Journal of Resources Development and Management
ISSN 2422-8397 An International Peer-reviewed Journal
Vol.50, 2018

Government Regulations on Rural Water Safety-Ghana

Richmond Asirifi Dankwa[1*] Osman Issah Fuseini[1] Abigail Asirifi Dankwah[2]

1. School of Public Affairs and Administration, University of Electronic Science and Technology of China, P.R. China Address: No.2006,Xiyuan Ave.West Hi-Tech.Zone,P.R.China
   Post Code: 611731
2. Faculty of Planning (Development Management), University of Development Studies, WA Campus, Ghana

* E-mail of the corresponding author: richmonddankwa411@yahoo.com

Abstract
Portable water accessibility remains one of the key issues in development. A survey from the United Nations, 2010 indicates that about 783 million people (11% of the global population) remain without access to an improved source of drinking water. The Government of Ghana has come out with numerous water projects in some poor communities in the Northern, Upper East and Upper West regions, yet unhygienic water and water pollution seems to still be a challenge facing citizens of this communities. It is therefore against this background that this research was conducted to find out about the impact of Government regulatory practices on water safety in the Wa Municipality which is in the upper west region. The study was guided by these questions: Does Government regulations on service assessment affect water safety? Does monitoring and control practice have a productive result on water safety? Do management plan on water safety has a direct impact on water safety? Does government released funds on water safety embarked upon as planned? The study employed the good governance theory, social capital theory, and the institutional change theory. The study did an empirical review of related literatures to answer the various research questions. It was revealed from the empirical review that service assessment, monitoring and control, effective management plan and government released funds intended for their right purposes have a significant positive effect on water safety. The study therefore recommended an implementation of a working and effective service assessment systems and monitoring and control mechanisms over water projects to ensure the provision of portable water to the intended communities in the municipality. Also, there is the need for the implementation of an effective management plan for water projects, as well as the timely provision and the right usage of project fund.
Keywords: Government Regulations, Monitoring and Control, Service Assessment, Rural Water Safety.

1. Introduction

According to the World Health Organization (WHO) Guidelines for Drinking-water Quality, “The most effective means of consistently ensuring the safety of a drinking-water supply is through the use of a comprehensive risk assessment and risk management approach that encompasses all steps in water supply from catchment to consumer. In these guidelines, such approaches are called water safety plans (WSPs)” (WHO, 2006). The WHO Guidelines also place WSPs within a larger “framework for safe drinking-water” that includes the public health context and health outcomes and also contains health-based targets and drinking water surveillance (Fig 1). As such, WSPs are specifically linked to health, with an implicit expectation that implementation of WSPs will safeguard health in areas with acceptable drinking water quality and improve health in areas with poor drinking water quality. Access to safe drinking water remains one of the key issues in development. Approximately 783 million people (11% of the global population) remain without access to an improved source of drinking water (United Nations, 2010). Globally, the effort to provide access to drinking water is comprised of a mix of government policy and aid, programs from international governing organizations, and projects funded by non-governmental organizations. Awareness of water issues has steadily increased, and the General Assembly at the United Nations (UN) recently recognized access to water and sanitation as a human right. Moreover, the UN claims to have helped 1.3 billion people gain access to drinking water during the decade of International Drinking Water Supply and Sanitation from 1981 to 1990 (United Nations, 2012). While the increased focus on water projects is helpful, there has been and continues to be a high failure rate of water sector development projects in the developing world. The Water Institute at the University of North Carolina at Chapel Hill states the average failure rate of water and related sanitation projects in the developing world is 35%, and in the most difficult areas upwards of 80% (The Water Institute, 2013). These numbers suggest that part of the underlying problem is not only the lack of projects, but also importantly the lack of good projects that are sustainable over the long term.

