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EVALUATING THE EFFECTS OF HOUSEHOLD'S SOCIO-DEMOGRAPHIC ELEMENTS ON THE DETERMINATION OF DRINKING WATER QUALITY AND QUANTITY IN RURAL SAVANNAH COMMUNITIES OF NORTHERN GHANA

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Abstract

The standard of living of communities which go beyond their basic human needs can be sustainable only if their demands for quality water and consumption standards have regard for socio-demographic variabilities and ecological sustainability. This rural ecological study utilised cross-sectional survey design to evaluate the effects of socio-demographic elements on access to adequate and quality water, with particular focus on historically disadvantaged villages/settlements and water end-users (households) from rural Savannah area of Ghana. A sample size of 450, composed of 392 household heads and 58 staff from water related institutions were randomly selected through the proportionate, systematic and simple random sampling techniques. Structured questionnaires and interviews were modes for data collecting while correlation and descriptive statistics were deployed in analysing the data. Gender and age variations existed with male headed households relatively higher than females. Women were responsible for domestic water collection, yet they lacked voice in decision making on water and sanitation. Dependency on surface water prevailed and consumption patterns peaked significantly in dry seasons. This was remarkably noticeable among the economically active and

youthful population. Education levels, income, composition of HHs, distance of walk in daily haulage of water, primary sources of water utilised, water demand, treatment carried out on drinking sources and strategies for solid waste disposal were significantly associated with and generally determined the quality and quantity of water available and accessible by the people. There is the urgent need to ensure balance between rural water supply, population growth, water consumption patterns and provision of sanitary facilities in order to maintain a robust rural economy and ecological equilibrium. Water and sanitation policy initiatives should have regards for the "rurality" of the people and socio-demographic variabilities. Ecological conservation measures should be founded on multi-stakeholder and community management approaches.

Keywords: Public administration, Household, Socio-demographic elements, Water quantity and quality, Rural Savannah Community, Northern Ghana

INTRODUCTION

The standard of living of communities which go beyond their basic human needs can be sustainable only if their demands for quality water and consumption standards have regard for socio-demographic variabilities and ecological sustainability. Yet, many rural poor communities live below the world's ecological means, in terms of their access to quality drinking water (United Nations, 2018a). The essential needs of a vast number of people in developing countries for food, water, clothing, shelter, jobs and sanitation are not being met, and worst still, beyond these basic needs, rural people have legitimate aspirations for improved quality of life. A world in which poverty and water inequity are endemic would always be predisposed to ecological and other crises (United Nations, 2018b).

The approach by countries towards achieving sustainable local development must, therefore, ensure that all communities meet their basic water consumption needs and that opportunities are extended for rural people to satisfy their aspirations for a better life (Brundtland Commission, 2014). Furthermore, the effective distribution of water resources and promotion of water quality at the rural level can only be pursued if demographic developments and population increases are in harmony with the changing productive potential of their ecosystems (Solane & Jouravlev, 2006). This is essential for poverty reduction and human development, especially in sub-Saharan Africa where poverty is more widespread in rural areas than in cities (World Bank, 2018).

The majority of rural dwellers are powerless households, for whom a common constraint is access to water for production and meeting their biological consumptive needs (Food &

Agriculture Organisation-FAO, 2017). Moreover, water is a human right and a common good, yet quite paradoxically, powerless rural households have difficulties in accessing portable water (Choguill, 1996). For Todaro and Smith (2014), water and sanitation are at the very core of sustainable development, pivotal to the survival of people and their ecosystems. As a result, civil society actors are advocating for better rural water and ecological management (Kramer & Pahl-Wostl, 2014).

Nonetheless, universal access to portable water and curtailing open defecation seem to be eluding rural areas of Central, Southern, Eastern and South-Eastern Asia and sub-Saharan Africa (UNESCO, 2017). In sub-Saharan Africa, in every 10 persons, 4 lack access to improved drinking water (WHO and UNICEF, 2017). This puts the health of populations at risk of disease infection (WHO, 2014) since access to quality drinking water relates to all aspects of human growth and development (Awoke, 2012). As the second-driest continent in the world, after Australia, Africa suffers from acute water scarcity problems and rural households are affected the most (Paulson, 2015; Misra, 2014).

The management approaches for domestic water resources in rural sub-Sahara Africa (SSA) have largely been ineffective and this accounts for water scarcity, hunger, poverty, ill-health and resource conflicts in parts of the sub-region. The use of unsafe water has been the cause of diseases such as cholera, dysentery leading to increased death rates among rural African populations. This is because the rates of access to portable domestic water services in rural SSA are among the lowest worldwide, with approximately 1 in 2 rural dwellers, or 278 million people in total, lacking access to an improved water source (Joint Monitoring Programme, 2010).

In Ghana, access to water appears to be geographically, economically and socially determined. Therefore, to reverse inequalities of water supply at the rural level, the Community Water and Sanitation Agency (CWSA) and the District Assemblies (DAs) have established decentralised sub-structures including the Water and Sanitation Committees (WATSAN) and Water and Sanitation Management Teams (WSMTs) to manage water and sanitation delivery at the local level (CWSA, 2015). Nonetheless, power asymmetries and pervasive scarcity of water turn to perpetuate rural poverty and the narrative of decision-making between powerholders and powerless, compelling rural residents to extensively depend on surface (unimproved) water sources (Umesh & Nagarkatte, 2017). Meanwhile, water and sanitation are *sine qua non* to human life (Wumbei, 2017). Hence, the absence of water exacerbates or reinforces the margenalisation and powerlessness of rural people (Lockwood & Smits, 2011). Due to lack of politico-ecological voice and prevailing socio-economic conditions, rural people have limited influence or no real voice in water accessibility and sanitation service delivery.

A top-down decentralised approach in Ghana (Ahwoi, 2010), was supposed to empower rural people, resolve power imbalance and make water accessible to all persons, irrespective of geographic locations (Ayee, 2008, CWSA, 2014a), yet the narrative suggest polar opposite in rural water and sanitation sector. The rationale for this rural ecologically driven study lies in locating the socio-demographic elements of end-users of water (household's) and the palpable effects on rural water quality, access and sustainability. This is because, though Ghana is "on track" for reaching access to water by the Millennium Development Goal (MDG) for improved water by 2015 (UNICEF and WHO, 2017), nonetheless, "significant populations especially in the northern part of the country have unmet needs for safe drinking water" (German Industry and Commerce in Ghana-GICG, 2018: 25).

At the national level, (79%) of Ghanaians have access to basic water, however, the rural-urban disparities reveal that (93%) urban households have access to water compared with (68%) rural access. Moreover, in rural settings, about (9%) have access to limited water, (6%) unimproved water and (16%) of rural people use surface water. Besides, national sanitation coverage is 21%, with 25% access by urban areas and 17% coverage in rural settlements (Ghana Statistical Service-GSS, 2018). The geo-politics and ecological landscape reveal inequalities and power asymmetries (wealth disparities) on access to quality water (CWSA, 2013), with the wealthier/powerholders (97%) having more power/influence over water allocation than the powerless/poor (51%) and urban centres (93%) more likely to have access to quality water than powerless rural (68%) settlements.

Meanwhile, access to improved sanitation appear better in urban centres (25%) than rural settlements (17%) and open defecation is more widespread (70%) among the poorest rural household populations in Ghana (GSS, 2018). About (12%) of residents in northern Ghana lack access to basic sanitation while (50%) lack access to safe drinking water and, therefore, use unimproved water (surface water), as drinking water sources. *"An improved source includes a public standpipe or outdoor tap, a protected well, a protected spring, or rainwater. However, these sources don't completely prevent water borne diseases. Children have high mortality rates and serious health issues due to the lack of safe water and sanitation access"* (GICG, 2018: 15).

The situation is pellucid in the case study area (Savannah Region) of northern Ghana and rural settlements of Buipe, Bole and Damongo communities which are hydrologically constrained with rates of basic water and sanitation access lower than the national average (GSS, 2014a; GSS, 2014b). In the Savannah area, there is a substantial need for not only "improved" but also "safe" water service delivery and water treatment options suitable to the socio-economic and ecological conditions of rural settlements (GSS, 2014c; GSS, 2014d).

Moreover, the effective management of drinking water and sanitation sectors of rural economies require competent individuals who have the requisite knowledge, information, adequate incentives and capacities to discharge responsibilities and decisions at the local level. Nonetheless, local authorities and community stakeholders are constrained with technical capacities, financial resources, managerial competencies, political and ecological unpredictabilities which turn to affect access to quality water by rural dwellers. There exists a substantial variation between urban and rural settlements in access to water. It appears geographical locations, power-relations, wealth/affluence and distance from social amenities dictates accessibility to improved water and sanitation services. This is worst particularly among communities located farther from these social amenities. There is the need to stabilize and ensure sustainability in the rural water sector and this cannot be achieved without understanding the ecological preconditions and socio-demographic situations under which rural people live and operate. This study thus evaluates the effects of household's socio-demographic elements on the determination of drinking water quality and quantity in rural Savannah communities of northern Ghana.

Rural Political Economy and Development; Human Needs of Water

The unrestricted access to safe drinking water is a basic human need and an essential ingredient for sustainable rural development. As a result, water supply and sanitation service delivery must form part of any environmental and primary health care strategy. In the early 1970s, a study on domestic water use in East Africa, by White, Bradley and White (1972) developed three categories of water use-*consumptive* (drinking and cooking), *hygiene* (washing, cleaning, and bathing), and *amenities* such as watering lawns and other non-essential activities (Hall, Koppen & Houweling, 2014). Furthermore, White, et al. (1972) demonstrates that the productive use of water, intended for domestic uses only by rural households (from piped and non-piped sources), was a largely unrecognized, but important factor supporting livelihoods. However, in a follow-up study some 30 years later, Thompson et al. (2001a) added *productive uses* as a fourth category. The frontiers of water use were widened from a productive standpoint to include health and well-being perspectives.

The productive uses of rural water were expanded to include consumption by livestock (e.g. cattle, goats, pigs and sheep), brewing beer, distilling gin, making fruit juice, brick-making and the construction of homes, irrigating trees and horticultural crops (Thompson, et al., 2001a: 31). The productive use of rural water resources has been found to have the capacity to increase employment, rural household's income, food security and livelihoods in rural settlements (Kurian & McCarney, 2010). Similar studies show access to water have positive

impact on reducing poverty (Moriarty, Butterworth, & van Koppen, 2004), empowering women (Torres, Smits, & Torres, 2003) and improving the sustainability of water (Thompson et al., 2001b; Van Koppen, Moriarty & Boelee, 2006; World Bank, FOA and IFAD, 2009). In rural industry, water is essential for car-washing, arts, ice-making, brick-making, pottery, butchery, and other small-scale commercial activities (Van Koppen et al., 2009; Smits, Van Koppen, Moriarty & Butterworth, 2010). Water-dependent activities provide critical income streams (Smits et al., 2010), especially for rural poor who often lack opportunities for wage and salary work (Noel, Phuong, Soussan & Lovet, 2010). Nonetheless, in the Saboba-Chereponi district, Limantol (2009), found that the sustainability of rural water systems is threatened by inconvenient siting of water-points, geological limitations, lack of spare parts, failure to account transparently for funds generated, lack of maintenance, community's lack of sense of ownership and lack of capacity.

The WHO and UNICEF (2012) found that poor water access in rural communities is associated with many water-related illnesses, food insecurity, loss of productivity, poor livelihoods and irregular school attendance, especially for women and girls respectively. The access to water and sanitation services among rural settlements is generally considered as a prerequisite for the attainment of other human rights (Gleick, 1998). The human rights to water, entitles everyone to sufficient, safe, acceptable, physically accessible and affordable water for personal and domestic uses. This is because safe water and adequate sanitation in rural economies are necessary measures to prevent death from dehydration, reduce risk of water-related diseases and to provide for consumption, cooking, personal and domestic hygienic requirements (CESCR, 2003).

In a multi-country study which assessed the link between the productive use of piped, rural domestic water systems, poverty-reduction, and system sustainability among rural households in Senegal, Kenya and Columbia, the Water and Sanitation Programme (WSP, 2014), discovered that high proportion of households were engaged in productive uses of water. In the three countries, between 71% and 75 % of all rural households interviewed were engaged in productive activities that used water sources. The use of piped water supply was considered a more important source than other water sources for households as between 54% and 61% of households used piped water to support their daily livelihoods. These uses met various needs including domestic, consumption and production-based activities. For Hall et al. (2014), expanding the human rights to water should be extended to address the rights of households to access quality water to enable them to meet the full range of domestic, health, sanitation, and livelihood needs in rural settlements. A rural household study by Wilson and Ramphele (1989) discovered that in rural South Africa, the causes of mortality among infants in particular are as a

result of intestinal infection. Hence, proper disposal of waste and household hygiene are very important indicators of the health status and socio-economic conditions under which rural communities live.

Rural Households Water Treatment and Storage

The livelihood of rural communities depends on diversified water sources including village ponds, rivers, lakes, streams, piped water, rain water, dams, boreholes and groundwater wells. These water sources play vital role in the socio-cultural, economic and environment development of rural settlement communities, yet rural water sources are continuously being polluted by human activities of clothes washing, mining, farming activities, industries, bathing and shared surface water use with animals (Peeler, Opsahl & Chanton, 2006). Further, the lack of basic sanitation infrastructure results in the engagement in unsanitary activities like open defecation, poor solid waste and waste water disposal which turn to affect the quality of rural household water resources. The process of transporting water either by vehicles, main pipe lines, or head portership and the storage processes could re-contaminate water sources and become critical obstacles to maintaining rural water quality (Kurian & McCartney, 2010).

Meanwhile, it is also difficult for rural residents to have portable drinking water purifiers to treat household water as they simply cannot afford the cost of water purifier or they are not so educated on application of water purification technologies or they don't know the threats involved in the use of surface water sources (Lothrop, 2015). Opryszko et al. (2013) concludes that the basic treatment methods and designs deployed for surface water purification in deprived rural communities should involve either simple filtration or through ultraviolet light disinfection, combined with rural-based hygiene education, provision of waste disposal facilities and periodic community cleaning exercises. Moreover, in rural Arizon community, Lothrop (2015) found that approximately 42 percent of educated households treated their water sources. The residents with higher income (OR = 1.25; 95% CI (1.00 – 1.64) and education levels (OR = 1.49; 95% CI (1.12 – 2.12) were more likely to treat their water and thus drink from quality water sources. However, in rural India, though surface water sources support the livelihoods of marginalized rural communities, due to contaminations of these drinking water sources, around 38 million Indians are affected by waterborne diseases annually, of whom 1.6 million children are estimated to die of diarrhea alone (Singh & Kumar, 2014). In a related study in Saboba, Limantol (2009) discovered that with the exception of guinea worm infection, the most common disease infections in the rural communities were water-borne. The prevalence of malaria accounted for (81.6%), diarrhoea (68.3%), typhoid fever (66.7%), skin diseases (23.3%), intestinal worms (6.7%), and bilharzias (5.1%).

