarly, Tanzania's access to drinking water stands at 79% and 34% respectively. Zambia also has higher access to drinking water in the urban area at 86%, while the rural area has 44% coverage. In addition, levels of malnutrition are significantly high in all the three countries. Malawi, Tanzania and Zambia are estimated to have 37%, 35% and 40% stunting of children under the age of five. The trend is the same when it comes to the percentage of people practicing open defecation. The percentage of people practicing open defecation in rural Malawi is at 7% as compared to the 1% in urban settlements. Percentage of open defecation in rural Tanzania is at 13.8% and 2.5% in the urban area. Similarly, in Zambia the figures indicate 32% for rural areas while only 3% for the urban areas.

However, Malawi's rural access to improved sanitation (53%) is higher than urban Malawi (44.7%) and rural Tanzania (13.8%) and Zambia (18.5%). This significant difference is mainly because most (about 50%) urban households in Malawi have shared toilets while most rural households do not share toilets (NSO and ICF 2017).

The 2012 Water and Sanitation Program (WSP) in all three countries indicated a huge number of people with no latrines and many using unsanitary or shared latrines if they were available. In Malawi, 5.2 million people were using unsanitary shared latrines while 1.4 million people had no latrines. Tanzania registered about 26 million people with shared latrines, while Zambia registered 4 million people using shared latrines, while 5.4 million and 2.1 million people had no latrines in both countries respectively (WSP 2012). These figures explain the high infant mortality rate, widespread malnutrition and perennial cholera outbreaks in this region.

Despite these challenges, hand hygiene and usage of soap in urban and rural Tanzania has done better than both Malawi and Zambia. This could be attributed to the high Islamic religion percentage (35% Muslims) in Tanzania (Office of International Religious Freedom 2019b). The Muslim community generally has a high usage of water due to the teachings of their beliefs. For example, they use water to wash themselves after using the toilet while others are content with just using toilet paper. Another reason could be good economic policies which have seen the country at the top of sub-Saharan East Africa GDP, and most people can afford some basic necessities. Campaigns and community sensitization may have also helped, but more study would provide more significant answers.

Finally, the statistics of health output indicate whether progress is being made in relation to WASH. Malawi's under five and infant mortality rate (63 deaths and 42 deaths per 1,000 births respectively) remains to be a problem despite positive improvements through the years (NSO and ICF 2017). Stunting remains to be a big problem for Malawi at 37%. Cholera cases seem to drop but the high Case Fatality Rate (CFR) of 3.9% shows that it is still a big problem. Tanzania health statistics indicate a bigger under five and infant mortality rate. Under five mortality rate was estimated at 74 deaths while infant mortality rate stood at 68 per 1,000 live births (Ministry of Health and Social Welfare 2008). Stunting remains a challenge (35%) for Tanzania, and cholera case also seem to be high but low CFR of 1.7% shows a positive progress. Looking at the same parameters, Zambia is ahead of the two countries in progress with 61 under five and 42 deaths per 1,000 live births (Zambia Statistics Agency et al. 2019). Stunting remains higher (40%) than the other two and cholera cases seem to have been increasing. However, the CFR of 1.9% shows that Zambia is progressing than Malawi in managing cholera response.

4.4. Policies

The most important policy in Malawi is the National Water Policy of 2005 which endorsed the Integrated Water Resources Management and Water. This is a good policy because it recognized the need to equally focus on both water and sanitation independently through the National Water Policy and the National Sanitation Policy in order to achieve the MDGs and the SDGs in an all-inclusive manner. This would eventually help to easily track

accountability, participation and easy execution of tasks because the tasks had been shared and budget divided into water and sanitation respectively. Consequently, it simplified the investment process.

Zambia's most significant strategy was the Water, Sanitation and Hygiene Education (WASHE), adopted in 1996 (Ministry of Energy and Water Development 2010). However, WASHE was to work in the rural areas only with the objective of promoting integrated development of water, sanitation and health education to improve the impact of water supply and sanitation on health and to promote community management to ensure sustainability of services through better financial support, operation and maintenance. This emphasis on education lacked practicality because the government did not invest more on infrastructure development for the communities to exercise the knowledge they were taught, and they also needed to focus more on the growing urban population.