In Ghana, water safety faces severe problems, partly due to a neglect of the sector until the 1990s. Tariffs were kept at a low level which was far from reflecting the real cost of the service. Economic efficiency still remains below the regional average, resulting in a lack of financial resources to maintain and extend the infrastructure. Since 1994, the sector has been gradually modernized through the creation of an autonomous regulatory agency, introduction of private sector participation, and decentralization of the rural supply to 170 districts, where user participation is encouraged. To overcome the lack of coordination between the numerous institutions which were created since 1993, a National Water Policy (2013) was launched at the end of February 2008, which focuses on the three strategic areas: (i) water resources management; (ii) urban water supply; and (iii) community water and sanitation. According to a multi-donor review of Ghana's water supply sector, it is quite well structured, with the government in charge of policy and regulation, while the private sector and communities play important roles in service delivery. The institutional framework for sanitation is less clear, with responsibilities not being clearly defined (Water Aid 2010).

The Wa Municipality have serious concerns with respect to water safety. Based on challenges of water safety, citizens of this communities faces numerous water borne diseases which could have been prevented. The Government of Ghana has enacted several policies and regulations regarding water safety in the poor communities in Ghana yet unhygienic water and water pollution seems to still be a challenge facing citizens of this communities. As a result of the poverty situation facing citizens in this communities, the World Bank and other stakeholders have embarked on numerous water projects in the Northern, Upper East and Upper West regions of Ghana. However, this projects seems to die out without proper monitoring control, service assessment etc. It is therefore against this background that this research was conducted to find out how government regulatory practices affects water safety in these three (3) communities.

1.2 Statement of the problem

Numerous water projects on water safety has previously been enacted and there yet more projects in the pipelines yet water safety seems to be a challenge that cannot be prevented. Irrespective of Government regulations being enacted and implemented, this problem still persists. Due to this problem, stakeholders and Non-Governmental Organizations have taken water safety in this 3 communities upon themselves due to the mass understanding on the failure of government regulations in curbing this problem if not total eradication but to an appreciable level. Annual reports of the Northern Regional Health Directorate 2007 show that the number 4 topmost diseases in these 3 district are water related disease. Some topmost diseases suffered by resident of these community are Cholera, Diarrhea etc. Water Safety therefore is a serious concern that needs much attention. This research therefore seeks to analyze three government regulation practices and its effect on water safety in these 3 communities.

1.3 Research objectives

The overall objective of this study is to determine the impact of Government regulatory practices on water safety in the Wa Municipality of Ghana. Specifically, the study seeks to:

1. identify the effect of service assessment on water safety.
2. examine the effect of monitoring and control practices on water safety.
3. assess the impact of management plans on water safety.
4. identify whether or not government released funds on water safety are spent as planned.

1.4 Research Question

The study was guided by the following research questions:

1. Does service assessment affect water safety?
2. How does monitoring and control practice affects water safety?
3. What is the impact of management plan on water safety on water safety?
4. Does government released funds on water safety embarked upon as planned?

1.5 Research significance

The study contributed to the development of knowledge in planning and other fields in the social sciences. It provides inputs into water and sanitation policy formulation in the country in general and the study communities in particular. Enhancing water and sanitation services delivery will boost economy efficiency as there is a high correlation between inadequate water supply and human cost due to illness. It can further serves as academic reference material for students, researchers and other academicians who want to research into governmental control mechanisms on water, sanitation and hygiene can use this study as a reference.

1.6 Research Delimitation and Innovation

Several measures and policies have been enacted by parliament to curb safe water crisis yet this challenge still

exist. Several institutions and stakeholders have amounted pressure on the Government as to the reason why this challenge isn't dealt with. It is increasingly clear that Government have run out of ideas in desolating this challenge. It is therefore important that this research could be carried in those communities where this crisis is severe so as to discover the objective measures to be taken to solve this problem. The research contributes to validating already published research. The research also thus contributes with a more complete view on the subjects of rural water resource and accessibility. Furthermore, this study serves as source of knowledge of how to avoid the pitfalls when it comes to rural water safety and implications, hence optimizing the positive outcomes or benefits, while reducing the negative outcome of ensuring rural water safety

1.7 Conceptual Framework

In ensuring water safety, government will have to released funds, of course there must be some regulations and managerial plan to guide the project. After the funds have been released for water project, there should be monitoring and control mechanisms in place for the people in the community to be able to assess the service provided or the water safety. This ensures efficient distribution of safe water within the rural communities.