Besides, Schouten & Moriarty (2003) studies discovered that low incomes *(sig.= 0.07, p > 0.05),* occupation *(sig= 0.06, p > 0.05),* and education levels (*sig= 0.08, p > 0.05),* of rural populations significantly influenced the water and sanitation sectors of rural communities in Rwanda. In a related survey among 15 clustered villages in South Africa, Rietveld, Haarhoff, and Jagals (2009) conducted a chi-square test which established high positive association between gender, marital status and poverty among the inhabitants and these variables turned to have significantly impacted on water and sanitation maintenance. In Bangladesh, Kabir and Howard (2007) found a significant association between educational achievements (p=0.05), gender (sig= 0.06, p > 0.05), and occupation prestige (sig= 0.08, p > 0.05) among rural populace to be positively related with households' determinants of quality water and their participation in rural water and sanitation

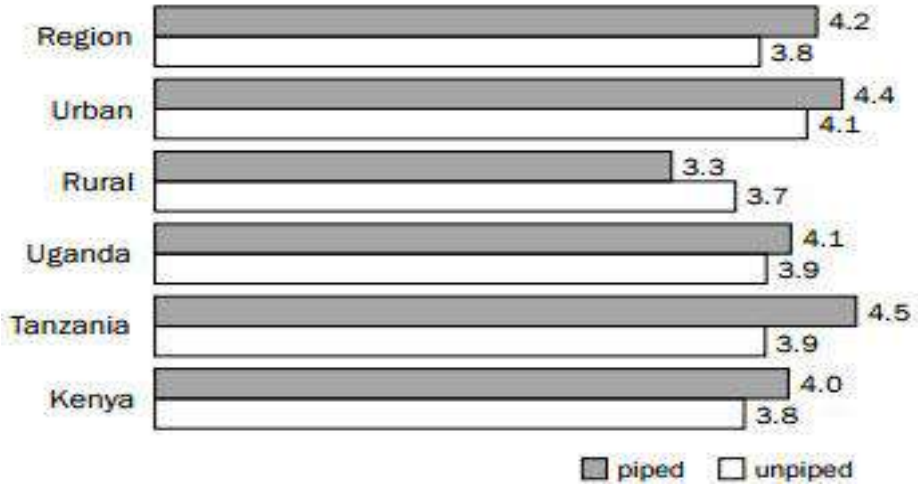
Determining the Basic Quantity of Rural Household Water Needs

There have been divergent views among water experts and international organizations, such as the World Health Organization (WHO), on the minimum quantity of water required per capita for use among rural households. There is a significant variation among scientific researchers on recommended average water quantity measures in society. The WHO has recommended 20 liters per capita per day as a minimum requirement of water for domestic hygiene purposes (WHO & UNICEF, 2000). However, Gleick (1996) showed that 50 liters per capita per day would be sufficient to meet the domestic needs of water by rural households. For Gleick (1996), approximately, 5 liters per capita per day are required for drinking, 20 liters per capita per day are required for sanitation, 15 liters per capita per day are required for bathing, and 10 liters per capita per day are required for food preparation.

A more conservative estimate is, 7.5 liters per capita per day can be enough to meet the daily basic consumptive needs (Howard & Bartram, 2003). However, the authors noted that 7.5 liters per capita per day cannot entirely meet the hygienic needs. Therefore, they claimed that 50 liters per capita per day can meet most of their water needs and 100 liters per capita per day will satisfy all the basic water needs of rural households (Chenoweth, 2008). Furthermore, the availability of rural household water and sanitation amenities depends on various factors such as culture, tradition, religion, appropriate technology, accountability, transparency, rural lifestyle and many others. A study by Muhanad (2016) discovered that climatic conditions, human behavior, household's income, occupation, geography and other factors can play major roles in determining the minimum water and sanitation needs for households. Therefore, understanding the community's characteristics regarding individual's behavior, community activities, and the

socio-economic dynamics is the key role for defining and meeting the water and sanitation needs of rural communities. Furthermore, Thompson and Munguti (2001), using the quantitative methodology with over 1000 sample size, carried out a follow-up study in over 50 selected rural communities of Tanzania, Uganda and Kenya. From Figure 1, the study found that the quantity of water consumption among rural respondents was almost constant among the surveyed households, at approximately 4 liters per capita per day (Thompson & Munguti, 2001).

Figure 1: Consumptive Use of Water. Units are in Liters



Source: Thompson and Munguti (2001)

In other words, the study found no statistical variation in water consumption among users of piped and unpiped rural households across the three countries concerning the consumptive use of water. Furthermore, Moriarty, Butterworth and Van Koppen (2004) discovered that the low levels of household hygiene in rural settings and dependence on surface water by unpiped households for drinking, bathing, washing and cleaning, are the direct consequence of ill-health among rural dwellers. For disadvantaged unpiped communities, White et al., (1972) found that the quantity of water is highly valued compared to the quality of water among poor rural households. Singh and Kumar (2014) confirms that this makes rural settlements exposed to diseases infection, which are usually transferred through uncleaned hands, unhygienic food and uncleansed dishes. These diseases are more likely to be either food-borne or water-borne. Hence, Noel et al., (2010) concludes that inadequate quantity and quality of water devoted for household hygienic purposes, are likely to make the health of rural dwellers more disadvantaged and deteriorated compared with urban households.

Water Collection, Sanitation and Health (WASH)

The availability of sanitary and water supply facilities and ease of access to service delivery relatively influences the burden of rural sanitation and water collection. Thompson et. al., (2003) discovered, comparatively, rural households in Toronro, tend to walk long distances in other to obtain their water sources from outside the dwelling units, while most urban households which used piped supplies had reduced time and distance of walk to water sources. Furthermore, in rural communities classified as 'piped', such as Iganga in Uganda and Temeke-Dares Salaam in Tanzania, significant number of unpiped households exist (Thompson, et. al., 2000). In a related study, Huttinger et al., (2017) showed that, in rural Rwanda, even though the physical infrastructure of water and sanitation facilities are in place, sanitation and water supply systems and services no longer function properly, thus forcing families to adopt unhygienic and liquid waste practices. Similarly, in Ghana, Awepuga (2016) discovered that due to excessive droughts and unreliable supply from piped schemes, households are being compelled to collect consumptive water from unprotected and polluted external sources. The study found that the irregularities in water supply and non-availability of sanitary facilities among communities, resulted in the purchase of water from private vendors, frequently at relatively high prices. In a related piloted rural water and sanitation study in the Afuaman community of the Ga West district in the Greater Accra region. Similarly, Opryszko et al., (2013), analysed samples of rural water for *Escherichia coli* and conducted a cross-sectional household survey involving 49 rural households selected across five villages. The study found that households which utilized piped water had improved water quality compared with households using untreated surface water (adjusted incidence rate ratio = 0.07, 95% confidence interval = 0.02, 0.21).

The practice of unhygienic sanitary habits was found positively associated with water quality (0.08), household health (0.06) and education levels of households (0.05). The implication is that this likely contributed to diarrheal disease burden, caused by waterborne pathogens, including bacteria, viruses, and protozoa, that are transmitted through faecal–oral route. Moreover, the maintenance, repair and servicing culture for rural water and sanitary systems remains critical for the health of rural populations. However, Thomson et al. (2000) discovered that in rural Uganda, reliability of water supplies has declined significantly among households over the last three decades. The factors which contributed to this situation included a lack of system maintenance, mismatch between network capacity, technology deficits, poor sanitation practices and population increase. A trend analysis and comparison between water and sanitation service delivery revealed that;"while in 1967 practically all sampled piped households received 24-hour service delivery, in the early 2000, only 56 percent of them

benefited from the same level of service, almost 40 percent received less than 12 hours of service, and roughly 20 percent got one to five hours of service per day.

Not surprisingly, more affluent areas such as Parklands in Nairobi, Oyster Bay in Dares Salaam, and Tororo in Uganda all enjoyed virtually continuous 24-hour water supply, while high-density, low-income settlements such as Karuri, Kenya and Dodoma, Tanzania, could count on a maximum of only five hours of service per day" (Thomson et al., 2000: 43).Furthermore, the burden of collecting water and waste disposal relates with the nature of existing water supply and waste service delivery in rural settings. The disposal of household waste and rural water supply often involves substantial inconvenience in terms of time spent in collection, physical effort required and adverse health effects which may impact on persons who bear responsibilities for household water collection. Studies in sub-Saharan Africa confirm that in rural settings, the principal drawers of water include women (Thomson, et al., 2000), child drawers and teenagers (Jagals, 2012), who are burdened with the primary responsibility for collecting water for either domestic household consumption or commercial purposes.

In a related demographic study involving the use of several indicator cluster analyses, Graham, Mitsuaki and Kim (2016) describes the gender variation in water collection labour and challenges of water haulage in 24 sub-Saharan African (SSA) countries. The study found that;"an estimated 3.36 million children and 13.54 million SSA adult females were responsible for water collection in households (HHs) with collection times greater than 30 minutes. Among households spending more than 30 minutes collecting water, adult females were the primary collectors of water across all 24 countries, ranging from 46% in Liberia (17,412 HHs) to 90% in Cote d'Ivoire (224,808 HHs). Across all countries, female children were more likely to be responsible for water collection than male children (62% vs. 38%, respectively). Six countries had more than 100,000 households (HHs) where children were reported to be responsible for water collection (greater than 30 minutes): Burundi (181,702 HHs), Cameroon (154,453 HHs), Ethiopia (1,321,424 HHs), Mozambique (129,544 HHs), Niger (171,305 HHs), and Nigeria (1,045,647 HHs)" (Graham et al., 2016:4).

Furthermore, Graham et al., (2016) established that in rural areas, "the proportion of households lacking access to water on their premises was more than 90% in half of the countries (13 countries). Only four countries had less than 75% of rural households without access to water on their premises (68%, Cote d'Ivoire; 68%, Namibia; 60%, Mali; and 73%, Swaziland). For urban areas, access to water on the household premises was higher–only two countries, Central African Republic (89%) and Liberia (85%) had more than 75% of households lacking water on household premises. Fourteen countries had between 50% and 75% of households lacking water on their premises and eight had less than half of households without

water on their premises. Ethiopia had 99% of rural households lacking water on their premises versus 50% of urban households, Lesotho had 95% of rural households versus 37% urban, and Zimbabwe 86% rural households versus 23% urban (Graham et al., 2016: 5).

The average trip of unpipped households to their main water sources is often higher among low income earning rural settlements. Thompson, Porras, Katui-Katua, Mujwahuzi and Tumwine (2003) discovered that in rural Dodoma of Tanzania and Karuri of Kenya, on average, 80 percent of rural households embarked on three trips to their main water sources. In Dodoma community alone, the average distance to water sources was (1-15 minutes, 45%), (15-30 minutes, 50%) and (31 minutes and above, 5%). The adverse effects of excessive drought resulted in drying up of primary water sources of rural settlements and as a result, households had to trek over longer distances to the next accessible sources.

Nevertheless, the drawers of water must queue for long time to collect water. In East Africa, Thompson et al., (2003) observed that due to high population density, coupled with excessive drought, non-functionality of piped households and limited water technology in rural areas, the minimum time spent in queues for water has phenomenally increased from 17 to 25 minutes for a return journey within rural settlements In rural Liberia, Graham et al., (2016) further found that “only 2% of households without water on premises reported spending more than 30 minutes collecting water, while it was 58% in rural Mauritania. In 13 of the 24 countries, 20–50% of rural households reported spending more than 30 minutes collecting water. In nine SSA countries, less than 20% of rural households reported spending more than 30 minutes collecting water. The percentage of urban households that reported to spend more than 30 minutes collecting water was generally lower in contrast to rural households, ranging from 3% in urban Madagascar to a high of 39% in urban Mauritania” (Graham, et al., 2016:5)

In effect, the upsurge in time required for fetching and haulage of water can unfavorably affect the time required for related household socio-economic activities including cooking, washing, cleaning, farming and trading activities. Furthermore, it could truncate children’s education, resulting either in truancy or irregularities in school attendance among children in rural settings. Moreover, competition for water over limited time could result in unhealthy struggles, social upheavals and civil unrest among households which could threaten rural peace and sustainable development. Furthermore, the principal mode for transport of household water and waste involve the use of women, teenagers and children (Opryszko et al., 2013), who continue to walk to and from the sources, carrying water or waste on their heads using either plastic jerrycans, baskets or saucepans (Nsubuga, 2016). As a result, they become prone to health problems include frequent headaches, general fatigue and pains in the chest, neck and waist, and further account for truancy and irregularity in school attendance among children from

rural settlements. In peri-urban Ghana, Nauge and Strand (2013) found a significant positive relationship between teenage girls' school attendance and water hauling activity, which meant that as the duration for water fetching among teenage girls reduces, average school attendance turns to increase by 24 percent, with stronger effects among poor communities.

Research Gaps

Even though a population and housing census was carried out by the Ghana Statistical Service (GSS) on water and sanitation access in northern region, this was done more than a decade (10 years) ago. It is curious and of interest to know the current state of affairs and why there continue to exist a substantial variation in access to adequate and quality water. Moreover, no comprehensive study has thus far been done in the newly created Savannah Region of northern Ghana pertaining to socio-demographic effects on ecological sustainability. The socio-economic interest and needs of rural actors have therefore, not been adequately researched and well-articulated. Similarly, it appears much research on urban and peri-urban areas on Water, Sanitation and Health (WASH)specific projects have already been done by conservationists and civil society groups. This present study, however, relocates scholarly attention on filling the vacuum created in the rural ecological space. Arguably, though research findings from peri/urban contexts could have policy relevance for rural settings, the demography of rural Savannah communities, livelihoods, variabilities of household's socio-economic and ecological experiences are unique and so sophisticated that they are elusive and resistant to simplistic project duplication and extrapolations by policy makers and, therefore, necessitates a comprehensive and independent enquiry. This rural ecological study closes that knowledge gap by interrogating the connection between socio-demographic elements and access to adequate and quality water, with particular focus on historically disadvantaged villages/settlements and rural end-users (households) from the Savannah area.

METHODOLOGY

Study Setting: Why rural Savannah Communities?

The study was conducted in three preselected communities of Bole, Buipe and Damongo, located at the Bole, Central Gonja and West Goja Districts in the Savannah Region of northern Ghana, with total rural household population of 19,646, composed of Bole (7, 765), Buipe (8,905) and Damongo (2,976) (GSS, 2014a; GSS, 2014b; GSS, 2014c).Ghana was under the British Colonial rule until it became the first sub-Saharan African country to obtain its political and economic independence on 6th March 1957. With the adoption of the 1992 republican constitution, the country was ushered into a democratic regime where decentralisation and

popular participation were adopted as the ultimate pathways to sustainable socio-economic development (GoG, 1992). However, for the past decades, the country has struggled to redress the historical underdevelopment and imbalance of access to resources particularly within northern Ghana, which was historically reserved as British protectorate for cheap source of manpower to the industrial and mining sectors (Roger, 1975; Brukum, 1998). The map of Ghana, showing the regional location and land area of northern Ghana and the specific region (Savanna) where the study was conducted is presented in Figure 2. The northern ecological area, composed of Northern, Upper West, Upper East, Savannah and North-East regions, covers a total land area of 70,383 km^2, making northern Ghana the largest in terms of land marks in Ghana (GSS, 2012a; CWSA, 2015). As a result, the North-East and Savannah Regions were carved out of the Northern Region in 2019. The rural dwellers in the communities have access to diversified water sources including pipeborn water, public taps, boreholes, water vendors, dugout-wells, water from streams and rain water (GSS, 2012b). Yet, the paradox is that rural water scarcity continues to prevail. Water in the areas are classified as 'improved' or 'unimproved' (GICG, 2018). The sources considered as improved are pipeborn public water into homes, public standpipe, borehole, protected (lined) dugout-well, protected spring, and rainwater collection, while unimproved sources are unprotected wells, rivers and springs, vendors and water from tanker-trucks (Stoler, Weeks & Appiah, 2013; CWSA, 2013).