Malawi has seen positive progress due to the reforms in policies coupled with huge investment in infrastructure development and execution. Priority towards water sector development in Malawi is higher than in Tanzania. The budget allocation for water sector development stood at approximately \$13.2 million USD in 2017/2018 financial year, and approximately \$21.9 million USD for 2018/2019 financial year (JICA 2019). These figures indicate Malawi's water sector development budget allocation increased by 65% in the financial year 2018/2019. This has allowed Malawi to initiate several water developmental projects, such as; Lilongwe Water Supply Resources Efficiency Programme, Mzimba Integrated Urban Water and Sanitation Project, and Lilongwe Water and Sanitation Project (JICA 2019).

On the other hand, Tanzania's failure can be attributed to poor investment in infrastructure and WASH. The approved budget to the water sector has declined over the years. The approved water sector budget indicated that there was a decline from 957 billion Tanzania Shillings (\$412,449,997.3 USD) in 2016/2017 fiscal year to 702 billion Tanzania Shillings (\$302,586,204.9 USD) in the fiscal year 2017/2018 (ZIPAR and UNICEF 2019). Furthermore, the locally approved allocation was at 690 million Tanzania Shillings (\$262,500 USD) in 2016/2017 and 409 million Tanzania Shillings (\$176,293 USD) in 2017/2018. In addition, only 32% of the approved allocation was used in 2016/2017.

Zambia has shown slow, but positive progress through scaling up of funds towards the water development sector. Budget allocation was increased by 252% from 564.5 million Zambian Kwacha (\$30,947,107 USD) to 1.98 billion Zambian Kwacha (\$108,547,868 USD) in 2018 and 2019 respectively (ZIPAR and UNICEF 2019). Zambia's recent increment in budget allocation towards WASH from 564.5 million Zambian Kwacha (\$30,947,107 USD) to 1.98 billion Zambian Kwacha (\$108,547,868 USD) in 2018 and 2019 is probably a positive response to the persistent cholera outbreaks which claimed over 100 lives between 2017 and 2018. Within the same period Zambia has intensified interventions and WASH education. Projects such as; Lusaka Sanitation project, Kafue Bulk Water Supply and Sanitation project, Kafulafuta Water Supply, and the Nkana Water and Sanitation projects have been initiated as key projects.

Conclusion

Generally, sanitation and hygiene performance have been a huge challenge to all three countries as they seem to have made little or no progress towards their targets. Water, sanitation and hygiene move together and usually budget allocation in all the countries is disbursed as one sum to cover the whole WASH sector. However, more effort has been placed on access to water than sanitation and hygiene.

Many policies and projects that were developed have not been as successful were intended. Moving forward to achieve the SDGs by 2030, some changes need to be made and implemented. Despite upholding the notion that there is no single model that guarantees an effective water governance, this paper has found other factors

that are universal and need to be done. Huge investments in water sector infrastructure development and water governance are very crucial. Malawi's success in water sector development has been achieved due to its high investments in WASH unlike Tanzania and Zambia. However, Zambia's emphasis on WASH education coupled with investments would ensure development and sustainability of the WASH sector. Water governance is of great importance because it ensures good management system of the water sector. However, central to this, is the WASH education which can help people understand WASH as a basic right in which they also need to take their responsibility as a stakeholder. This will ensure inclusiveness in participation, accountability, transparency and good policies because every member of the society will know and play their role.

Besides this, the government and citizens need to take the leading roles in funding and managing their WASH systems for it to be sustainable. Water, sanitation and hygiene funding must be clearly addressed, and task execution must be well promoted. Donor funding is not reliable as it may change or cease as observed from a recent drop of funding in all three countries. Campaigns and interventions need to be encouraged because they have shown that they have been successful in many cases and areas of sanitation in Malawi and Tanzania. Therefore, it is imperative that huge investment plans towards infrastructure development and water governance be made in Malawi, Tanzania and Zambia, and every society in order to achieve the current SDGs by the year 2030.

In addition, a further analysis of the discussion indicate that WASH is a complicated subject that needs strong political will and leadership and inclusive approach. All beneficiaries and institutions always need to be well coordinated and monitored to ensure sustainability. This monitoring involves evaluation and audit of WASH institutions. Cost effective ways of handling sanitation need to be developed to match the economic capacity of the people.

Finally, all three countries are still facing the challenge of providing potable water supply and sanitation. The biggest challenges are lack of investment strategy and management to promote infrastructure development, good maintenance and sustainability.

There's need for further study to understand more about the challenges and differences and why only sub-Saharan countries have performed poorly among the rest of the developing and middle-income countries.

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