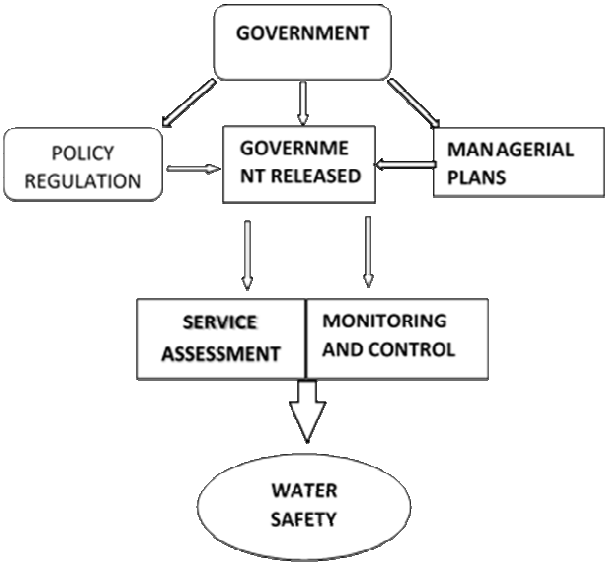

Figure 1. Conceptual Framework

2. Literature Review

The section of study presented on the review of related studies and theories underpinning the study.

2.1 General Overview of Water Safety

Although WSP uptake is relatively limited worldwide, an existing literature reviews a number of efforts underway to applying the WSP framework. For instance, starting with Iceland in 1997 (Gunnarsdóttir and Gissurarson 2008) and Australia in 1999 (Byleveld et al. 2008), WSPs can be found in some form or another in utilities and regions worldwide. (Bartram et al. 2009)[9] provided case studies of numerous jurisdictions where WSPs have been implemented, including, for example Australia, Latin America and the Caribbean, and the United Kingdom. But, as stated earlier, they are by no means universally located despite their significant reported benefits.

2.1.1 Benefits of Undertaking Water Safety

Tangible outcomes following a WSP approach in the short term include changes in organizational structure or daily procedures within a water supply (Gelting et al. 2012), better risk awareness among water operators (Mullenger et al. 2002; Gelting et al. 2012), more efficient water management practices (Medema et al. 2001; Davison and Deere 2007; Jayaratne 2008), improved compliance with water regulations (Metge et al. 2003; Dyck et al. 2007; Gunnarsdóttir and Gissurarson 2008; Gunnarsdóttir et al. 2012), and a reduction in customer complaints (Mullenger et al. 2002;Parker and Summerill 2013). As noted in the Introduction, the intent of a WSP is ultimately to protect public health, and while many water suppliers naturally anticipate improvement in this area as a result of adopting a WSP approach, clearly identifying specific public health benefits associated with WSP implementation in the short term remains a major challenge for many early adopters (Mullenger et al. 2002; Parker and Summerill 2013). Gunnarsdóttir et al. (2012) observed a 14% reduction of clinical cases of gastrointestinal illness over a10-year period for Icelandic regions adopting a WSP approach. At this time, our

exhaustive literature reviews of several databases (including Web of Science, PubMed, and Google Scholar) did not reveal any other peer-reviewed publications that have linked changes in public health to WSP implementation. It is worth noting, though, that one major challenge in comparing pre- and post-WSP public health benefits for many utilities is the lack of accurate baseline data on gastrointestinal issues related to past water quality failures (Rinehold et al. 2011). Because WSP benefits to public health and utility management increase over time, interim goals are recommended as a way for utilities to track progress and quantify accomplishments (Bartram et al. 2009; Mudaliar 2012). By identifying these goals at the outset of WSP implementation, utilities can "build a body of evidence" (Mudaliar 2012) that the approach is working towards an intended outcome, including improved public health. At the same time, interim goals can help to maintain interest and motivate water suppliers over the long term, while enhancing the confidence of policy makers and stakeholders regarding the validity of a WSP approach (Foster-Fishman et al. 2006; Bartram et al. 2009; Summerill et al. 2010a; Rinehold et al. 2011).

