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TOWARDS SUSTAINABLE RAINWATER HARVESTING: UNVEILING THE CONCERNS OF RESIDENTS IN YILO KROBO MUNICIPALITY

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Abstract

Purpose — The study aimed at investigating residents' concerns about rainwater harvesting and its use among households in the Yilo Krobo Municipality.

Methods — The study used questionnaires to solicit the views of residents in the Yilo Krobo Municipality and the results were analyzed using descriptive and nominal logistics regression approaches

Findings — The study found that residents have concerns about the quality of rainwater which had implications for their harvesting and usage. They were also concerned about the mode of collecting as well as storage facilities used in storing rainwater. Variables such as age, occupation, and education were factors contributing to residents' desire to harvest rainwater.

Conclusion & Recommendation — The study concluded that people's concerns about the quality of rainwater influence their desire to harvest it. Respondents with low education and farmers tend to harvest rainwater. The study recommends education on how to harvest and store rainwater to reduce contamination in the water.

Keywords: Domestic water, climate change, water scarcity, fresh water, water storage

Introduction

Water scarcity is a global phenomenon and even though about two-thirds of the earth's surface is made up of water, saltwater makes up about 97% and the remaining is fresh water which limits the supply of fresh water in large quantities (Owusu & Asante, 2020). About 1% of the 3% is available for human consumption. The rests are glaciers or cryosphere. With the increasing world population, the demand for freshwater continues to increase, thus putting pressure on the limited sources, hence alternative sources of water become critical (Andoh et al., 2018). Water has no substitute and various sources of good drinking water need to be explored. It has been estimated that about 2.2 billion people worldwide struggle to have access to safe water which has become worse with climate variability especially long drought conditions (Owusu & Asante, 2020). Rainwater harvesting (RWH) is a long tradition among several people in different geographical areas and is used for domestic, industrial, and agricultural purposes (Owusu & Asante, 2020; Velasco-Muñoz et al., 2019). Various underground and surface water sources are fed by rainwater. However, climate variability can affect the supply of these water sources when there are prolonged droughts with intermittent rainwater supply.

Water resources are threatened and face various forms of degradation and other challenges such as an increase in urban growth, an increase in the use of water for industrial and agricultural purposes, and inadequate distribution of water resources (Velasco-Muñoz et al., 2019). RWH, therefore, provides the opportunity for people to have access to fresh water to supplement their water needs. RWH implies the application of different means to collect, store, manage, and use rainwater (Owusu & Asante, 2020; Velasco-Muñoz et al., 2019). Some of the uses of rainwater for domestic purposes include washing, bathing, cleaning, and car washing, and when rainwater is treated to meet the quality of drinking water standards, can fully replace household water needs and reduce the pressure on pipe-borne water. About 60% of domestic water use can be replaced with rainwater (Struk-Sokołowska et al., 2020). Furthermore, rainwater for laundry activities can account for about 15% of household water use. Rainwater is soft, prevents limescale from settling in washing machines, it leathers quickly and so reduces the amount of detergent used, and can help to reduce the amount of energy used in washing and increase the lifespan of the machine. Using less energy and detergent can reduce pollution and be safe for the environment (Struk-Sokołowska et al., 2020).

In Ghana, people get their water supply from ground and surface water sources such as boreholes, wells, rivers, lakes, and RWH. The quality concerns of surface water such as rivers and lakes as well as the cost of constructing boreholes and wells usually limit their usage (Owusu & Asante, 2020). RWH becomes a cheaper alternative, however, peoples' perception of rainwater can influence their desire to harvest it. Even though RWH can help reduce water scarcity for domestic and commercial use, people's desire to harvest it matters. When people perceive the benefits associated with RWH, they are likely to harvest it. Even when people are on the national grid and receive water from service providers, RWH could help supplement their water needs and reduce the cost of their water usage. The quantity that could be stored at a time could also help reduce water scarcity. The concerns that people may have about rainwater could also influence their decisions to harvest it. This study seeks to investigate residents' concerns about rainwater usage and the factors influencing RWH in the Yilo Krobo Municipality in the Eastern Region of Ghana.

The study is relevant in the context of the study area and other similar municipalities for these two reasons. First, a study shows that rainwater use constitutes a small share (less than 1%) of the sources of water in the Yilo Krobo Municipality (Gbedemah et al., 2022). However, access to other sources has been problematic, either due to erratic supply in the case of pipe-borne water from service providers, or quality concerns in the case of unimproved sources such as rivers and streams.