Figure 2: Location of the Savannah area where the survey was conducted

Source: Kojo (2019)

In the water and sanitation sub-sector, the pursuit for addressing inequitable resource allocation was shown by the establishment of the Community Water and Sanitation Agency (CWSA) to ensure potable water supply and sanitation service delivery are accessible to margenalised and impoverished rural communities (CWSA, 2014b). This was to further decentralise water provision and bride development gaps between rural and urban water supply with the ultimate aim of socio-economic empowerment of peripheral communities. Nonetheless, since post-independence, rural communities continue to experience deterioration in socio-economic and resource allocation. In this malaise, the rural water and sanitation sub-sector of the Savannah ecological area has not been spared. Meanwhile, a balanced rural ecology is undoubtedly, an essential pillar for stability of rural economies. Hunger and poverty looms as agriculture, fishing, trade and artisanship which constitute the mainstay and livelihoods of the rural communities, suffers with reduction in water supply. The rural settlements have been losing the cream of their population due to limited social amenities including water, sanitation facilities, formal employment and commercial activities (GSS, 2012b; GSS, 2014b). Therefore, the decentralisation approach provides for macro (top-down) and micro (bottom-up) level development and the process involves the participation of myriad of powerful actors. However, the danger is that if the socio-economic interest and needs of micro-level (less powerful) actors are not adequately articulated and sustainably addressed, it becomes impossible to enact effective policies which are relevant to the conditions of rural communities and households. As alluded to at the inception of this study, it is the unaccounted socio-demographic and untold ecological narratives and the effects on rural Savannah water and sanitation sector that this study researched into.

Study Design

The features of this study were in accordance with the quantitative research approach. Arural-driven cross-sectional survey research design was adopted. This design enables a systematic collection of data from populations through direct solicitation, such as face-to-face interviews, telephone interviews and mail questionnaires (McClosky, 1969). More specifically, the survey design enabled this study to test hypothesis, provided quantifiable data to answer questions that have been raised, or solution to problems that have been observed, assess needs and set goals, determine whether or not specific objective have been met, established baselines against which future comparisons can be made, analyze trends across time, and generally describe what exists, in what amount and in what context (Isaac & Michael, 1997). Though limited by its capacity for in-depth and exploratory intensity, nonetheless, the quantitative research approach was chosen to obtain a more quantifiable, reliable and objective understanding of the articulated

problem, eliminated research bias and enabled the analysis of relationships between the study variables.

Sampling Design

The study area consisted of three districts. A total sample size of 450, composed of 392 rural household's heads and 58 staff from water related institutions were randomly selected for the study. The determination of households samples were based on the rural population and a mathematical approach developed by Miller and Brewer (2003); {*n=N/ [1+N (α)²]}, where, n= sample size, N = the sampling frame (19,646), α= error margin, set at (0.05) and 1= constant value, hence n=19,646/[1+19,646 (0.05)²], n=392.02.* The units for household analysis were determined and selected across each of the districts based on *a* single population proportion formula {*P x n/N; where P = proportion of each district's rural population strata, n = sample size and N = total rural population}*. The houses and household heads were selected using systematic random sampling techniques, mathematically expressed as; {K^{th} *= N/n},* where *N= total rural population (19,646) and n= sample size (392), hence,* K^{th} *=19,646/392, therefore,* K^{th} *= 50*. The systematic selection was based on the sample interval (1-50^{th}) and a roster list of households obtained from the District Assemblies and the Ghana Statistical Service (GSS).

The next cohort of sample were the representatives at the institutional level. In survey research, it is often sometime not possible, however, to know the true population. In such cases, Attewell and Rule (1991) suggests that a theoretical sample may be used. Theoretical samples purposively select organisations that exhibit the desired features that are the focus of the researcher's study. Although the theoretical samples are not randomly selected, individual respondents within that sample can be selected at random to achieve an approximate effect (Attewell & Rule, 1991). A total of 8 institutions with 68 staff were initially targeted and purposively selected including Non-governmental Organizations (NGOs)ie World Vision (10 staff), Community Water and Sanitation Agency (CWSA-20 staff), Ministry for Water Resources, Works and Housing (MWRWH-3 staff), traditional authorities (5 people), District Assemblies (ADs 10 staff), water research institutions (Council for Scientific and Industrial Research-CSIR-5 staff), Water and Sanitation Committees (WATSAN-10 members) and Water and Sanitation Management Teams (WSMTs-5 members). The total sample size for the institutional staff were determined based on mathematical approach developed by Miller and Brewer (2003): *n=N/ [1+N (α) ²], where, n= sample size, N = sampling frame (68), α= error margin, set at (0.05) and 1= constant value, hence n=68/[1+68 (0.05)²], n =58.12.* Hence, a sample size of n = 58 workers, were selected at the institutional level. Similarly, the units for analysis were determined based on the proportionate size (P x n/N) of staff across each institution and the simple random

sampling (with replacement) approach was then deployed in selecting the institutional participants.

Operationalisation and Classification of Variables

A household head (HD) was considered as a male or female who was recognized as the legitimate representative of the household. A household (HH) was considered as members of a house (dwelling unit) who shared common water and housekeeping arrangements, however, may not necessarily be biologically related.An unimproved water included sources from dams, pool, rivers, streams, or rainwater, whereas, improved water was considered to be sources tested and approved (with pH > or= 7) for human consumption. Improved sources included pipeborn water connected into residence or outside dwelling units, human-powered or mechanized boreholes. Unimproved sanitary status were households without latrines or toilet facilities who practiced open defecation and had no environmentally friendly mechanisms for solid waste/ refuse disposal. Households with improved sanitation were houses with flush latrines and ventilated improved pit latrines.Meanwhile, socio-demographic variables were classified into gender, HH income, occupation category, education, primary water sources, HH water quality/treatment, appearance and taste of HH water, responsible for HH water collection, distance of walk involved in water haulage, HH major uses of water, HH solid waste disposal, HH toiletry practice, HH composition/size, liters (Ls) per capita per day water consumption and management of HH drinking water.

Data Collection Tools and Quality Assurance

The data was collected from two different levels, namely household level and institutional level, using self-designed structured questionnaires (for institutional staff) and interviews (for households). Due to time limitation, language barriers and the total sample size (ei. 450), which made it difficult for the researcher to collate in time, the study employed the services of 10 research assistants and 3 supervisors, who were trained and engaged for both the pilot study and the actual data collection exercise. The pilot/pretest phase occurred in December 2018, while the actual field data collection exercise was conducted between January and March 2019. The data instruments were meant to obtain primary information including the socio-demographic characteristics, sources of water supply, availability and accessibility of water, amount of water consumption, sanitation and hygiene practices, water quality assessment and factors which affect water, sanitation and hygiene practice within the communities. Data collectors and supervisors were trained, and regular supervision and follow-ups were made by the principal investigators to assure quality data collection. The pre-test was done at Savelugu District, a

non-selected neighbouring district which shared similar socio-demographic characteristics with the study area. Meanwhile, reliability and validation of the instruments were undertaken, and results of the pre-test were compared with the accepted industry standard for reliability coefficients developed by Cicchetti and Sparrow (1981), who found that coefficients between; 0-0.4 (Poor); 0.4-0.59 (Fair); 0.60-0.74 (Good) and 0.75-1.00 (excellent). However, guided by Pallant (2003), in this study, a Cronbach alpha value of ($\alpha = 0.7$) reliability statistic was assumed to assure the accuracy and quality of the measurement tools.

Data Processing and Analysis

The actual field data collected was reviewed and checked for completeness and consistencies by the supervisors and principal investigator. Abnormalities, omissions/oversights, ambiguities, intrusive and missing data sets, clerical/typo errors detected in the responses were immediately rectified through post-field brainstorming sessions with the data enumerators and supervisors. The data was checked, coded, entered into the computer and cleaned before analysis. The Statistical Product for Social Sciences (SPSS version 25) and Microsoft excel were utilised for the data analysis. Descriptive frequencies were used for checking outliers while the non-parametric correlation analysis was carried out to determine association between socio-demographic elements, water quality and access among the rural dwellers. The odds ratio, 95% confidence interval and the corresponding *"p-values*" were determined for each of the socio-demographic variables. The decision rule applied in the hypothesis test was *{accept null hypothesis, if "p-value" > 0.05 and do not accept null hypothesis, if "p-value" <or = 0.05}.* The data was presented using tables and figures for vivid pictorial illustration and reference point for presentation, interpretation and discussion of the findings.

Ethical Considerations

Since research often involve a great deal of cooperation and coordination among many different people in different disciplines and institutions, ethical standards promote values such as trust, accountability, objectivity, integrity, mutual respect, and fairness which are essential for collaborative work (Litwin, 1995; Punch, 2010).Therefore, ethical clearance and permission to undertake this study was obtained from the Research Ethics Committee (REC) of the University of Johannesburg. Official letters were secured from the Department of Anthropology and Development Studies and same were distributed to the institutions involved in the study to seek for permission and facilitate the data collection activities. Meanwhile, local ethnical clearance letters were obtained from the District Assemblies and the Community Water and Sanitation

Agency which had the oversight responsibilities and mandate over local development activities and provision of social amenities in the study communities.

An informed consent form to participate in the study was designed, attached to each instrument and signed by each of the participant before conducting the interviews. Where the respondent was illiterate (household heads) and could not independently sign the consent form, his/her name initials were written on the instrument as an indication of consent. Moreover, an introductory letter was attached to the cover page of each questionnaire which briefly explained to the study participants about the objective for the study, mode of filling and returning the questionnaire, anonymization, utilization of the data and data protection protocols. The participants were assured of their confidentiality, voluntary participation, security over their private information and the rights of the respondents to withdraw from the interviews or not to participate were respected.

FINDINGS AND DISCUSSIONS

Socio-Demographic Characteristics of the Respondents

The study used the Cronbach Alpha to measure the internal consistency of the research instruments. Consistent with Sarantakos (2005), the Cronbach Alpha determined the scale reliability and enabled the study to determine the close relationships or association between the individual items and collectively as a group. Table 1 presents the reliability and scale statistics of the data collection instruments.

Table 1: Results of reliability statistics of the research Instruments

Reliability statistics		Scale statistics			
Cronbach's Alpha	N of Items	Mean ($\bar{x}$)	Variance	St. Dev	No of items
0.930	0.916	268.78	1.808E3	42.523	74

N= 450; Source: Fieldwork (2019)

The parameters for Cronbach alpha ranged from (0 to 1) and this study considered a higher value as an indication of better internal consistency and ultimately, the reliability of the instruments utilised by the study. According to Pallant (2005), the standard minimum Cronbach Alpha value is $\alpha = 0.7$. Therefore, from Table 1, the computed Cronbach's Alpha value for all the items was 0.930 with a mean of ($\bar{x} = 268.78$), a standard deviation of (SD = 42.54) and 74

set of items/variables. The lower standard deviation values disclosed that, on average, most of the items were best-fit and very close to each other.

The results meant that the research assessment tools were reliable and able to reproduce stable and consistent results and, therefore, were suitable to be utilised for a larger scale study. The results provided sufficient confirmation and justification of the reliability of the data collection instruments and the selected variables utilised by the study. A total of 450 respondents were approached and all participated in the study. With the support of the data enumerators and supervisors, all the items were retrieved as complete and well filled, thus translating into (100%) response rate. The high response rate lowered the risk of non-response bias, possibly an indication of the familiarity and good relationship the enumerators had with the household respondents. It further reflects the application of effective community entrytechniques and the generally high interest the respondents attached to water, sanitation and health issues in the Savannah area.

Gender and Age Categorisation of the Respondents

The total respondents for the study was 450, composed of 392 (87.11%) household heads drawn from the Bole, Buipe and Damongo rural catchment areas and 58 (12. 89%) drawn from staff of water sector institutions in Ghana. The gender and age composition of the respondents are depicted by Table 2. The nature of the ruralecological context of the study, the research design and randomized nature of the sample selection made it impossible for the study to achieve gender balance. The respondents were primarily adults, aged between 18 years to 50 years and above. There were gender and age variations, with male heads in male headed households constituting the majority (68.2%) and female in female headed households (31.8%) being the minority. Comparatively, the results were similar with GSS (2014a) GSS (2014b) and GSS (2014c) which found that the proportion of male headed households were comparatively higher than females headed households in the Damongo and Buipe, Bole communities.

Table 2: Respondents gender and age Distribution

Gender	Age range (in years)								Total	
	18 - 28		29 – 39		40 – 49		50 & above			
	No	%	No	%	No	%	No	%	No	%
Male	34	7.6	132	29.3	92	20.4	49	10.9	307	68.2
Female	27	6.0	47	10.4	45	10.0	24	5.3	143	31.8
Total	61	13.6	179	39.8	137	30.4	73	16.2	450	100.0

Though women are often responsible for domestic water collection, unfortunately, the findings of this study revealed they could be underrepresented and thus lack real power and voice in decision making on water. The findings are indications of the existing unbalanced socio-demographic structure, which offer enabling rural-ecological and sociological support for possible male domination and control over decision-making on water in the communities. This was pellucid during the fieldwork as males were generally considered as bread-winners and decision makers. Consequently, it was difficult to get more women to answer questions because they appeared to be constantly busy with domestic errands. The married women who participated in this study have had to seek for approval from their husbands if they had to spend much time in conversation with people who were strangers or unfamiliar to them and their husbands. Meanwhile, the majority (39.8%) of the respondents were youthful population aged between 29 - 39 years, followed by those within the 40 - 49 years bracket (30.4%), then 50 years and above (16.2%) and the least respondents (13.6%) were between 18 to 28 years. The results meant that water utilisation and participation turn to peak among the youth population who constitute the most energetic, agrarian and economically active population. However, water use and participation in local decision-making turn to decline with increase in age (old-age) and reduction in socio-economic activities among the rural dwellers. The results resonate Graham, Mitsuaki and Kim (2016) multiple indicator cluster analyses, which found gender and age variations in water discourse, water haulage and utilisation to have adverse effects on ecological decision making among 24 sub-Saharan African (SSA) countries. Similar to this study, Muhanad (2016) discovered that a patriarchal social arrangement established on a male chauvinist culture, tradition, religious practices and rural lifestyles accounted for social and ecological imbalances, lack of voice and opportunities for women in rural settlements and traditional African societies. Moreover, Rietveld et al., (2009)also found a positive association between gender, marital status and poverty among 15 clustered South African villages and these variables turned to have significantly impacted on water and sanitation maintenance.

Community location and marital status of the Respondents

The location of communities and the status of marriage of residents is perceived to be essential in terms of involvement in decision making which affect the welfare and development of the localities. The geological area combined with updated knowledge on human development status provide vital information for spatial planning, budgeting, policy formulation, ecological governance and sustainability. Consequently, this study evaluated the social status and community location effects on decision making and water allocation in the rural settlements.