One example of interim goal-setting occurs in Alberta (Canada), where as part of a WSP approach all utilities are required to identify short- and long-term interventions for each risk identified within a water supply (Reid et al. 2012; AESRD 2014). For example, a risk could be significant human activity occurring in a watershed area (e.g., wastewater discharge from private septic systems in the watershed area). A short-term intervention for this risk could be to post informational signs indicating that the area is a source of drinking water, while a long-term intervention could include a range of actions from fencing to implementing bylaws that would limit human activity in the area, or governmental purchasing (and protection) of watershed lands (AESRD 2014). In establishing and achieving these incremental goals, utilities can begin to address risks immediately after they are identified, while limiting the demand these changes place on resources (Davisonet al. 2005; Seghezzo et al. 2013).

2.1.2 Barriers to Implementing Water Safety

Water suppliers may view a WSP approach as creating additional and otherwise unnecessary work for already over-burdened water operators and managers (e.g., Williams and Breach 2012). For example, utilities already meeting water quality regulations may be unmotivated to adopt WSPs, seeing little incentive in proactively seeking out new or additional risks (Zimmer and Hinkfuss 2007; Mayr et al. 2012). Where water suppliers already have quality management programs in place, the shift to a WSP approach can be viewed as redundant. In a study of five German water utilities, Schmoll et al. (2011) found between 70% and 90% of these utilities' current practices aligned with those suggested within a WSP framework. While this did not create a barrier for WSP integration per se, the authors noted that the utilities expressed concern about the possibility that transitioning to WSPs might be both a financial and a time burden. More generally, utilities may perceive WSPs as a burden in terms of having to "step up their game" in response to some of the more rigorous aspects inherent in a WSP approach (Summerill et al. 2010b; Mayr et al. 2012). One of the first steps for any water utility in a WSP approach is to undertake a full system assessment. This includes a physical assessment of the water distribution system—and the identification of specific risks — from water source to consumer tap. In some systems, factors such as high operator turnover, poor record keeping, and a history of ad hoc repairs can make the assessment a challenge (Godfrey et al. 2005; Mahmud et al. 2007; Bartram et al. 2009; Viljoen 2010). To address the absence of data within a particular water supply, (Godfrey et al. 2005), for example, combined local knowledge and socio-demographic data in a water supply to help identify past and present risks. Importantly, the authors found that access to limited data did not rule out the opportunity to undertake and benefit from a WSP approach. Some water suppliers may associate a WSP approach with an increase in spending requirements. In practice, this is often true at the front end; that is, much of the cost associated with WSPs are incurred early in the implementation period, and largely as a result of repairs required to address significant risks within a system (Gregor & Winstanley 2005; Chang et al. 2013). Over the long term, however, a WSP approach is more of a tool for reducing costs associated with providing safe drinking water, resulting from improved operational practices, better managerial efficiency, and efficient water use as a result of infrastructure improvements and better leak detection (Dyck et al. 2007; Tabesh et al. 2009; Parker & Summerill 2013).

While the financial burden incurred as the result of an outbreak of waterborne illnesses should be viewed as considerable enough to warrant that all available efforts to protect water safety have been taken (Corso et al. 2003; Halonen et al. 2012; Huovinen et al. 2013), this remains a difficult link for some utilities, particularly among those where outbreaks have not previously occurred and motivation for change is limited (Hrudey 2011)[36]. Small, rural, and remote communities1 can face additional challenges in implementing policies such as WSPs. For example, a survey of small water utilities in Iceland found the original WSP approach to be too extensive and time consuming given the resources available (Gunnarsdóttir and Gissurarson 2008). As a result, a modified five-step WSP approach was developed. In Bangladesh, small utilities are provided with examples and a template of a WSP to speed up their own implementation (Mahmud et al. 2007), while in Austria, small utilities