While previous studies have highlighted the challenges and benefits of RWH in the global south countries (Abraham et al., 2020; Andoh et al., 2018; Owusu & Asante, 2020), few studies have been conducted in the Yilo Krobo Municipality on factors that influence residents concern on the use of RWH, especially between rural and urban settlements where water infrastructure and services are relatively poor. This study, therefore, fills this gap by examining residents' concerns in the utilization of RWH and further examines how their background characteristics such as age, gender, and level of education among others play a significant role in influencing these concerns associated with RWH. Thus, providing perspectives on ways to improve the use of rainwater will significantly address water challenges in the municipality. Second, the findings can be used as an exemplar to understand RWH challenges in other similar study contexts, and can also be built on for other exploratory and detailed studies on RWH in small towns and rural communities.

1.1 Perceptions of people regarding rainwater

People's perceptions can influence rainwater harvesting. Perception according to Bennett et al. (2016; 585) is the way people or a particular person "observes, understands, interprets, and evaluates a referent object, action, experience, individual, policy, or outcome". These authors go on to show that perception is a broad term that is used to show attitudes, beliefs, and values. These broad evaluations of behaviors of people in a particular situation can be positive or negative (Fishbein & Ajzen, 2011). People's perceptions can be influenced by their attitudes, knowledge, beliefs, lived experiences, other people's opinions, outreach campaigns, groups with different perspectives, emotional responses, socio-cultural backgrounds, etc (Vaske et al., 2021; Niemiec et al., 2020). According to Upham et al. (2009), research findings on people's perceptions of a particular situation will inform policy on the right course of action to take or recommend. Mankad et al. (2015;184) for instance point out that people's "decision to install a rainwater tank will increase when householders feel threatened by water scarcity, and believe that a rainwater tank is an effective way to address that threat". Another study by Chubaka (2017; 308) found that Adelaide's "households' drinking water preference was based on the community's perception of municipal water, and the choices of many households were driven by water taste rather than water quality".

Chew et al. (2019) found that women's daily water source choices and perceptions in the Eastern Region of Ghana were based on multiple factors, including seasonality, accessibility, physical burden, spiritual, religious, or community messaging, and ease of use. In Ghana, a study by Abraham et al (2020) on RWH in the Cape Coast Metropolitan area concluded that harvesting and use of this rainwater are low. Relatedly, Owusu & Teye (2014) researched RWH in Ghana and points out that high levels of unmet demand for pipe-borne water are being experienced in peri-urban areas of the capital city of Ghana (Accra), and as such residents have resorted to RWH to meet these needs. The main hindrance to harvesting rainwater on a large scale is the nature of tenancy arrangements in Ghana which makes it difficult for tenants to construct their own system of collecting water because their tenure in the house is not guaranteed.

1.2 Factors influencing rainwater harvesting

People are also concerned about the quality of rainwater. Studies show that the quality and quantity of rainwater depend on the geography, characteristics of the climate, prevailing human activities, and the volume of the storage tank (Hamilton et al., 2019). Rainwater is found to be generally clean and has low hardness and a quasi-neutral pH (Liuzzo et al., 2016). Rainwater is said to be free from geogenic chemicals but is mainly contaminated through anthropogenic sources which can also be described as low (Qi et al., 2019). The quality of rainwater may be contaminated due to trace metals, pathogenic organisms, and physical objects such as dead leaves or animal droppings (Hamilton et al., 2019).

1.3 Domestic rainwater harvesting: principles, system components, and quality issues

Center for Affordable Water and Sanitation Technology (CAWST, 2011) asserts that RWH systems can be divided into three main components: the catchment surface; and the storage. Khayan et al. (2019) posit that the quality of RWH will depend on these three main components.

Other studies assert that the quality and quantity of rainwater depend on the geography, characteristics of the climate, the prevailing human activities, the volume of the storage tank, contamination of the catchment area, intensity of rainfall, periods of dry season preceding the rains, and method of collection (Andoh et al., 2018; Biswas & Mandal, 2014). Rainwater is found to be generally clean and has low hardness and a quasi-neutral pH (Liuzzo et al., 2016).