As illustrated by Table 3, the results revealed that most of the respondents (41.6%) were from Buipe, followed by Bole (36.2%) and Damongo (15.1%) respectively. Besides, a significant majority of the respondents were married (76.9%), while about (15.1%) were single and only (8.0%) were either widowed, separated or divorced. Inferably, the demand, consumption pattern and decision-making power on water is more likely to be concentrated with married couple who had relatively larger households than single, widowed, separated and divorcee rural dwellers. Majority of the respondents were from Buipe (41.6%), Bole (36.2%), Damongo (15.1%) and other (7.1%) adjourning minority areas. Access to quality water is determined through population index, local community contribution (5%), poverty index and geological factors. Therefore, impoverished settlements with relatively higher populations which were hydrologically constrained and yet could contribute locally to WASH projects were more likely to have access to quality water than least populated areas.

Table 3: Community location and marital status

Marital status	Community location									
	Bole		Damongo		Buipe		Other		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Single	27	6.0	12	2.7	22	4.9	7	1.5	68	15.1
Married	124	27.6	45	10.0	152	33.8	25	5.6	346	76.9
Widowed/ separated/ divorced	12	2.7	11	2.4	13	2.9	0.0	0.0	36	8.0
Total	163	36.2	68	15.1	187	41.6	32	7.1	450	100.0

Moreover, the married respondents from rural settlements of Buipe are most (33.8%) likely to be affected than Bole (27.6%) and Damongo (10.0%) settlements. Efforts must therefore be made by the DAs, CWSA and civil society groups to curtail segregation, marginalisation, dictatorship and absolutism of the majority in water allocation decisions making. An equal playing field and effective decentralisation would be pivotal for ensuring that the interest, needs and views of the most vulnerable and minority groups such as singles, widows, separated and divorcees are effectively harnessed and integrated into development activities within the communities.

The findings suggest that, at the local level, the practice of using geographical parameters, local contributions of communities and population indexes in determination of water access could in effect result in deprivation of least populated and impoverished communities a

legitimate access and human rights to quality drinking water. Undeniably, the localities would require capacities (human, finance, logistics), social and technological reengineering to achieve a balanced rural ecology and equitable access to social amenities. The findings affirm the rational for the top-down (decentralised) development approach in Ghana (Ahwoi, 2010) which was supposed to empower rural people, resolve power imbalance and make social amenities (water& sanitation) easily accessible to all persons, irrespective of geographic locations (Ayee, 2008, CWSA, 2014a). Nonetheless, this study revealed policy implementation deficiencies in Ghana's decentralisation and local governance strategy as "significant populations and locations especially in the northern part of the country continue to have unmet needs for safe drinking water" (GICG, 2018: 25). Similarly, the CWSA (2013), discovered that the geo-politics and ecological landscape reveal inequalities on access to quality water, with wealthier/powerholders (97%) and populated areas having more influence over water allocation than least populated and impoverished (51%) settlements.

Education, occupation and economic Livelihoods

The educational attainment of rural dwellers is essential for understanding the rural-ecological context and water quality standards. Moreover, education affect attitudes, influence perceptions (rural world views), levels of participation and ultimately, decision making power on sustainability and reliability of water delivery. Besides, the type of occupation and livelihood activities in rural economies adversely have implications on the environment, rural health, demand and consumption patterns of drinking water. Therefore, this study examined the levels of educational attainment, occupation and economic livelihoods of the respondents to understand how their knowledge and economic activities shape their world-view of water quality and participation in the sustainability of their ecological systems.

From Table 4, the results showed that majority of the respondents (40%) had obtained Junior High or Middle school education, about (18%) had Senior High School education, 17% nonformal education, 13% tertiary education and 12% obtained basic (primary) education. Moreover, 153 (33%) of the respondents were either public or civil servants, 117 (26%) were either peasant or commercial farmers, 119 (27%) were engaged in petty trade and commercial activities while 61 (14%) were skilled artisans engaged in either hairdressing, tailoring, construction and masonry industry. An illiterate rural population could become a recipe for ecological disruption and artificialization. This is because education appears to have the capacity to change people's world views, shape perceptions and adoption of attitudes and behaviours which are ecologically friendly.

A careful scrutiny of the disaggregated data on educational levels revealed that illiteracy rate among the rural dwellers was averaged (17%).A further probe showed that most of those with primary/JHS and Middle school education could also be school drop outs. If these were discounted, then the illiteracy rate would average (69.0%), which is fairly similar to the illiteracy rates of the Bole (58.4%), Damongo (68.7%) and Buipe (71.3%) communities (GSS, 2014d; GSS, 2014c; GSS, 2014b; GSS, 2014a).The respondents with primary, JHS/middle school, SHS and nonformal education were mostly either engaged in peasant farming 113 (25.1%%), trade and commerce 115 (25.6%) or artisanship 59 (13.6%) while those with tertiary education 47 (10.5%) were largely engaged in the public or civil service sectors. Inferably, the livelihood and economic activities of respondents engaged in trade/commerce, agriculture and artisanship would on average, therefore, depend more on availability and reliable access to water than would those in the public and civil service sector. Moreover, limited education could have adverse effects on knowledge on water since the consumption of unimproved water and unsanitary practices could pose public and environmental health risks to rural dwellers.

Table 4: Education and economic livelihoods of the Respondents

Educational attainment	Occupational categories									
	Farmer		Trader		Artisan		Public/ Civil servant		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Primary	17	3.8	25	5.6	6	1.3	6	1.2	54	12
JHS/Middle School	35	7.8	42	9.3	25	5.6	79	17.4	181	40
SHS	23	5.1	25	5.6	17	3.8	18	3.9	83	18
Tertiary	4	0.9	4	0.9	2	0.4	47	10.5	57	13
Nonformal education	38	8.4	23	5.1	11	2.4	3	0.4	75	17
Total	117	26	119	27	61	14	153	33	450	100

Moreover, an unstable rural ecology, unbalanced power or lack of participation in decision making on water allocation would invariably affect rural health and the informal sector of the rural economy which employ majority of the rural dwellers and for whom water is a basic need for human survival and productive activities. Nonetheless, favourable environment, sustainable interventions and locally suitable initiatives could result in the area becoming a food basket for the Savannah area of Northern Ghana. Therefore, this study concludes that water policy

initiatives and ecological conservation projects should have regards for the “rurality” of the local people, variabilities of rural education, impact on nonformal jobs and socio-economic livelihoods of rural dwellers in the Savannah area of Ghana.

The findings appear to have confirmed Opryszko et al.,(2013) who observed that education was essential for rural-based health promotion, basic and simple water treatment, maintenance of sanitary environments and ecological conservation. The practice of unhygienic sanitary habits was found to be positively associated with water quality (0.08), household health (0.06) and education levels (0.05). Similarly, Lothrop (2015) discovered that about (42%) of educated households of rural Arizon community treated their water sources. Moreover, the residents with higher education levels (OR = 1.49; 95% CI (1.12 – 2.12) were more likely to maintain a sanitary environment and treat their water and thus drink from quality water sources. Moreover, Muhanad (2016) similarly discovered that climatic conditions, human behaviour and occupation play major roles in determining water consumption patterns and basic sanitation needs for both urban and rural settlements.

Household’s composition and average Income

The income disparities of rural households show politico-economic power, variations of access to social amenities and services between the most powerful and powerless (poor) households and the capacity to influence decision making and development activities at the community level. The findings (see Table 5) of this study indicate that the household sizes of rural dwellers were substantially dissimilar, with the least household size (40%) ranging from 1 to 5 membership and the maximum households (5.1%) averaging 17 and above while (5.8%) of the respondents did not know the composition of the household members. The majority of the households (44%) were on average, low income earners, with incomes between GH¢100.00 - GH¢500.00 (dollar equivalence $1= GH¢ 5.2). The least earning households were those with low education and mostly engaged in the informal sector of the rural economy. Relatively, households with high membership (17 & above) earned lessor incomes compared with households with less membership.

In terms of household location and income levels, on average, rural dwellers from the Buipe area had the highest household size (12-16) and received the least incomes (GH¢100 and below), followed by residents from Bole settlements with (6-11 hh size) and average incomes of GH¢100-500

Table 5: Household's composition and income (per month)

HHs average income (GH¢)	Household size											
	1-5		6-11		12-16		17 & above		Don't know		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No	%
Below GH¢ 100	48	10.7	48	10.7	20	4.4	5	1.1	2	0.4	123	27.3
GH¢100-500	76	16.9	62	13.8	37	8.2	14	3.1	9	2.0	198	44.0
Gh¢501-1000	13	2.9	4	0.9	4	0.9	1	0.2	2	0.4	24	5.3
GH¢1001-1500	19	4.2	12	2.7	3	0.7	1	0.2	10	2.2	45	10.0
GH¢1501-2000	21	4.7	21	4.7	10	2.2	2	0.4	2	0.4	56	12.4
Above GH¢2000	3	0.7	0	0.0	0	0.0	0	0.0	1	0.2	4	1.0
Total	180	40	147	32.7	74	16.4	23	5.1	26	5.8	450	100

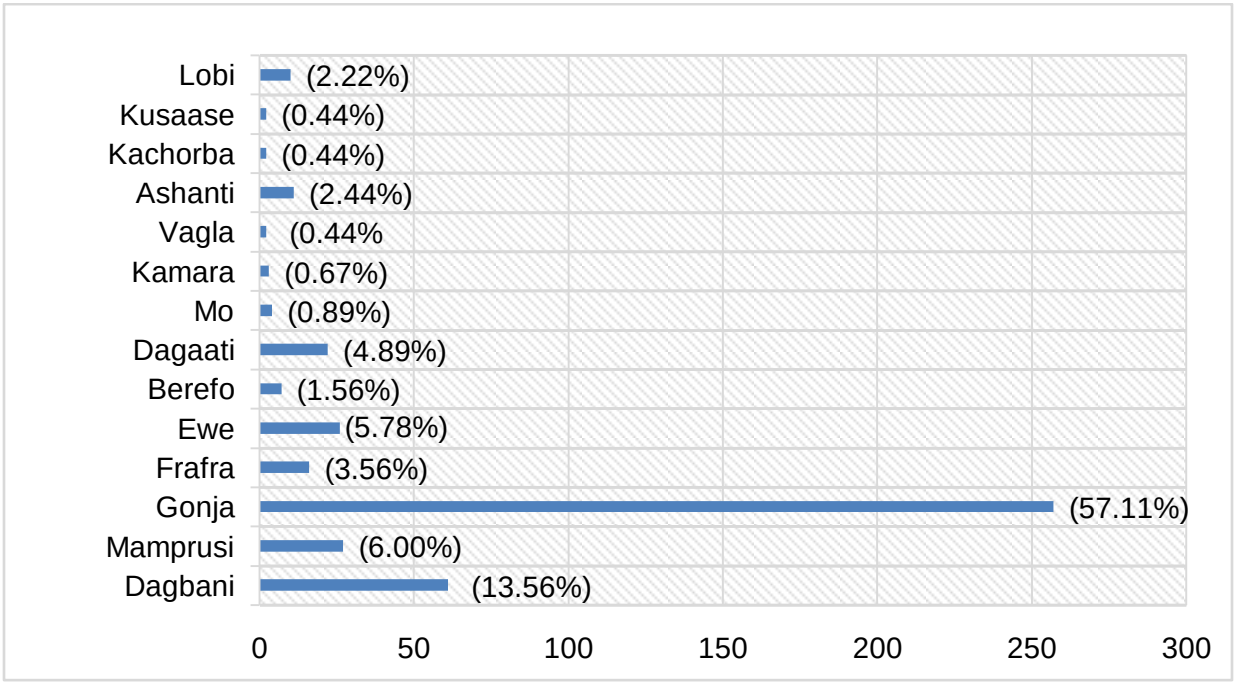
Household consumers from Damongo settlements offered appreciably more positive and significant appraisal with household size of (1-5) and averagely received incomes between GH¢1000 - 2000. The results showed that, comparatively, affluent/wealthier households with better incomes and less membership are relatively likely to have lessor water consumptions, power to control and influence over decision making on water allocation in the rural settlements. In effect, water inequalities and plight of rural poor households would turn to worsen if efforts are not made to redress exclusion, asymmetrical power relations and lack of voice of powerless households on community water allocation. The results resonate Lothrop (2015) who discovered that in Arizon community, residents with higher incomes (OR = 1.25; 95% CI (1.00 – 1.64) were more likely to drink from improved (quality) water sources than households with lower incomes. Besides, a related study showed low-income settlements such as Karuri, Kenya and Dodoma, Tanzania, could count on a maximum of only 5 hours of portable water access per day than relative relatively higher income settlements which had continuous or uninterrupted drinking water supply annually (Thomson et al., 2000).

Ethnic backgrounds of the Respondents

The ethnicity and racial affiliations are essential demographic elements which provide information on population distribution for planning and allocation of resources towards spatial development. This is because no meaningful socio-economic development activities can be undertaken in a rural setting without understanding the ethnicity, culture, traditions and racial characteristics of the population who whom such initiatives were targeted. Therefore, in this

study, an evaluation and appreciable understanding of the ethnic and cultural settings of the study areas served as point of reference for equitable distribution of resources, socio-economic amenities and avoidance of possible water related ethnic conflicts. It provides sufficient indicators for governmental service provision related to social services including water and health. More importantly, ethnic variabilities and their implications are relevant for inclusive policy formulation, determination and implementation of water sector initiatives which are suitable to local conditions and improvement of the quality of life of rural dwellers. As depicted by Figure 3, the findings of this study revealed a multi-ethnic, culturally and linguistically diverse character of the population with a majority 257 (57.11%) from the Gonja heritage (perhaps the indigenous settlers), followed by the Dagbaani's 61(13.56%) and Mamprusi's 27 (6.0%). Moreover, the findings showed a co-existence between the indigenous people with other groups (perhaps migrants settlers) such as the Ewe's 26 (5.78%), Dagaati's 22 (4.89%), Frafra's 16 (3.56%), Ashant's 11 (2.44%), Lobi's 10 (2.22%), Berefo's 7 (1.56%), Mo's 4 (0.89%), Kamara's 3 (0.67%), Vagla's 2 (0.44%), Kusaase's 2 (0.44%) and the Kachorba's 2 (0.44%), who constitute the minority ethnic groups.

Figure 3: Ethnicity of the Respondents



Inferably, the findings demonstrated that the diverse racial, cultural elements, traditional norms and value systems the local people attached to water and sanitation issues could become essential socio-ecological pillars, catalyst for conservation practices and management of water

resources. Therefore, while there is the need to harness development potentials among the varied racial and cultural elements, equally important considerations are efforts for unity in diversity, multi-stakeholder approaches and ensuring minority interests and needs are solicited and effectively represented in water allocation and local development activities within the communities. The results confirmed Chenoweth (2008) who discovered that eco-friendly cultures, traditions, religious and ethnic identities account for improved social lifestyles and when effective exploited, could become catalyst for improved human-ecological relationships and preservation of environmental resources including water.