are provided with a software-supported WSP guide (Mayr et al. 2012). Small, remote, and indigenous communities in Australia have access to a customizable online tool that facilitates the development of WSP approach (NWC 2014). In seeking to implement WSPs in remote Pacific Island countries, (Hasan et al. 2011) found many individuals lacked experience with formal education and had limited understanding of the technical aspects of a water supply system. To overcome this gap, local facilitators were trained to carry out instruction on WSP implementation in a culturally appropriate manner and in the local dialect. In recognition of the challenges faced by these and other small, rural, and remote communities, a number of guides have recently been published aimed specifically at facilitating WSP uptake under constrained circumstances (e.g., WHO 2012).

2.2 Review on the Research of Water Safety in Ghana

The main sources of water supply in Ghana include surface water, ground water and rain water. According to FAO (2005), Rainfall although not reliable, has a mean ranging from 2150mm in the south-western part to 800 mm on the south- eastern. Rain harvest is not so popular among urban settlers. Nevertheless, it provides a significant amount of domestic water in the southern rural areas particularly in during the humid months of May, June, July and August. Sarpong, (2005), estimated total annual run-off as 56.4 percent. The main surface waters are made up of the Volta river system which covers about 70 percent of the entire country and it consist of rivers Oti, Daka, White and Black Volta, Pru, Sene and the Afram rivers. Rivers Bia, Tano, Ankobra, Pra which drains the south-western regions also covers about 22 percent of the country, while the coastal zone is drain by rivers Ochi- Nakwa, Ayensu, Densu and the Tordzie takes charge of about 8 percent of the country (FAO,2005). Greater part of the rural Ghana relies on ground water which is often extracted from boreholes while urban Ghana gets about 95 percent of its waters from surface water. The main rock formation is the sedimentary and the non-sedimentary which provides quality ground water but for few instances where there is localized pollution (Sarpong, 2005). According to Turney (2007), Water Resources Management is seen by many institutions as the integrating concept for a number of water sub-sectors such as hydropower, water supply and sanitation, irrigation and drainage, and environment and this ensures that an integrated water resources will incorporate social, economic, environmental and technical dimensions which enhances accountability in the management and development of water resources. However, in Ghana, there are different institutions managing these related sectors. The main body managing and providing drinking water is the Ghana Water Company.

2.2.1 Ghana Water Company

Since independence, the state-owned company (Ghana Water Company Limited) has been managing water supply systems in almost all urban areas especially administrative cities with the state providing the finances for both technical and human resources. The company's task was mainly to supply water however, it relayed on professionals outside the organization for technical studies and other detailed engineering designers. The company could not cope with rapid population growth and urbanization. It was unfortunate that the company had no hand and could not integrate with water sub-sectors such as hydropower, sanitation, irrigation and drainage, and environment which could have ensures that social, economic, environmental and technical dimensions are taken into account in pursuance of proper management and development of water resources. The other sub sectors were under different institutions and this contributed to create poor sanitation and poor hygiene in most urban areas. A paper by Well (2005), reveals that since 2000, the company have been experiencing considerable deterioration to the extent that about 40 percent out of the total 70 percent taps had water running through them and this was also irregular and the urban population has to some extent wait for days before any water runs in their taps. The company had to deal with lack of autonomy with weak management which also resulted in debt. In 2002, it was estimated the company was indebted to the tune of $ 400 million and about 50 percent of all waters produced were not able to be accounted for. It came to light that in the year 2003 alone, losses in operation were cost about $ 34 million – almost 100 percent of the total revenue and the urban population have since been suffering to get water and therefore had to rely on other source of getting water (Well Factsheet,2005). Apart from the Ghana Water Company, there is some Non-governmental organization (NGO) and some few local based private companies who are involved in managing and provision of water particularly in the urban areas.