The main quality issues of RWH come from debris, dirt, and dust that gathers on the catchment area, which in Ghana is mainly the roof. These unwanted materials are not supposed to enter the delivery system which will be transported into the storage tank when the first or second rain falls. There is a need to devise a system that is to divert these unwanted rainfalls (first flush) outside the system (DTU, 2002). The second area of the RWH component that hinders the quality of the harvested water is the storage device which is also the component that requires the largest capital investment. There is no single requirement for the storage device as one can construct it by him/herself or purchase them in the market. Some people use cement or brick blocks to construct it while others depend on commercially constructed plastic storage devices. Others use local materials such as plastic, or fiberglass containers as storage devices.

2 Materials and methods

2.1 Study Area

The Yilo Krobo Municipality is situated in the Eastern Region of Ghana and falls within latitudes $6^0$00'N-$0^0$30'N and longitudes $0^0$30'E-$1^0$00'W. In 2020, it was shown that 122, 705 people lived in the municipality, and out of this, 59,656 are males while 63049 are females (GSS, 2021). According to the Ghana Statistical Service (GSS, 2014), approximately 34 percent of the population is between the ages of 15 and 35, while approximately 37 percent is under the age of 14. The population is made up of 52 percent women and 48 percent men. The population of these communities makes up 61 percent of the population of the municipality, while about 212 of the 237 settlements in the municipality have fewer than 500 residents. Since there are so many small rural villages in the municipality, it is impossible to supply water and other infrastructure services to them all, this condition presents challenges for the Municipal Assembly in terms of providing potable water facilities. A map of the study area is shown in Figure 1 below.