Households water collection, utilisation and average distance to water Sources

The results of the study (see Table 6) demonstrated that women 319 (70.9%) were often responsible for household's water collection, followed by children 94 (20.9%), whereas men 21 (4.7%) and domestic servants 10 (2.2%) the least responsible for fetching water at the rural household level. Majority of the respondents 258 (57.3%) walked between 1-5 minutes to water sources outside their dwelling units, about 115 (25.6%) walked between 16-30 minutes daily to water sources, 46 (10.2%) trekked about 31-41 minutes daily to point sources while some 31 (6.9%) of the respondents confirmed they walked above 41 minutes each day in order to have access to water outside their dwelling units. About 41 (9.1%) of the respondents confirmed that children in the communities walked between 1-15 minutes daily in order to fetch water. While more women 22 (4.9%) mostly walked the longest distances, their men 14 (3.1%) counterparts rather walked the shortest distances (1-15 minutes) to water sources. The use of children in water haulage, particularly during morning hours could result in truancy, school dropout and increase the illiteracy rate in rural settlements as more children would become burdened with water collection to the neglect of school attendance.

Beside the enormous physical exhaustion and health risks, an increased burden of water collection would invariably reduce the time of women towards other productive economic ventures and engagement in social and politico-ecological activities including participation in development activities in rural settlements. Since women are the primary duty bearers of water collection, it is essential that their voices and views are solicited and are afforded equal opportunities to fully participate in rural water distribution. The DAs, CWSA and other development practitioners must educate and train women on issues of water and household hygiene for safe water delivery at the rural level. The findings affirm similar studies which revealed that access to water had positive impact on reducing poverty (Moriarty, Butterworth, & van Koppen, 2004), empowering women (Torres, Smits, & Torres, 2003) and improving the

sustainability of water (Thompson et al., 2001; Van Koppen, Moriarty & Boelee, 2006; World Bank, FOA and IFAD, 2009).

The findings further justify the observations that in rural sub-Saharan Africa, the principal drawers of water include women (Thomson, et al., 2000), child drawers and teenagers (Jagals, 2012), who are burdened with responsibilities for collecting, domestic, consumptive and commercial water. Moreover, an estimated 13.54 million SSA adult females were found to be responsible for water collection households (HHs), yet they lacked power and voice in WASH delivery decisions in rural sub-Saharan Africa. "Female children were more likely to be responsible for water collection than male children (62% vs. 38%, respectively). Six countries had more than 100,000 households (HHs) where children were reported to be responsible for water collection (greater than 30 minutes): Burundi (181,702 HHs), Cameroon (154,453 HHs), Ethiopia (1,321,424 HHs), Mozambique (129,544 HHs), Niger (171,305 HHs), and Nigeria (1,045,647 HHs)" (Graham et al., 2016:4).

Table 6: Water collection responsibilities and distance to water sources

Persons Responsible	Average distance to water source (Minutes)									
	1-15		16-30		31-41		Above 41		Total	
	No	%	No	%	No	%	No	%	No	%
Women	192	42.7	77	17.1	28	6.2	22	4.9	319	70.9
Men	14	3.1	4	0.9	0	0.0	3	0.7	21	4.7
Children	41	9.1	30	6.7	17	3.8	6	1.3	94	20.9
Domestic servants	7	1.6	2	0.4	1	0.2	0	0.0	10	2.2
Don't know	4	1.6	2	1.7	0	0.0	0	0.0	6	1.3
Total	258	57.3	115	25.6	46	10.2	31	6.9	450	100

This is essential in rural communities where the source of water supply, particularly for consumption and domestic purposes have tremendous effect on burden of diseases. This study found that water was so central to the life of rural dwellers such that it determined their choice of settlements and economic prospects of the local communities. The main sources of water for residents in the communities were pipe-born water 161 (35.8%); unpiped water 230 (51.1%) mainly from boreholes, dugout well, rain and sachets water; and surface water 59 (13.1%) including rivers, ponds, streams, lakes, streams, dams, lagoons and rain water (see Table 7). Though majority (51.1%) of the rural dwellers relied on unpiped water, less than (5%) of the households had pipe-born water connected to their dwelling units. Moreover, the use of surface

water significantly increases (76.4%) especially during the dry season due to reduction in the quantity of water from unpiped (boreholes) sources as a result of prolonged drought. This affirmed Awepuga (2016) discovery that due to excessive droughts and unreliable supply from piped schemes, households are compelled to collect consumptive water from unprotected and polluted external sources. Moreover, the findings corroborate with Thompson, Porras, Katui-Katua, Mujwahuzi and Tumwine (2003) discovery that in rural Dodoma of Tanzania and Karuri of Kenya, on average, 80 percent of rural households embarked on three trips to their main water sources. In Dodoma community alone, the average distance to water sources was (1-15 minutes, 45%), (15-30 minutes, 50%) and (31 minutes and above, 5%).

Similarly, WHO and UNICEF (2012) also found that poor water access in rural communities is associated with many water-related illnesses, food insecurity, loss of productivity, poor livelihoods and irregular school attendance among children in SSA. Similarly, in peri-urban Ghana, Nauge and Strand (2013) found a significant positive relationship between teenage girls' school attendance and water hauling activity. Though water access is considered a universal human right, yet truancy in school due to water scarcity or prolonged water haulage has equally been discovered to account for child exploitation, social injustice and infringement against the human rights of children in SSA (Gleick, 1998). Moreover, Thompson et. al. (2003) discovered that, comparatively, rural households in Toronro, who had no water connected to their units tend to walk long distances in other to obtain quality waterwhile most urban dwellers who utilised pipeborn supplies had reduced time and distance of walk to water sources.

Table 7: Primary sources of water utilised by rural Households

	Primary source of water							
	Pipe-born water		Unpiped water (boreholes, dugout well, rain, sachet)		Surface water (rivers, lakes, lagoons)		Total	
Uses of water	No	%	No	%	No	%	No	%
Consumption	18	4.0	14	3.1	6	1.3	38	8.44
Domestic	141	31.3	206	45.8	51	11.3	398	88.44
Commercial	2	0.4	2	0.4	2	0.4	6	1.32
Recreational	0	0.0	8	1.8	0	0.0	8	1.8
Total	161	35.8	230	51.1	59	13.1	450	100.0

The findings showed that water resources in the rural settlements were largely used either for consumption/drinking 38 (8.44%); domestic i.e. cooking, washing and cleaning 398 (88.44%), commercial/industrial and agricultural 6 (1.32%) and recreational purposes 8 (1.8%). While 18

(4.0%) and 141 (31.3%) utilised piped-borne water (outside dwelling units) for consumption and domestic only, the majority of rural dwellers 206 (45.8%) turned to use boreholes/dugout water for domestic purposes. About 51 (11.3%) and 6 (1.3%) of the households relied solely on surface water for domestic and consumption purposes respectively. In effect, access to pipe-bone water remained a major challenge. Consequently, boreholes, rain harvesting, dugouts and surface water remained the dominant sources of water for domestic, consumption and recreational purposes. The communities have two major rivers, namely; the White Volta (WV) and Black Volta (BV), which run through the Savannah area, offering rural dwellers opportunities for large scale fishing, aquaculture and small-scale irrigation schemes which could aid dry season farming and transportation of farm produce along the river basins. Nonetheless, constant pollution through human activities (illegal mining, farming, washing, dumping of refuse and construction) renders the rivers unsafe for direct water harvesting for consumptive purposes. The results confirm Peeler et al., (2006), who found rural water sources are continuously being polluted by human activities of clothes washing, mining, farming activities, industries, bathing and shared surface water use with animals. Moreover, it validates GICG (2018) and (GSS, 2012) which found that rural dwellers have access to diversified water sources including pipeborn water, public taps, boreholes, water vendors, dugout-wells, water from streams and rain water. Similarly, the findings corroborate White et al., (1972) categorization of water use-*consumptive* (drinking and cooking), *hygiene* (washing, cleaning, and bathing), and *amenities* such as watering lawns and other non-essential activities (Hall, Koppen & Houweling, 2014).

Rural water quality, treatments carried out and consumption Patterns

Furthermore, the availability and access to quality/clean and affordable water to a large extent determines the living environment of individual human beings and affects the state of health and production capacities of rural economies. The availability and access to improved drinking water is an important aspect of the health of household members and their standard of living. Therefore, this study evaluated the quality of water sources utilised and basic water treatments carried out by households in the rural areas and the results are illustrated by Table 8. The findings showed that the water sources for the rural dwellers were essentially categorised as either ‘cleansed’ or ‘uncleansed’. The study found that 187 (41%) of rural dwellers considered their water sources as quality/cleansed for consumption were clear, colourless and tasteless (pH =7). The sources of water, especially from the piped-born water, public standpipes, boreholes, protected dugout-well, protected springs and rainwater collection schemes were regarded to be good and residents were satisfied with the quality in terms of the taste, odour

and colour. Nonetheless, the overwhelming majority 263 (59.0%) confirmed the water they consumed were uncleansed. These unimproved sources were found to have odour, muddy, sour taste, salty, acidic and coloured with pH < 7 and pH > 7 and these included unprotected wells and springs, rivers, lakes, streams and water from tanker-truck service providers. The study further discovered that, 298 (66.2%) of households directly consumed the water they collected without treatment, 45 (10.0%) boiled their water, 86 (19.1%) of households who could afford utilised water filters, while 21 (4.7%) had absolutely no knowledge of whether the water they consumed were either treated or otherwise.

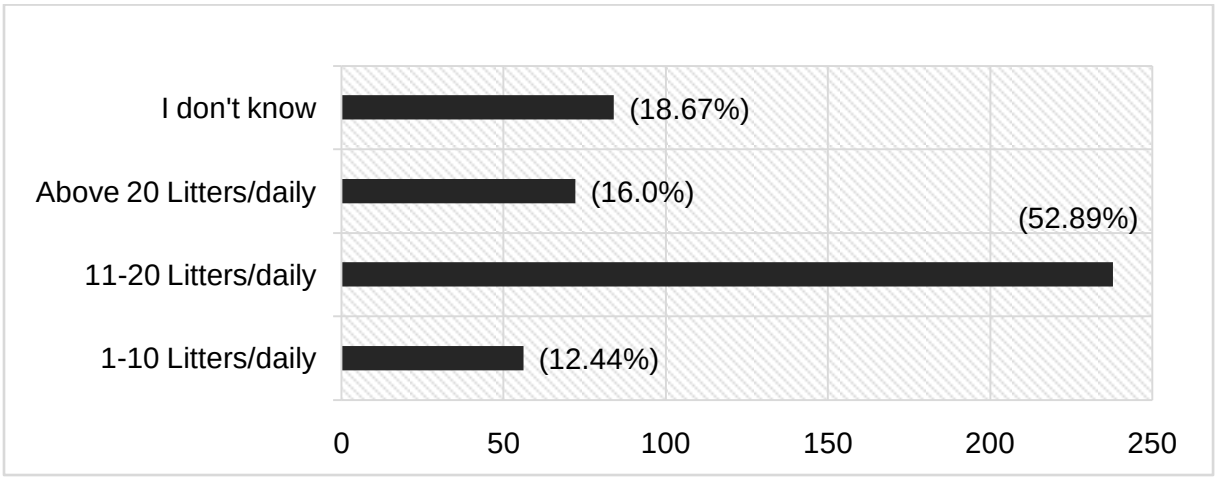
Table 8: Water quality and treatments options utilised by rural Households

Households water quality (pH)	Water treatment carried out									
	No treatment		Boil water		Use purifier/filter		Don't know		Total	
	No	%	No	%	No	%	No	%	No	%
Clear/ colourless/ tasteless (pH = 7)	133	29.6	23	5.1	22	4.9	9	2.0	187	41
Odour/muddy/ coloured (unsafe, pH < 7)	36	8.0	18	4.0	22	4.9	3	0.7	79	18
Sour taste/salty/ acidic (unsafe, with pH > 7)	129	28.7	4	0.9	42	9.3	9	2.0	184	41
Total	298	66.2	45	10	86	19.1	21	4.7	450	100

The results revealed a worsening situation of water quality among rural settlements in the Savannah areas where high proportions of households still depend on polluted surface water as their source of drinking water which could lead to increases in waterborne diseases. The study further found that the water quality and accessibility were affected by ecological and human activities including low water pressure 20 (4.44%), facility breakdown 180 (40.0%), the practice of illegal sand and gold minding by the people in the rural settlement 40 (8.9%), unstable electricity power for mechanised boreholes 190 (42.22%), low rainfall and prolonged harmattan 20 (4.44%) seasons which results in the drying-up of water resources especially ponds, rivers and dugout-wells in the rural areas. Moreover, the Joint Monitoring Programme (JMP, 2010) similarly found that the lack of eco-friendly human activities has been the cause of water pollution and the consumption of unsafe water results in diseases outbreak such as cholera, dysentery leading to increased death rates among rural African populations. This is because the

rates of access to portable domestic water services in rural SSA are among the lowest worldwide, with approximately 1 in 2 rural dwellers, or 278 million people in total, lacking access to an improved water source. Meanwhile in rural India, though surface water sources support the livelihoods of marginalized rural communities, due to contaminations of these drinking water sources, around 38 million Indians are affected by waterborne diseases annually, of whom 1.6 million children are estimated to die of diarrhea alone (Singh & Kumar, 2014). Therefore, Opryszko et al.,(2013), WHO (2014) and CWSA (2015) concludes that the basic treatment methods and designs deployed for surface water purification in deprived rural communities should involve either boiling, simple filtration or through ultraviolet light disinfection, combined with rural-based hygiene education, provision of waste disposal facilities and periodic community cleaning exercises. The water consumption patterns (see Figure 4) showed that most of the households 238 (52.89%) consumed between 11-20 liters of water per day, 84 (18.67%) did not know the quantity of water consumed by their households, 72 (16.0%) utilised above 20 liters of water daily, while 56 (12.44%) utilised between 1-10 liters of water every day.