2.2.2 Review on the Research on Government Regulations on Water Safety

The constitution of Ghana before 1992, did not provide any institutional basis for the regulation of water as it does for the related resources of land, fisheries and forestry through the establishment of Lands, Minerals and Fisheries Commissions charged with the responsibility for the management and coordination of policy in relation to these resources. The activities of these Commissions could, however, impact on the water sector. Perhaps taking a cue from the Constitution which provides for the creation of other Commissions to address natural resource management, the Legislature has established a Water Resources Commission (WRC) pursuant to the Water Resources Commission Act, 1996 (Act 522) for the management of the water resources of Ghana, inter alia. The WRC Act is the major instrument that governs water use and management in Ghana. However, prior to,

and after the enactment of the WRC Act, various governments have sought, through the instrumentality of legislation and policy initiatives, either directly or indirectly, to regulate water and its uses through various ministries, departments and agencies (MDAs) of state. Consequently several enactments that have a bearing on water use and or management exist on the statute books. (Ghana Water & Sewerage Corporation Act, 1965: Act 310).

2.2.2.1 Reasons

As part of its mandate, an initial focus of the WRC was to regularize water rights for existing water users and the granting of water rights to all users of naturally occurring water. Water use regulations and procedures for the issuance of rights to water uses by means of permits was prepared by the Commission and passed by Parliament at the end of 2001 (L.I.1692). The regulations are currently being implemented. The WRC Act vests the property in and control of all Water Resources in the President on behalf of, and in trust for, the people of Ghana. Water Resources is defined comprehensively under the Act; it encompasses "all water flowing over the surface of the ground or contained in or flowing from any river, spring, stream or natural lake or part of a swamp or in or beneath a watercourse and all underground water but excluding any stagnant pan or swamp wholly contained within the boundaries of any private land" (Section 37) No person is allowed to divert, dam, store, abstract or use water resources, construct or maintain any works for the use of water resources except with the permission of the WRC, and in accordance with the provisions of the WRC Act. The only permissible use of water resources without recourse to the WRC is for the purpose of fighting fires. The Act, however, recognizes the rights of persons with lawful access to water resources to abstract and use same for domestic purposes. The import of the foregoing provisions is to oust customary water holding rights by stools, families and communities in favor of the state. Until the passage of the legislation, customary water rights were, by and large, regarded as part of land rights.

2.2.2.2 Related issues and challenges

Perhaps, not unmindful of the import of the legislation which essentially expropriates communal and private property rights in water in favor of the state, the Act makes provision for persons who claim existing rights of access to any water resources to notify the WRC within twelve months from the coming into force of the WRC Act, (The Act entered into force on 31 December 1996)[48] the WRC is enjoined to conduct the necessary investigations and where satisfied that such rights exist in relation to the person, "may take such action as it considers appropriate". The WRC Act does not provide for what appropriate actions are to be taken under such circumstances. Presumably these could include payment of compensation. It is however, doubtful whether any such claims were made upon the coming into force of the Act. Indeed in a predominantly illiterate society, one wonders how such legislative provisions would come to the notice of the affected parties. The net effect of the legislation then could, sub-silent, divest customary holders of proprietary rights to water without prompt adequate and effective compensation as required in such circumstances by the 1992 Constitution among many an illiterate community unaware of the changes introduced by the legislation (Art. 20).

In addition to divesting stools, communities and families have their customary ownership of rights to water, the WRC Act 1996 vests in the state, the right to grant water rights. In that regard, any person may apply to the WRC in writing for the grant of water rights (Section 16). Upon receipt of such an application, the WRC is enjoined to conduct such investigations as it considers necessary, including consultations with the inhabitants of the area of the water resources concerned, prior to arriving at its decisions. As part of the process, any person who claims that his or her interest will be affected by the grant may notify the WRC within three months and such objections may be considered in determining whether or not the water rights should be granted. The WRC Act is silent about avenues that exist for persons dissatisfied with its decisions. However, such persons could invoke the supervisory jurisdiction of the High Court or rely on the constitutional guarantees of property rights to ventilate their grievances (Section 16;8). A grant of water rights shall be subject to ratification by Parliament (Section 16;8). However, Parliament may, by resolution supported by not less than two-thirds of members exempt such class of water rights as it shall so resolve from the requirements of ratification. Parliament is yet to exercise this power. The Act bans a transfer of water rights granted without the prior written approval of the WRC. The Commission also reserves the right to suspend or vary water rights.