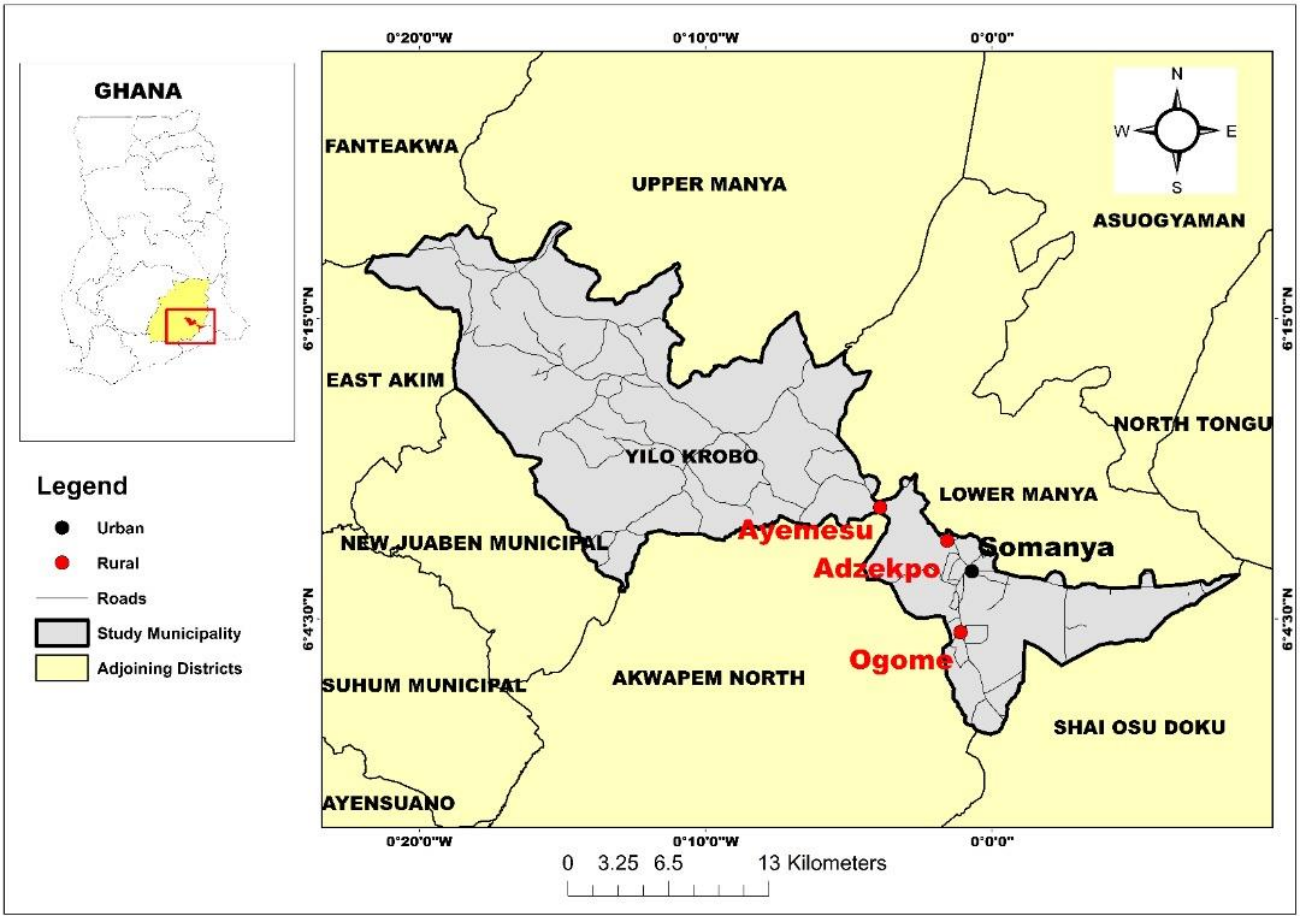

Figure 1: Map showing the study area.

About 27.1 percent of the households in the Yilo Krobo Municipality rely on rivers or streams for domestic usage, according to the GSS (2014). Other water sources utilized for residential purposes include borehole/tube wells (12.9%), public taps/pipes (13.9%), and pipe-borne sources outside the home (14.3%). 20.0 percent of the population has access to public taps and standpipes, which are the primary sources of water for domestic use in the municipality's urban districts.

2.2 Methods

The target population for the study consists of people who live in the municipality and are at least 18 years old. The same family did not have more than one sample of a given age group. The household was used as the analysis unit since several questions were specific to the household the respondent was a member of. With a 95% level of confidence, a 7% margin of error, and an expected total of 20,613 residences, the sample size was calculated (Israel, 1992). The overall sample size collected was 400, and of this total sample, 160 (40%) were drawn from rural populations and 240 (60%) from the urban population. According to official records, the municipality is primarily rural, yet, because of the municipality's rugged terrain, the dispersed nature of the rural villages, government restrictions on mobility, and resource constraints, the researchers took more samples from urban areas.

The research design used for this study was a cross-sectional survey. This research design allows for studying the attitudes and perceptions of a subset of a population at a point in time (Creswell, 2014). Regarding the sampling of respondents, the study used a multi-stage sampling approach (Fuller, 2011; Lohr, 2019). An initial stratified sampling of the respondents was conducted. At this point, a

portion of the sample was divided between the two research populations, which were divided into urban and rural areas (i.e. rural and urban). Fourty (40%) was allotted to rural areas, because of the difficulty in reaching the villages, such as inadequate roads and resource limitations, with about 60% going to metropolitan areas. Due to the small number of rural communities, the population was sampled randomly. Ayemesu, Adzekpo, and Ogome were the three rural communities covered by the sample survey; each had about 53 respondents sampled. For the urban community which was Somanya, a multistage cluster sampling procedure was adopted. To facilitate the sampling process, Somanya was divided into thirteen clusters using the already established unit committee demarcated areas. Four clusters (unit committees) were then sampled from the list of thirteen clusters in the second stage of the sampling process. The third and final stage involved a simple random sampling of sixty (60) respondents (heads of households) from dwelling units in each of the four clusters selected.

The results were analyzed using both descriptive and inferential statistics. The descriptive statistics were frequency and percentage distribution of variables. These variables include demographic variables, perception of RWH, and concerns about the quality of harvested rainwater. Nominal logistics regression was performed to predict the effects of respondents' characteristics on their desire to harvest rainwater. Regarding the qualitative data, a total of thirty (10) households that have RWH systems in place were observed to ascertain their concerns and how they harvest water. In-depth interviews were held with some of these household heads on issues concerning RWH in the Yilo Krobo municipality. Thematic content analysis was used to analyze the qualitative data. This data was analyzed by first transcribing the interviews conducted with household heads. This was followed by a first reading of the transcripts to get a general overview and insight into the responses provided. The second reading followed next and sought to identify responses that fit under specified themes that have a bearing on the study. These themes include quality, components of the RWH system, water storage, and accessibility.

3.0 Results and Discussions

3.1 Profile of Respondents

There were more female respondents than males and the highest age group falls within 31-40 followed by those between the age group of 41-50, then 18-30. The pattern of age distribution indicates that the majority of the respondents fell within the working class. Respondents who were married constituted the largest proportion, followed by those who were single. The greater number of respondents have had Senior Secondary School education and the majority were traders. The respondents' characteristics are shown in Table 1.