Figure 4: HHs water consumption partern (litters daily)

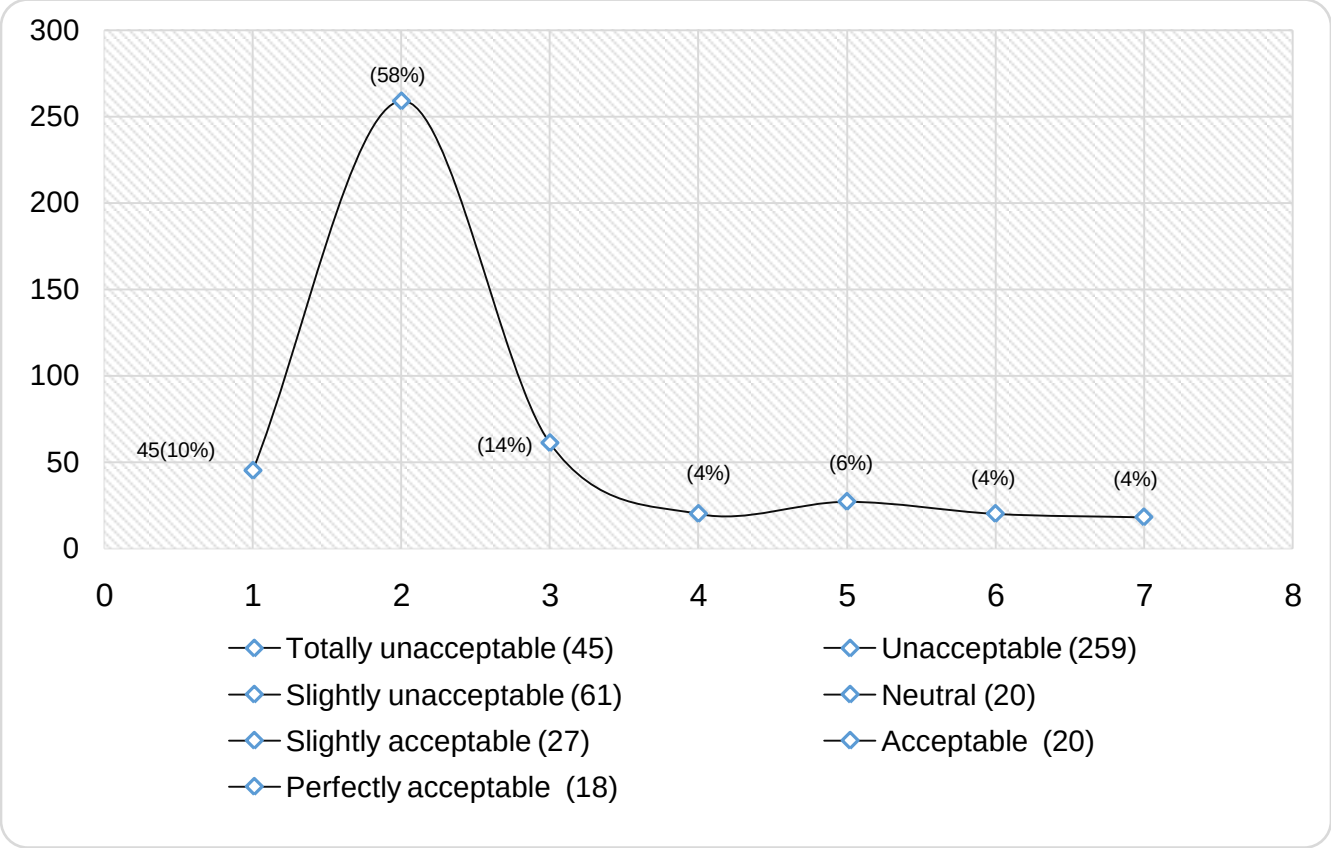


N = 450

The results (see Figure 4) give credence to similar studies by GSS (2018) and GICG (2018) which found that in Ghana, the quantity and access to improved water and sanitation appear relatively better in densely populated and endowed urban centres than impoverished and least populous rural settlements. Hence, lacking improved water, most rural communities are compelled to revert to the use of unimproved water (surface water) for consumption and domestic purposes. Contrary to WHO and UNICEF (2000) recommendation of 20 liters per capita per day as a minimum requirement of water for domestic hygiene purposes, this study

found that (see Figure 4) most of the rural dwellers (53%) utilised between 11-20 liters of water daily for multi-purposes (consumptive, domestic, commercial and recreational).Moreover, the results appear to be disconnected with Gleick (1996) proposition of 50 liters per 5 liters, 20 liters, 15 liters and 10 liters per capita per day requirement for consumption, sanitation, bathing and food preparation (cooking) respectively. Moreover, it further disagrees with the conservationist estimate of 7.5 liters per capita per day for consumptive needs (Howard & Bartram, 2003) and 100 liters per capita per day for consumptive, domestic, commercial and rural recreation (Chenoweth, 2008).This study found substantial variabilities from the disaggregated data across gender, occupation and utilisation of water. Comparatively, most of the respondents confirmed that females 315 (75.00%) utilised relatively more water than males 135 (25.00%). This could possibly be inferred from women's multifaceted need of water for productive, domestic and household hygiene purposes. The findings showed that the variations were more noticeable in the domestic, commercial and informal sectors of the rural economy. Moreover, water consumption was higher among rural settlers in Buipe (53.4%) than Bole (30.15%) and Damongo (16.45%) settlements. The variations could possibly be attributed to the differences in population densities. The agriculture, artisanship, rural industry, construction and masonry sectors, consumed relatively higher water (87.51%) than the civil and public service sector which accounted for only (12.49%) of rural water utilisation. The unavailability of water, therefore, would inexorably constrain the wellbeing and socio-economic livelihoods of rural dwellers. In effect, the variation of the findings could equally be an indication that water access and utilization cannot be rigidly cast-in-iron or stone, as consumption patterns are influenced by socio-demographic and ecological settings. The study concludes that there is the need to ensure balance between rural water supply, population growth and water consumption patterns in order to sustain/maintain a robust rural economy and ensure rural-ecological equilibrium in the Savannah area. This is because, as illustrated by figure 5, the study found that more than half of the respondents 259 (58%) confirmed that the management of drinking water in the rural areas were unacceptable whereas about 61 (14%) viewed water management in the rural household level to be slightly unacceptable. This confirmed White and Bradley (1972) observation that water quantity (accessibility and availability)appears to be highly valued and much more of a concern compared with water quality (safety and portability)among peripheral households. Moreover, this study validates Noel et al.,(2010) argument that the quantity, quality and management deficiencies of rural water are likely to make the health of rural dwellers more disadvantage, deteriorated and more margenalised.

Figure 5: Management of drinking water in the communities



N = 450

The finding further showed that 45 (10%) perceived rural water management as totally unacceptable, 27 (6%) slightly acceptable, 20 (4%) acceptable, 18 (4%) perfectly acceptable and 20 (4%) of the respondents were neutral/unaligned in terms of the management of drinking water at the rural household level. The results sharply affirmed the need for the rural settlements to reconsider the community management approach, a citizen participatory oriented model which encourages local people in the rural settlements to control, own, operate, maintain and manage their water schemes. Hence, a demand-driven, decentralised and participatory orientation to water supply in the rural settlements which is people-centred, and bottom-up oriented would be necessary to as a precondition for equalisation of access to power over decision making and development processes.

Sanitation and solid waste management Practices

The availability and access to safe sanitation practices and services have effects on the living conditions and health status of any human environment. General waste management and toilet services are key indicators in the measurement of the living environment of human beings.

Where these facilities are not available or inadequate, it depicts a potential for rural water pollution and outbreak of diseases. Consequently, this study evaluated the household's sanitation practices and mechanisms utilised to manage solid waste at the community level. The findings revealed that two types of waste were generated among the rural settlements; solid waste and liquid waste. Moreover, at all levels of waste management, it appeared inadequate logistics and lack of adequate education on proper waste disposal prevailed.

This problem has a chain reaction, as improper and indiscriminate waste disposal leads to pollution of water bodies and poses several health problems, which in turn, results in high mortality rates at all ages. The labour force and productivity suffer in the long run. The most intractable challenges to waste disposal among the rural dwellers were the unavailability of modern and hygienic solid waste disposal systems. The study found that among the rural dwellers, waste was either disposed into public bins 78 (17.3%), public/private bins 9 (2.0%), disposal into the bush 236 (52.4%), disposal into lagoons and rivers 5 (1.1%), gutters or backyards 62 (13.8%) and burning or incineration 56 (12.4%).

These environmentally unfriendly waste disposal systems could turn to pollute water bodies in the communities and adversely result in ill-health. The practice of open defecation 257 (57.1%) was the most common toiletry practice utilised by most of the residents and this could be attributed to inadequate toilet facilities, particularly among the rural settlements. Moreover, the use of improved flush/water closets 11 (2.4%) were limited to only a few households (0.4%).The findings of this study validate Todaro and Smith (2014), who posits that water and sanitation are essential for sustainable development and the United Nations (2018b) which observed the basic needs of people in SSA for food, water, clothing, shelter, and sanitation are not being met and this affect the quality and standards of human life.

Table 9: Toiletry practices and strategies for household's solid waste disposal

Strategies for household's solid waste disposal	Toiletry practices utilised by household members											
	Open defecation		Flush/ water closet		Dugout public latrine (KVIP)		Gutters/ backyards		Don't know		Total	
	No	%	No	%	No	%	No	%	No	%	No	%
Disposal into public bins	38	8.4	2	0.4	37	8.2	1	0.2	0	0.0	78	17.3
Disposal into public/private bins	8	1.8	0	0.0	1	0.2	0	0.0	0	0.0	9	2.0

Disposal into the bush	144	32.0	5	1.1	83	18.4	1	0.2	3	0.7	236	52.4
Disposal in lagoons/ rivers	4	0.9	0	0.0	0	0.0	0	0.0	1	0.2	5	1.1
Disposal in gutters/ Backyards	21	4.7	2	0.4	38	8.4	1	0.2	0	0.0	62	13.8
Burning/ Incineration	38	8.4	2	0.4	16	3.6	0	0.0	0	0.0	56	12.4
I don't know	4	0.9	0	0.0	0	0.0	0	0.0	0	0.0	4	0.9
Total	257	57.1	11	2.4	175	38.9	3	0.6	4	0.9	450	100

Table 9...

Even though about 175 (38.9%) households utilised public latrines, the ownership and management of public latrines were in the hands of the District Assemblies, and rural dwellers had no control and could not interfere with the conditions of these facilities. The findings implied that solid waste disposal was a major development challenge to the residents and the commonest way of disposing domestic waste was to throw them into nearby bush, drains or burn them. Moreover, properly constructed drains, which constitute a major feature of safe sanitation were either non-existent in the rural settlements or they are choked with waste. Surface drains were however very common, but majority of residents disposed their waste water on open spaces, surface drains and walk ways. This impeded easy movement within the rural areas and the stench from stagnant waste water further pollutes the environment. Again, hand washing with soap was not a common practice among residents, which showed that basic personal hygiene could be a serious challenge to the people.

In terms of gender and waste disposal, the study found that females generated more waste (78.4%) than males (21.6%) in the rural areas, however, children (54.2%) and women (45.8%) were generally responsible for collection and disposal of solid waste at the household level. There were significant variations on toiletry practices across the three communities. Open defecation was more profound among rural settlements in Buipe (52.2%) and Bole (30.1%) than Damongo (17.7%) settlement areas. However, incineration, littering and disposal of waste into the bush and backyards showed no variabilities across the study areas. This meant that rural settlements across the Savannah areas utilised similar or same strategies for disposing waste and this practice could affect the quality of water sources available in the areas. The results implied that modern, hygienic and well managed solid waste disposal facilities were seriously

lacking. Besides, regular cleaning around settlements and desilting of choked drains were not commonly practiced.

There was no recycling and reuse of waste in the communities and waste separation was not a common practice among the rural settlements. Clearly, implications are that more waste management facilities are required, and this must be supported with vigorous education, engagement of stakeholders and sensitisation on basic personal hygiene and environment health. Similarly, Huttinger et al., (2017) revealed that, in rural Rwanda, open defecation and littering are common and that even though the physical infrastructure of water and sanitation facilities are in place, sanitation and water supply systems and services no longer function properly, thus forcing families to adopt unhygienic and liquid waste practices.

In like manner, Opryszko et al., (2013) discovered *Escherichia coli* in untreated surface water (adjusted incidence rate ratio = 0.07, 95% confidence interval = 0.02, 0.21) and unhygienic sanitary habits are found to be positively associated with water quality (0.08), household health (0.06) and education levels of households (0.05). The presence of bacteria, waterborne pathogens, protozoa and viral diseases contributed to diarrheal disease burden which are transmitted through faecal–oral route.

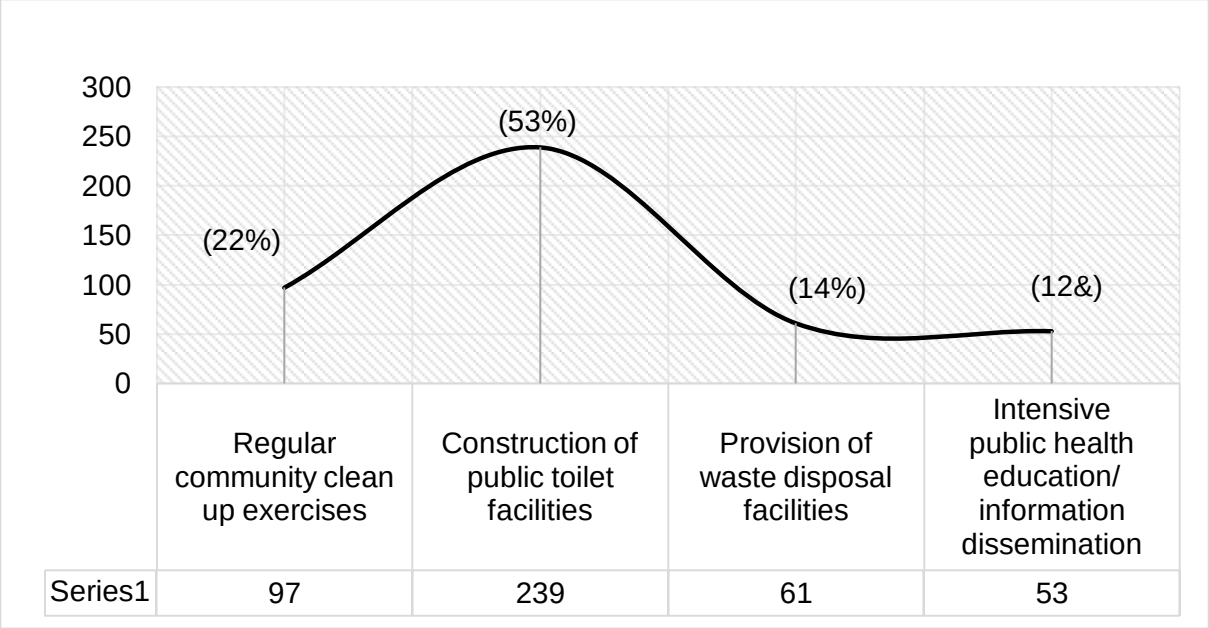
How to remove constraints and increase demand for improved rural sanitation and environment

Since acceptable waste management and active participation of local people helps to prevent or minimize the risk of water related infections and improve the quality of water and the environment, the study further enquired from the respondents on durable strategies to promote household hygiene and environment safety in among the rural dwellers. In Figure 6, the study found that a sanitary environment in the communities required political commitment and investments into the construction and utilisation of appropriate types of toilet facilities 239 (53%) for the rural settlements.

The active involvement of the communities and participation of the local people through community labour, financial contributions and attitudinal changes towards regular community clean up exercises 97 (22%) were proffered by the respondents to be essential priorities for stable rural ecology, public health preservation and sustainable rural livelihoods. Moreover, the findings showed (see Figure 6) that considering the literacy levels of the rural dwellers, about 53 (12%) of the respondents perceived that appropriate policy initiatives, budgetary allocations and development plans suitable for rural conditions were necessary. The findings showed the need to intensify public health education and information dissemination in order to change public

attitudes/perceptions and help reduce or eliminate potential waste and water related health vulnerabilities among rural settlements in the Savannah area.