Table 1: Demographic background of respondents

Background of respondents	**Type of settlement**		**Total**
	Rural	**Urban**	
Gender			
Male	58 (36.2%)	108 (45.0%)	166 (41.5%)
Female	102 (63.8%)	132 (55.0%)	234 (58.5%)
Total	160 (100.0%)	240 (100.0%)	400 (100.0%)
Age			
18-30	8 (5.0%)	70 (29.2%)	78 (19.5%)
31-40	60 (37.5%)	70 (29.2%)	130 (32.5%)
41-50	58 (36.2%)	46 (19.2%)	104 (26.0%)

51-60	20 (12.5%)	20 (8.3%)	40 (10.0%)
61+	14 (8.8%)	34 (14.1%)	48 (12.0%)
Total	160 (100.0%)	240 (100.0%)	400 (100.0%)
Education			
None	10 (6.2%)	16 (6.7%)	26 (6.5%)
Non-Formal Educ.	18 (11.2%)	20 (8.3%)	38 (9.5%)
Primary	4 (2.5%)	12 (5.0%)	16 (4.0%)
JHS/Middle	16 (10.0%)	30 (12.5%)	46 (11.5%)
SHS/O'Level	46 (28.8%)	66 (27.5%)	112 (28.0%)
Voc/Technical	24 (15.0%)	24 (10.0%)	48 (12.0%)
Polytechnic/Nursing	40 (25.0%)	18 (7.5%)	58 (14.5%)
University	2 (1.2%)	54 (22.5%)	56 (14.0.0%)
Total	160 (100.0%)	240 (100.0%)	400 (100.0%)
Occupation			
Farming	34 (21.2%)	8 (3.3%)	42 (10.5%)
Trading	52 (32.5%)	74 (30.8%)	126 (31.5%)
Civil servant	24 (15.0%)	30 (12.5%)	54 (13.5%)
Teaching	8 (5.0%)	34 (14.2%)	42 (10.5%)
Artisan	36 (22.5%)	26 (10.8%)	62 (15.5%)
Others	6 (3.8%)	68 (28.4%)	74 (18.5%)
Total	160 (100.0%)	240 (100.0%)	400 (100.0%)

The background of respondents is important in our understanding of RWH. In most African societies, women perform most household chores, and such gender roles can have implications for those who harvest rainwater. The educational characteristics of respondents could also influence their knowledge of the need to harvest rainwater. Education could be formal or informal, and the majority of respondents have had formal education. Again, the type of occupation can influence peoples' desire to harvest rainwater. Most of the respondents are traders followed by those in public service. In a study from Ethiopia, it was found that farmers harvested rainwater because of the benefits they get from it to irrigate their farms and that knowledge of people has a positive influence on RWH techniques (Mengistu, 2021).

3.2 Perception of Rainwater harvesting

Respondents were asked to indicate whether they believe RWH will be welcomed by residents. The majority (72%) were positive that this is possible. People are positive about harvesting rainwater in the future since there have been challenges with water emanating from erratic supply from service providers, coupled with the rising cost of accessing water in recent times (Gbedemah et al., 2022). Thus, respondents may probably be viewing RWH as a viable option, especially when average rainfall is also rising.

Respondents were asked to provide their reasons for their choice and the majority said they will harvest it because it is the only available alternative (72%) whilst a good number felt it is not a clean source of water (28%). Cross-tabulation results show that more women (42%) believe that RWH is possible and can be harvested on a large scale. However, most respondents were concerned about the quality of rainwater (see figure 2). In many developing countries, women usually fetch water to perform household chores (de Moraes & Rocha, 2013), and their perception of RWH is crucial since it can influence their desire to harvest it. Some women collect rainwater based on seasonality, and ease of access (Chew et al., 2019). When there is water scarcity, they are those who suffer the most,

and even girls of school-going age may equally be affected. Water is one of the greatest challenges facing poor urban households and more women preferred that governments and institutions address their water challenges (Eshun & Denton, 2022a, 2022b) which requires critical attention. Just about 2% of the respondents indicated that they are harvesting rainwater, even though the majority perceive that they will do so if the quality concerns are addressed. The low patronage of RWH was noted by Abraham et al (2020) and this requires critical attention.

The quality of rainwater could be analyzed from laboratory testing; however, people's experiences could influence their perceptions about the quality of rainwater. Rainwater quality could also depend on other issues including the location, the intensity of rainfall, the number of dry periods before the rains, the method of collection, and the storage systems used (Andoh et al., 2018; Biswas & Mandal, 2014). There are cases where excretion from lizards, birds, and other flying insects falls on rooftops which happens to be the main source of collection. Debris, dust, and related foreign materials can also find their way into the storage, and techniques to filter the water become crucial (Andoh et al., 2018). About 16% of the respondents said they are artisans who could be engaged to come out with technological designs that can help the local members to harvest rainwater in a manner that could reduce contamination. Creating awareness and training artisans can stimulate peoples' interest in RWH (Andoh et al., 2018) and also create jobs.

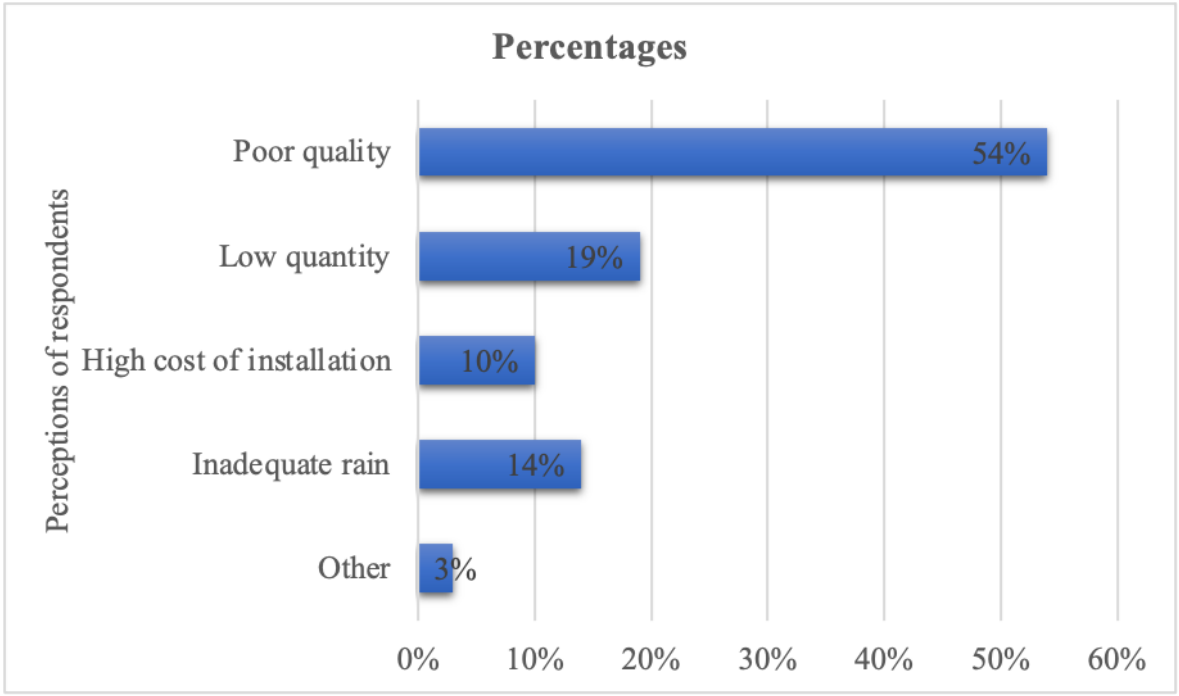

Figure 2: Residents' perceptions of rainwater

The quality concerns of rainwater are a global issue as studies from Indonesia report that the quality does not meet the requirements for drinking, yet rainwater is the main source of drinking water for residents in West Kalimantan, Indonesia (Khayan et al., 2019). In Ghana, studies from the central Gonja district show that rainwater can be used for bathing, cooking, and drinking (Andoh et al., 2018). Even where people do not directly drink the rainwater, it is used to wash clothes and hands, and even to cook meals. Other authors have also found that the high cost of the system, limited institutional support, inadequate information, and perception of the quality of rainwater as barriers

influencing RWH (Akuffobea-Essilfie et al., 2020). Qualitative information from the study highlights the quality concerns which prevent respondents from drinking the rainwater:

> *"We harvest rainwater, even though the volume is small. But because of the quality concerns, we use it for cooking, washing clothing, and bathing. If there is a way that the quality can be improved, we will use it as drinking water (Respondent from Adzekpo)."*

Rainfall figures from the municipal assembly point to the fact that the rainfall figures within the municipality range between 750 mm in the southern section of the municipality to 1600 mm on the mountainous areas. The average rainfall distribution in the Yilo Krobo Municipality has a mean value of about 1,270 mm. These figures indicate that there is much potential for RWH in the municipality. This is because, other areas in Ghana that are water-stressed and worse off as far as rainwater is concerned are harvesting rainwater (Owusu-Boateng & Gadogbe, 2016). The most important issue is whether households are ready to harness rainwater and more so whether they can do so.