Figure 6: Strategies for improving households sanitation and environmental conditions within the communities



Besides, 61 (14%) of the respondents perceived that popular accountability and transparency of the District Assemblies, government agencies and departments, private sector participation in the provision of waste disposal facilities and management of solid waste at the rural level were preconditions for environmental safety, hygiene promotion and water quality improvement in the rural areas. With extrapolative inference to the findings, the study concludes that two types of constraints need to be removed to enable the rural households opt for improved toilets and observe sanitary environments. The first category of constraints was permanent in nature, while the second typology of constraints was temporary or transitional. The permanent constraints to improved rural household hygiene and sanitation included duration of tenancy of household members, poverty and lack of land space for household's toilet construction. Most importantly, these permanent constraints were intractable as they could not be removed by short-term WASH projects and interventions, delivered through education, communication and information dissemination. Inferably, the permanent constraints would require strategic interventions, real-world efforts and proactive policy measures since these constrains were originated from the rurality, powerlessness and economic marginalisation or resource crunch of rural dwellers. Hence, policy strategies should target at cost reduction for improved toilet construction and

increase utilisation of improved sanitation facilities. The temporary constraints include appropriate technology, promotional, educative, and provision of waste disposal amenities. Moreover, to remove these temporary constraints among the rural settlements would require the fulfilment of myriad preconditions including; regular community clean up exercises involving the participation of all households.

The toilet and solid waste technologies should be viable and suitable to the economic, social and ecological conditions of rural dwellers. Besides, rural settlements adversely affected by the consequence of poor hygiene and sanitation and thus require improved sanitation systems ought to be prioritised and targeted through promotional, education and training schemes and adequate subsidies. Again, a strategic development plan and comprehensively tailored rural sanitation operational schemes, designed through active participation of the local people in consultation with districts and CWSA must be developed and implemented at the rural levels to remove power imbalance and improve access to sanitation services delivery among peripheral rural dwellers

Socio-demographic elements and effects on drinking water quality and quantity

The survey was designed to explore the socio-demographic factors associated with households (HHs) determinants of drinking water quality and quantity in northern rural communities. In table 9, the study was interested in measuring whether there exist a correlation between education levels, HH monthly income, number/ composition of HHs, distance of walk in daily haulage of water by HHs,primary source of water utilised by HHs, HHs water demand (liters per capita per day),water treatment carried out on HHs main drinking sources, frequency of solid waste disposal by HHs and finally, appearance & taste of HHs water. In terms of the strength and direction of the relationship(s), the Spearman's rank ordered (rho) non-parametric correlation was applied to describe the nature of the relationships between the variables (categorical variable and continuous variables).

In determining the strength of the relationship, different authors have suggested different approaches and interpretations (Cohen, 1998; Pallant, 2003; Gravetter and Walnau, 2000). However, this study considered and interpreted the size of value of the correlation coefficients *(r-values)* relative to the guidelines of Cohen (1998: 23), which suggest that coefficients with *"r-values"* between; *(r)= 0.10 to 0.29 or (r) = -0.10 to -0.29 = Small correlation*; *(r)= 0.30 to 0.49 or (r) = -0.30 to -0.49 = Medium correlation*; *(r)= 0.50 to 1.0 or (r) = -0.50 to -1.0 = Large/strong correlation*. In Table 10, for each of the pair of variables, the correlation coefficients, that is "*r-values*", the significance levels (Sig) or *"p-value*" and the number of cases (N = 450) are presented. The results (see Table 10) showed positive correlations and medium to large/strong

relationship between the listed socio-demographic elements. This indicates that an increase in score value of a household socio-demographic element was associated with a corresponding increase in score value of the other element. In determining the significance level, the study compared the *"p-values"* or (sig.) to the error margin (e) = 0.05 accepted by the study.

From Table 10, the results showed that the most significant household elements which influenced the determination of water quality and quantity are the level of education of households ($r = 0.791^{*}$, n = 450, p-value = 0. 002), HHs monthly incomes ($r = 0.710^{**}$, n = 450, p-value = 0.015), HHs composition ($r = 0.643^{*}$, n = 450, p-value = 0.026), distance of walk involved in daily haulage of water ($r = 0.534^{*}$, n = 450, p-value = 0.000), HHs primary source of water ($r = 0.663^{**}$, n = 450, p-value = 0.031), HHs water demand (measured in liters per capita per day) ($r = 0.653^{*}$, n = 450, p-value = 0.005), water treatment carried out on HHs main drinking sources ($r = 0.418^{*}$, n = 450, p-value = 0.023), strategies for solid waste disposal utilised by HHs ($r = 0.427^{*}$, n = 450, p-value = 0.043) and the appearance & taste of HHs water ($r = 0.332^{*}$, n = 450, p-value = 0.018).

Table 10: Correlation analysis between household's socio-demographic elements and drinking water quality (Spearman rank ordered correlation test)

Nonparametric Correlation Coefficients (Spearman's rho)			
Socio-demographic elements of HHs	Potable drinking water (pH = 7)		
	Correlation Coefficients (r)	Sig. (2-tailed)/ (p-value)	N
Education level	0.791*	0.002	450
HHs monthly income	0.710*	0.015	450
Number/composition of household	0.643*	0.026	450
Distance of walk in daily haulage of water	0.534*	0.000	450
Frequency of water usage from primary source	0.663*	0.031	450
HHs water demands (in liters per day)	0.653*	0.005	450
Frequency of water treatment carried out on drinking water	0.418*	0.023	450
Frequency of solid waste disposal	0.427*	0.043	450
appearance & taste of HHs water	0.332*,	0.018	450

*. Correlation is significant at the 0.01 level (2-tailed)

In testing for the hypothesis (Ho_1), the decision rule applied was *(accept null hypothesis, if "p-value" > 0.05 and do not accept null hypothesis, if "p-value" <or = 0.05).* Therefore, since the *"p-values"* or (sig.) of the listed socio-demographic elements were generally less than(<) the alpha level (α) of 0.05), the study proceeded to reject the null hypothesis (Ho_1) which assumed there was no significant association between household's socio-demographic elements and their determination of drinking water quality and quantity in rural Savannah communities. Moreover, to determine the amount of variance and the percentage of variation the variables shared, the study estimated the coefficient of determination (r^2), which according to (Pallant, 2003), Gravetteramd Walnau (2000), could be computed by squaring the *"r-values*" and multiplying the results by a (100%). The variance and percentage of variabilities between the variables are presented in Table 11.

Table 11: Coefficient of determination between socio-demographic elements, water quality and quantity

	Access to potable water		
Socio-demographic Variables	Correlation coefficient (r)	Coefficient of determination (r^2)	Percentage variation (100%)
Education level	0.791	0.791 x 0.791 x 100%	63
HHs monthly income	0.710	0.710 x 0.710 x 100%	50.41
HH composition	0.643	0.643 x 0.643 x 100%	41.34
Distance of walk in daily haulage of water	0.534	0.534 x 0.534 x 100%	29.0
Frequency of water usage from primary source	0.663	0.663 x 0.663 x 100%	44.0
HHs water demands (in liters per day)	0.653	0.653 x 0.653 x 100%	43.0
Frequency of water treatment carried out on drinking water	0.418	0.418 x 0.418 x 100%	17.47
Frequency of solid waste disposal	0.427	0.427 x 0.427 x 100%	18.23

The study found that the coefficient of determination (r^2) between education and determination of quality/clean and quantity/access water was computed as {r^2 = 0.791 x 0.791 x 100%}, hence, {r^2 = 62.5681%}. This meant that approximately, (63%) of variabilities in the quality and quantity of water utilised by the rural dwellers were explained by the education and knowledge levels

attained by the local people. Similarly, the coefficient of determination (r^2) between HH income and water quality was determined as {r^2 = 0.710 x 0.710 x 100%}, hence, {r^2 = 50.41%}. This implied that about (50%) of the variation in the quality and quantity of water demanded by households in the area was explained by the incomes earned by households in the rural settlements.

Moreover, using the same procedure (see Table 11), the study found that about {r^2 = 41.34%} of difference in the quality and quantity of water utilised by the local people were explained by the size/ composition of the households. In the same way, approximately {r^2= 29.0%) of the variabilities in water quantity and quantity were determined by the distance of walk in daily haulage of water, {r^2= 44.0%} was explained by rate of water usage from primary source, {r^2= 43.0%} of variabilities of water quality and quantity was as a result of the rate of HHs water demands (in liters per day), {r^2= 17.47%) of drinking water quality and quality was due to the frequency and kind of water treatment carried out on the main drinking sources.

On the other hand, the general household sanitary practices and strategies adopted for solid waste disposal accounted for approximately {r^2= 18.23%} of variabilities in the quality of water and the quantity of drinkable water consumed by households in the communities. The results meant that in the Savannah ecological area, the people's education levels, income, composition of HHs, distance of walk in daily haulage of water, primary source of water utilised, water demand, water treatment carried out on drinking sources and strategies for solid waste disposal were associated with and generally determined the quality and quantity of water the people drunk within the communities. Hence, to assure sustainability, improve quality and quantity of rural water supply and sanitation delivery, service provision must be demand-driven where rural dwellers are placed at the centre of participating, assuming ownership and managing their water services since they know the services which work best and are suitable to their settings. The findings disagree with Thomson et al. (2000) who discovered that in rural Uganda, reliability of water supplies has declined significantly among households over the last three decades. The factors which influence this situation included a lack of system maintenance, mismatch between network capacity, technology deficits, poor sanitation practices and population increase. Nonetheless, the study corroborates with Kabir and Howard (2007) who discovered that a significant association between educational achievements (sig= 0.03, p=0.05), gender (sig= 0.06, p > 0.05), and occupation prestige (sig= 0.08, p > 0.05) among rural populace in Bangladesh to be positively related with households' determinants of quality water and their participation in rural water and sanitation. Meanwhile, among rural communities in Rwanda, Schouten and Moriarty (2003) study similarly discovered that low incomes *(sig.= 0.07,*

p > 0.05), occupation *(sig= 0.06, p > 0.05),* and education levels (*sig= 0.08, p > 0.05),* of rural populations significantly influenced the water and sanitation sectors.

CONCLUSIONS, SUGGESTIONS AND FURTHER RESEARCH

The environment, socio-economic structure, population dynamics and ecological variabilities of rural dwellers affects the availability and distribution of quality water and the general quality of livelihoods. There were gender and age variations and the proportion of male headed households were relatively higher than female headed households. Nonetheless, women were often responsible for domestic water collection, but due to lack of gender balance, they were underrepresented and lacked real power and politico-ecological voice in decision making in the rural water and sanitation sector. Comparatively, affluent/wealthier households with better incomes and smaller household memberships were relatively likely to have less or water consumptions, power to control and influence over decision making on water allocation in the rural settlements. In effect, water inequalities and plight of rural poor households could worsen if efforts are not made to redress exclusion, asymmetrical power relations, lack of voice and powerless of households on rural water allocation.

The populations were multi-ethnic, culturally and linguistically diverse, yet both the majority (Gonja ancestry) and other minority (migrant settlers) peacefully co-existed, a demonstration of unity in diversity among the people. Besides, water utilisation and participation in decision making turned to peak among the youthful population who constituted the most energetic, agrarian and economically active population. Majority of the respondents had no water connected to their dwelling units and walked several distances to water sources outside their dwelling units. Women and children walked the longest distances than men. Water haulage had physical, emotional and economic drain on women and educational effects on children in the rural settings. Moreover, access to pipe-bone water remained a major challenge, consequently, boreholes, rain harvesting, dugouts and surface water remained the dominant sources of water for domestic, consumption, commercial and recreational purposes.

Dependency on surface water significantly increased during prolonged drought seasons while overwhelming majority confirmed the water they consumed were uncleansed and contained odour, muddy, sour taste, salty, acidic and coloured with pH < 7 and pH > 7. Most households directly consumed the water they collected without treatment (boiling or using any water treatment methods). A worsening situation of water quality prevailed as high proportions of households still depended on unpiped and polluted surface water. This could result in waterborne diseases and ill-health among the rural dwellers. The demand, consumption pattern and decision-making power on water was more likely to be concentrated with married couple

who had relatively larger households than singled, widowed, separated and divorcee rural dwellers. A resilient rural economy was dependent on stable political-ecology.

The agriculture, artisanship, industry, construction and masonry sectors relatively consumed higher water than the formal economy including the civil and public service. On average, the livelihood and economic activities of rural settlers engaged informal sector, depended more on availability and reliable access to water than those in the formal sector. The rate of water consumption was higher among rural settlers in Buipe which had relatively higher population demand than Bole and Damongo settlements. The rural settlements had access to diversified sources of water, however, the sanitation situation, could be generalized as being very chaotic and undesirable. Household waste were either disposed into public bins, public/private bins, disposal into the bush, lagoons and rivers, gutters or backyards, burned or incinerated. Open defecation was very common due to inadequate toilet facilities and the practice was more profound among rural settlements in Buipe and Bole than Damongo.

Therefore, water pollution and related infections prevailed. Females were found to generate more waste than males in the rural areas, however, children and women were generally responsible for collection and disposal of solid waste at the household level. Male involvement in the maintenance of a sanitary environment was virtually negligible, meanwhile, modern, hygienic and well managed solid waste disposal systems were seriously lacking. The hypothesis test (Ho1) found significant association between the household's socio-demographic elements and the quality and quantity of water they utilized. Since the *"p-values"* or (sig.) of the listed socio-demographic elements were generally less than(<) the alpha level (α) of 0.05), the study proceeded to reject the null hypothesis (Ho_1) which assumed there was no significant association between household's socio-demographic elements and their determination of drinking water quality and quantity in northern rural communities. The results meant that in Savannah area of northern Ghana, the people's education levels, income, composition of HHs, distance of walk in daily haulage of water, primary source of water utilised, water demand, water treatment carried out on drinking sources and strategies for solid waste disposal were associated with and generally determined the quality and quantity of water available and accessible by the people.

While there is the need to harness development potentials among the varied racial and cultural elements, this study recommends that equally important considerations are efforts for unity in diversity, multi-stakeholder approaches and the need to ensure minority interests and needs are solicited and effectively represented in water allocation and local development activities within the communities. There is the urgent need to ensure balance between rural water supply, population growth and water consumption patterns in order to sustain/maintain a

robust rural economy and ensure politico-ecological equilibrium. Water policy initiatives and ecological conservation projects should thus have regards for the “rurality” of the local people, variabilities of rural education, impact on nonformal jobs and socio-economic livelihoods of rural dwellers in the Savannah area of Ghana.

The decentralised institutional structure involving the traditional authorities, pressure groups, DAs, CWSA, civil society groups and the local people must initiate measures to curtail segregation, marginalisation, dictatorship and absolutism of the majority in water allocation decisions making. A community management approach;- a citizen participatory oriented model which is demand-driven, people-centred, bottom-up oriented and encourages local people in the rural settlements to control, own, operate, maintain and manage their water and sanitation schemes would provide an equal playing field pivotal for ensuring that the interest, needs and views of the most vulnerable and minority groups are effectively harnessed and integrated into development activities within the communities.

This study concentrated only on the rural-ecological and socio-demographic scenarios of the Savannah area of Ghana. A comparative study of other villages/settlements and incorporation of other variables, including eco-governance, eco-scarcity, climate change, and water sustainability would be an interesting study to analyse the regional variations in a multilinguistic, multi-cultural and diversified country like Ghana. Moreover, an in-depth qualitative or mixed research approach could give more integrated results and in-depth analysis on the topic and thus, better appreciation and utility of findings to both state and non-state actors engaged in the water sector.

Competing Interests

The author declares that there are no competing interests.

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REFERENCES

Addo, L. Y. (2010). Institutional analysis of urban water supply in Ghana: The case of Accra Metropolitan assembly: Aalborg, Denmark.

Ahwoi, K. (2010). Local government and decentralisation in Ghana. Accra: UnimaxMacmilan

Attewell, P., and Rule, J. B. (1991). Survey and other methodologies applied to IT impact research: Experiences from a comparative study of business computing. Paper presented at The Information Systems Research Challenge: Survey Research Methods

Awepuga, F. A (2016). Water Scarcity in the Tamale Metropolis and the Role of the Informal Water Sector in Urban Water Supply (Master's Dissertation). Kumasi: KNUST.

Awoke, Z.A., (2012). Assessment of challenges of sustainable rural water supply: Quarit Woreda, Amhara region: A Project Paper Presented to the Faculty of the Graduate School of Cornell University.

Ayee, J. R. A.,(2008). The balance sheet of decentralisation in Ghana. In: Saito, F. (ed.) Foundations for Local Governance. Physica-Verlag HD.

Brukum, N.J.K. (1998). Underdevelopment and the dilemma of independence: Northern Ghana in nationalist politics, 1946-1956: Research Review, 14 (1): 135-145.

Brundtl and Commission (2014). Defining sustainable development: The World Commission on Environment and Development: Milton Park, Earthscan/Routledge.

Cicchetti, D. V. and Sparrow, S. S. (1981). Development of criteria for establishing the interrater reliability of specific items in a given inventory: applications to assessment of adaptive behaviour. American Journal of Mental Deficiency, 86 (3): 127-137.

Chenoweth, J.(2008). Minimum water requirement for social and economic development. Desalination 229 (1): 245-256

Choguill, M. B. G. (1996). A ladder of community participation for underdeveloped countries. Habitat international, 20 (3), 431- 444.

Cohen, J.W.(1998).Statistical power analysis for the behavioural sciences (2nd ed). Hillsdale, NJ: Lawrence Erlbaum Associates

Committee on Economic Social and Cultural Rights (CESCR, 2003). General Comment No. 15. The right to water (arts. 11 and 12 of the International Covenant on Economic, Social and Cultural Rights). E/C.12/2002/11. New York: United Nations

Community Water and Sanitation Agency-CWSA (2015). Fact sheet: Rural and small Towns water service: Accra, Ministry of Water Resources, Works and Housing.'

Community Water and Sanitation Agency-CWSA (2014a). 2014 annual report: Accra, Ministry of Water Resources, Works and Housing.

Community Water and Sanitation Agency-CWSA (2015). Fact sheet: Rural and small Towns water service: Accra, Ministry of Water Resources, Works and Housing.

Community Water and Sanitation Agency-CWSA (2013). Fact sheets on water provision in Central Gonja District: Tamale, CWSA.

Community Water and Sanitation Agency (2014b). National community water and sanitation strategy (NCWSS). Accra: CWSA

Food and Agriculture Organisation (2017). Coping with water scarcity: Challenge of the 21st Century: Retrieved on 03/06/2018 from, http://www.fao.org/3/a-aq444e.pdf

German Industry and Commerce in Ghana-GICG (2018). Access to clean drinking water and water management in Ghana: Accra, GICG

Ghana Statistical Service-GSS (2018). Ghana multiple indicator cluster survey; Snapshots on key findings: Accra, Ghana Statistical Service

Ghana Statistical Service (2014a). 2010 population and housing census: District analytical report, West Gonja District; Accra, Ghana Statistical Service.

Ghana Statistical Service (2014b). 2010 population and housing census, District analytical report: Bole District Assembly: Accra, Ghana Statistical Service.

Ghana Statistical Service (2014c). 2010 population and housing census: District analytical report, Central Gonja District; Accra, Ghana Statistical Service.

Ghana Statistical Service (2014d). 2010 population and housing census: District analytical report, West Gonja District; Accra, Ghana Statistical Service.

Ghana Statistical Service-GSS (2012a). Multiple indicator cluster survey with an enhance malaria module and biomarker 2011: Accra, Ghana Statistical Service.

Ghana Statistical Service (2012b). 2010 Population and Housing Census: Summary of Final Results: Accra: Ghana Statistical Service.

Gleick, P.H (1998). The human right to water. Water Policy. 1:487–503. Retrieved on 15/10/ 2018, from doi: 10.1016/S1366-7017(99)00008-2.

Government of Ghana-GoG (1992). Constitution of the republic of Ghana: Accra, Government Press.

Graham, J. P., Mitsuaki, K., and Kim, S.S. (2016). An analysis of water collection labour among women and children in 24 Sub-Saharan African Countries. Retrieved on 20/09/2018, from, https://doi.org/10.1371/journal.pone.0155981

Gravetter, F.G and Walnau, L.B (2000). Statistics for the behavioural sciences (5th ed). Belmont, CA: Wadsworth

Hall, R. P., Koppen, B. V., and Houweling. V. (2014).The human right to water: The importance of domestic and productive water rights: Sci Eng Ethics, 20(4): 849–868.

Howard, G., and Bartram, J. (2003). Domestic water quantity, service level, and health. Geneva: World Health Organization.

Huttinger, A., Dreibelbis R, Kayigamba F, Ngabo F, Mfura L, Merryweather B, Cardon A, Moe C.(2017). Water, sanitation and hygiene infrastructure and quality in rural healthcare facilities in Rwanda; BMC Health Serv Res. 17(1):517. Retrieved on 15/12/2018, from, doi: 10.1186/s12913-017-2460-4.

Isaac, S. and Michael, W. B. (3rd Ed.) (1997). Handbook in research and evaluation: A collection of principles, methods, and strategies useful in the planning, design, and evaluation of studies in education and the behavioral sciences. San Diego: Educational and Industrial Testing Services

Jagals, N. (2012). The impacts of rural small-community water supply interventions in rural South Africa. Department of Environmental Health, Tshwane University of Technology.

Joint Monitoring Programme-JMP (2010) Progress on drinking water, sanitation and hygiene: Geneva, World Health Organization.

Kabir, A., and Howard, G. (2007). Sustainability of arsenic mitigation in Bangladesh: Results of a functionality survey. International Journal of Environmental Health Research, 17 (3): 207-218.

Kramer, A. and C. Pahl-Wostl, (2014). The global policy network behind integrated water resources management: is it an effective norm diffusor? Ecology and Society, 19 (4): 11.

Kojo, E. (2019). Map of the Republic of Ghana after 2019 referendum. Accra: Pulse Ghana

Kurian, M. and McCartney, P. (2010). Peri-urban water and sanitation services: Policy, planning and method (eds.).New York: Springer.

Litwin, M. S. (1995). How to measure survey reliability and validity: Thousand Oaks, Sage Publications.

Limantol, A.M. (2009). Impacts of rural water supply systems in farming Communities: A case study of the Saboba-Chereponi district (Master's Thesis), Kumasi: KNUST.

Lockwood, H., and Smits, S. (2011). Lessons for rural water supply: Moving towards a service delivery approach: London, Practical Action Publications.

Lothrop, N. (2015).Home water treatment habits and effectiveness in a rural Arizona community. Water Basel, 7(3): 1217–1231. Retrieved on 05/02/2019, from, doi: 10.3390/w7031217

McClosky, H. (1969), Political inquiry: The native and uses of survey research. New York: Macmillan.

Miler, R. and Brewer, J. (2003). The A-Z of social research. London: Sage.

Misra, K., & Malhotra, G., (2011), "Water management: the obscurity of demand and supply in Delhi, India", International Journal of Management of Environmental Quality, 23 (1): 23 – 35.

Moriarty, P., Butterworth, J. and Van Koppen, B. (Eds.). (2004). Beyond domestic. Case studies on poverty and productive uses of water at the household level. IRC technical paper series, no. 41. Delft: IRC International Water and Sanitation Centre.

Muhanad, A (2016). Applying the water governance framework on rural water development projects in Guatemala (Master's Thesis). Guateng: University of Wisconsin.

Nauges, C. and Strand, J. (2013). Water hauling and girls' school attendance: Some New Evidence from Ghana. Policy Research Working Paper. Retrieved on 20/08/2018, from: https://doi.org/10.1596/1813-9450-6443

Noel, S., Phuong, H.T., Soussan, J. and Lovett, J. C. (2010). The impact of domestic water on household enterprises: Evidence from Vietnam. Water Policy. 12(2):237–247. Retrieved on 04/10/2018, from, doi: 10.2166/wp.2009.102.

Nsubuga, W. F. (2016). Water provision in urban centres, water sources and supply institutions: a case Study of Lubaga division Kampala (Master's Dissertation): Kampala, Makerere University.

Opryszko, M. C., Yayi, G., MacDonald, L., Samara, K. and Kellogg J. S.(2013). Impact of water-vending kiosks and hygiene education on household drinking water quality in rural Ghana. Am J Trop Med Hyg, 88(4): 651–660. Retrieved on 13/11/2018, from, doi: 10.4269/ajtmh.12-0065.

Pallant, J. (2003). SPSS survival manual: A step by step guide to data analysis using SPSS for Windows (Version 10 and 11). Maidenhead: Open University Press.

Paulson, L. D. (2015). What is Water Scarcity? RWL Water, 5(2): 1-7.

Peeler K.A., Opsahl S.P. and Chanton J.P. (2006). Tracking anthropogenic inputs using caffeine, indicator bacteria and nutrients in rural freshwater and urban marine systems, Environ. Sci. Technol., 40 (3): 7616–7622.

Punch, K. (3rd Ed.) (2010). Introduction to social research: Quantitative and qualitative approaches. New Delhi: Sage Publications

Ramphele, R. (1989). Integrated water resources management: evolution, prospects and future challenges. Sustainability: Science, Practice, & Policy 1(1):15-21.

Rietveld, L. C., Haarhoff, J. and Jagals, P. (2009). A tool for technical assessment of rural water supply systems in South Africa. Physics and Chemistry of the Earth, Parts A/B/C. 34 (1-2): 43-49.

Rogers, P., and Hall, A.W., (2003). Effective water governance; TEC Background Papers No. 7: Stockholm, Global Water Partnership, Technical Committee.

Sarantakos, S. (4th. Ed) (2013). Social research. Macmillan: Red Glob Press

Schouten, T., and Moriarty, P. B. (2003). Community water, community management. London: ITDG Publishing.

Singh, S.K., and Kumar, L. (2014). Characterization of rural drinking water sources in Bhiwani district, Haryana: A case study. International Journal of Interdisciplinary Research and Innovations; 4 (6): 27-37.

Smits, S., Van Koppen B, Moriarty P. and Butterworth, J. (2010). Multiple-use services as an alternative to rural water supply services: A characterisation of the approach. Water Alternatives. 3 (1):102–121.

Solanes, M. and Jouravlev, A. (2006). Water governance for development and sustainability. Chile: United Nations.

Stoler, J., Weeks, J. R., and Appiah, O, R. (2013). Drinking Water in Transition: A Multilevel Cross-sectional Analysis of Sachet Water Consumption in Accra. PLoS One, 8(6): 67257.

Thompson, J., Porras, I.T., Tumwine, J.K., Mujwahuzi, M.R., Katui-Katua, M., Johnstone, N. (2001a). Drawers of water II. 30 years of change in domestic water use and environmental health in East Africa. London: International Institute for Environment and Development.

Thompson, J., Porras, I.T., Munguti, K, Mujwahuzi, M. R. and Tumwine, J. K. (2003). Drawers of water II: Assessing change in domestic water use in East Africa. Water Lines: 22 (1):22-25.

Thompson, J., Ina, T. P., Wood, E., Tumwine, J.K., Mujwahuzi, R. M., Munguti, K and Nick, J. (2000). Waiting at the tap: changes in urban water use in East Africa over three decades. Environment & Urbanization; 12 (2); 37-52

Thompson, J. and Munguti, K. K. (2001). Drawers of water II: 30 years of change in domestic water use & environmental health in east Africa. International Institute for Environment and Development, 3 (4): 30-67.

Thompson, J., Porras, I.T., Munguti, K, Mujwahuzi, M. R. and Tumwine, J. K. (2003). Drawers of water II: Assessing change in domestic water use in East Africa. Water Lines: 22 (1):22-25.

Todaro, P.T., and Smith, C. M. (12th ed.) (2014). Economic development: Pearson, United Kingdom.

Torres, A. S., Smits, S., and Torres, L. D. S. (2003). Recognizing reality: multiple use of rural water supply systems. Paper presented at AGUA 2003: International conference onmultiple uses of water for life and sustainable development, 29–30 September 2003. Cartagena de Indias, Colombia

Umesh, P., and Nagarkatte, N. O. (2017). Theory of Constraints: Creative problem solving: New York. Taylor & Francis Group.

United Nations (2018a). Our common future: Towards sustainable development: Retrieved on 05/06/2018, from, http://www.un-documents.net/ocf-02.htm,

United Nations (2018b). Our common future: Report of the World Commission on Environment and Development: Retrieved on 30/05/2018, from, http://www.un-documents.net/ocf-02.htm

United Nations Economic and Social Council (2017). Progress towards the Sustainable Development Goals: Report of the Secretary-General. Retrieved on 30/05/2018, from; http://www.un.org/ga/search/view_doc.asp?symbol=E/2017/66&Lang=E

Van Koppen, B., Moriarty, P. and Boelee, E. (2006). Multiple-use water services to advance the millennium development goals. Research report 98. Colombo: International Water Management Institute.

Van Koppen, B., Smits, S., Moriarty, P., Penning de Vries, F., Mikhail, M., and Boelee, E. (2009). Climbing the water ladder: Multiple use services for poverty reduction. The Hague: IRC International Water and Sanitation Centre and International Water Management Institute.

Water and Sanitation Program (WSP, 2014). The productive use of rural water supplies designed for domestic uses: Evidence from Senegal, Kenya, and Colombia. Hague: World Bank.

White, G.F., Bradley, D.J and White, A.U. (1972). Drawers of water: domestic water use in East Africa. Bull World Health Organ, 80 (1): 63-73.

World Health Organization (WHO) and United Nation Children's Fund (UNICEF) (2000). Global water supply and sanitation assessment report-2000. New York: World Health Organization.

World Health Organization (WHO) and United Nations Children's Fund (UNICEF) (2017): Progress on drinking water, sanitation and hygiene: 2017 Update and SDG Baselines. Geneva: WHO and UNICEF.

World Health Organization-WHO and United Nation Children's Fund-UNICEF (2012). Progress on drinking water and sanitation. 2012 update. New York: WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation

World Bank (2018). Understanding poverty. Retrieved on 04/06/2018, from, http://www.worldbank.org/en/topic/poverty/overview.

World Bank (WB), Food and Agriculture Organization (FOA) and International Fund for Agricultural Development (IFAD) (2009). Thematic note I: Gender and multiple-use water services. In Gender in agriculture. Sourcebook. Washington, D.C.: The World Bank.

World Health Organization -WHO (2014). Preventing diarrhoea through better water, sanitation and hygiene: Exposures and impacts in low- and middle-income countries: Geneva, WHO Press.

Wumbei, A.B.M.S (2017). Finding innovative ways to finance capital maintenance of piped systems in Ghana: Accra, IRC and Community Water and Sanitation Agency (CWSA)