3.3: Factors influencing rainwater harvesting

The background characteristics of respondents were run with their perception of RWH. This is shown in table 2. The nominal regression results indicate that an increase in the odds of the age category of respondents will increase their desire to harvest rainwater on a large scale and this is significant for all age groups. However, those who are between the ages of 41-50 have increased odds to harvest rainwater more than those within the age group 51-60, 31-40, and 18-30 respectively.

Table 2 Factors influencing rainwater harvesting

Item	**Estimate**	**Significant**	**Lower bound**	**Upper bound**
Age				
18-30	2.099	0.002	2.225	29.997
31-40	2.364	0.000	3.351	33.776
41-50	2.804	0.000	4.361	62.482
51-60	2.541	0.000	3.191	50.490
Education				
None	2.029	0.011	1.579	36.647
SHS	1.520	0.005	1.594	13.126
Occupation				
Farming	-2.548	0.000	0.024	0.253

Nagelkerke R^2 0.297

Again, those who have no education also have increased odds of harvesting rainwater than those who have attained Senior High School education. Education and knowledge about people can influence their perception to harvest rainwater (Mengistu, 2021). This study found that those who have had some formal education have a deeased odds of harvesting rainwater. This could be related to their concerns about the quality of rainwater. Those who are farmers have a decreased odds of harvesting rainwater even though this is significant at 0.000 and explains 29% of the model. The study, therefore, shows that age, education, and occupation influence people's perception of RWH.

Farmers due to the nature of their work are likely to harvest rainwater for irrigation purposes. In a study in northern Ethiopia, farmers perceived the harvesting of rainwater as a motivation and a sense of belonging. They believe that it helps them to increase crop production and their desire to apply RWH technologies was influenced by their education, size of the farm, and income (Mengistu, 2021). Educating farmers about the importance of RWH techniques could help increase their odds of harvesting rainwater for their farming activities. Furthermore, educating other groups such as women about RWH can reduce the pressure on portable drinking water from a centralized source. RWH can replace the water used in domestic activities such as cooking, washing, cleaning, bathing, and laundry which can reduce money spent on pipe-borne water (Struk-Sokołowska et al., 2020). Other studies found that the mode of housing, mode of RWH, income, water availability, and services influence RWH (Lebek & Krueger, 2021). A study in Ghana found that sex is a good predictor than the education of respondents to harvest rainwater. This study found that education is a significant predictor of residents' desire to harvest rainwater.

Respondents were asked to provide their reasons for not harvesting rainwater. Their responses are shown in figure 3.

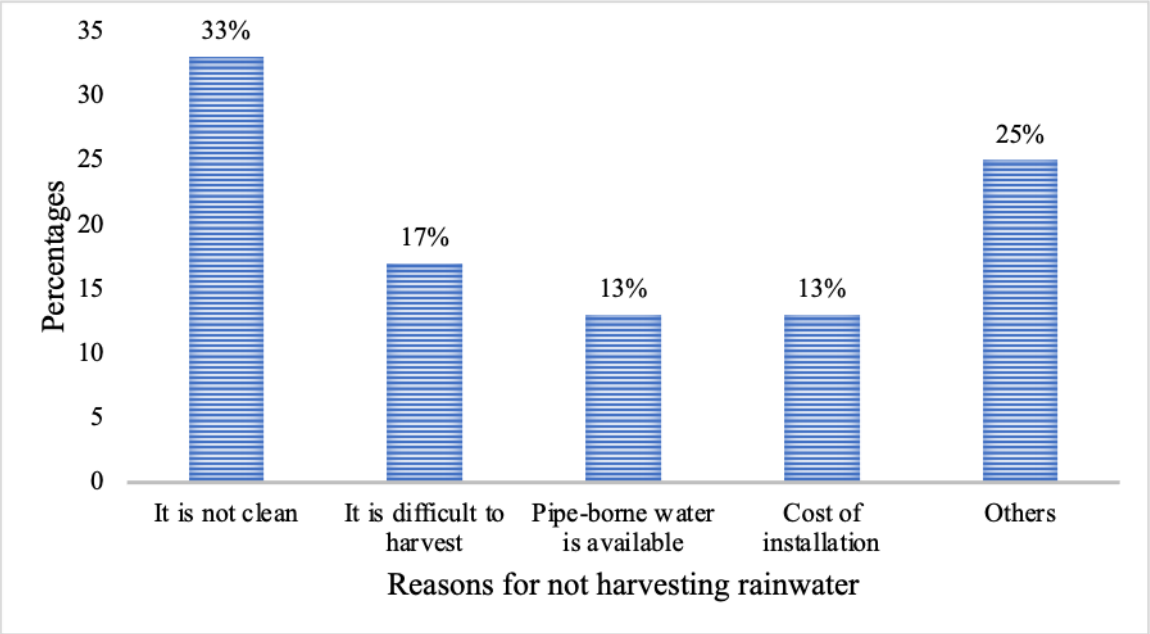

Figure 3: Reasons for not harvesting rainwater.

The majority of the respondents believe that rainwater is not clean so they do not harvest it. This goes to strengthen the quality concerns residents have about the rainwater. Others shared that it is difficult to harvest. This suggests that people require education in the method of RWH that could be easier for residents to use. It has been reported that RWH is usually cost-effective compared to the drilling of wells and boreholes (Biswas & Mandal, 2014; Owusu & Asante, 2020). However, some of the respondents complained about the cost of harvesting rainwater. Education on the appropriate methods can reduce people's perception of the cost and challenges associated with RWH and embrace the practice. This can help reduce water scarcity and reduce surface run-offs. Depending on the technology one may want to apply, the cost associated with it will in the long run become effective. Other authors share the view that the cost of harvesting rainwater is low (Owusu & Asante, 2020; Struk-Sokołowska et al., 2020).

The findings indicate that people perceive RW to be of low quality hence the low patronage. Observation in the field regarding those who harvest rainwater shows that the majority of them did not harvest rainwater based on the principles and systems outlined by the CAWST (CAWST, 2011). The observed RWH systems in the Yilo Krobo municipality did not have good surface catchments for RWH. Some of the houses have trees that extend into the catchments which will make the collected rain dirty. Other houses used catchment systems that are rusty because they used galvanized or corrugated iron sheets. Corrugated roofing sheets "affect the total alkalinity and methyl orange alkalinity of the harvested rainwater but had no impact on their physical appearance" (Omuku et al.,2022; 134). None of the observed ten households used nets to sieve the water that is entering the storage tank to prevent dirt. This mechanism should be constructed in such a way that, it can be removed, cleaned, and fixed back when the desired quality water is falling. In other words, the delivery system has to contain a flexible part that can be removed and replaced when rain is falling but this is not the case with about 90% of the ten RWH systems that were observed.

The continuous use of rainwater and its harvesting can lead to environmental conservation and poverty reduction because people will no longer go and purchase it from vendors. It can also be used as a climate change adaptation measure in areas where the rainfall pattern is becoming erratic (Abdeladhim et al., 2022). The development and propagation of domestic RWH in Ghana and other communities is a sure way to propagate the sustainability of water sources because it has been implemented and used in numerous countries around the world (Kim et al., 2016; Owusu & Teye, 2014; Prihanto et al., 2018).

4.0 Conclusion and Recommendations

Residents perceive that rainwater is of low quality which inhibits them from harvesting it. This study found that those who are connected to the Ghana Water Company Limited (GWCL) grid do not have the desire to harvest rainwater however, respondents believe they will harvest it when it is the available alternative. Another finding is that those with lower educational backgrounds have increased odds of harvesting rainwater and among other occupational categories, farmers are those who harvest rainwater. The study recommends the education of residents on the need to harvest rainwater as well as the appropriate technology to employ to reduce contamination in the water. The municipal authorities and educational institutions in the municipality and the country at large should promote RWH technologies to reduce pressure on freshwater resources, and as an alternative to reduce the cost of paying for water from the grid. The municipal authorities should also engage the media to publicize the environmental and cost benefits associated with RWH. Time and resources served as constraints in examining various roles artisans within the municipality can play in promoting RHW and further studies can look at this.

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