2.3 Research Theories

2.3.1 Good Governance Theory

Good governance is an indeterminate term used in the international development literature to describe how public institutions conduct public affairs and manage public resources. Governance is "the process of decision-making and the process by which decisions are implemented (or not implemented)". The term governance can apply to corporate, international, national, local governance or to the interactions between other sectors of

society. The concept centers on the responsibility of governments and governing bodies to meet the needs of the masses as opposed to select groups in society. Because countries often described as "most successful" are Western liberal democratic states, concentrated in Europe and the Americas, good governance standards often measure other state institutions against these states. Aid organizations and the authorities of developed countries often will focus the meaning of "good governance" to a set of requirements that conform to the organization's agenda, making "good governance" imply many different things in many different contexts.

Good governance theory applies to water safety as proposed by Sarpong (2005). He further argued that the adoption of good governance theories affects all sectors of the economy including the safety of water. Ali-Nakyea (2006) asserted that embracing the good governance theory in Ghana especially in the northern region will eradicate water starvation among citizens in the northern part of Ghana. Furthermore, Anim (2005) also concluded that taking steps to ensure that citizens are well catered by providing water safety etc. will render no delays in the provision of social amenities because the government will be well abreast with their responsibilities towards Ghanaians.

2.3.2 Institutional Change Theory

Institutional change (IC) transcends organizational change to focus on entire classes of organizations serving different societal functions (business, government, education, etc.) and how they are being transformed in response to a rapidly changing world. Unlike the “management” focus of organizational change – process design, teamwork, leadership, etc. – institutional change focuses on the underlying social rules or norms that define how these societal functions are structured and governed. Zack (2006) argued that most of us take the vast infrastructure of social institutions for granted because it is as ordinary and invisible as the air we breathe. But those who advocate changes are usually greeted with strong doubts and objections, which signals subtle barriers operating at the subjective level of cultural values and beliefs. These are the social norms governing institutions at a higher domain lying above the rational level of objective knowledge. A research conducted by Akerlof (2003) concluded that the handling of Water and water safety processes in the northern regional of Ghana is up hauling and that the government should adopt institutional change methods in curbing this issue. Ryder (2011) in buttressing Akerlof also asserted that the adoption of institutional change measures on water safety plans will serve as a greater good in curbing water crisis and the economy as a whole.

2.3.3 Social Capital Theory

Social capital may be defined as those resources inherent in social relations which facilitate collective action. Social capital resources include trust, norms, and networks of association representing any group which gathers consistently for a common purpose. A norm of a culture high in social capital is reciprocity, which encourages bargaining, compromise, and pluralistic politics. Another norm is belief in the equality of citizens, which encourages the formation of cross-cutting groups. Smith (1997) concluded that the social capital theory is important in issues surrounding water safety because it helps the government and its citizens to approaching issues surrounding water safety with extreme care since both parties possesses balanced norm in eradicating the challenges facing water safety. In Ghana, Akerlof (2003) asserted that in providing a balance approach to solving issues regarding water safety, the social capital theory puts both the government and citizens in a pole position in curbing this issue. Sarpong (2005) argued that Ghanaians approach on water safety seems not to be the best and that the government should provide educational measures on social capital theory in order curb citizen’s reluctant approach in handling facilities in reference to water safety.

2.4 Status of Rural Water Safety Regulations, Problems and Policies in Ghana

2.4.1 Status of Water Regulations from 1928 – 2004

Gyau- Boakye and Dapaah-Siakwan (1999) noted that in 1844, during the pre-colonial era, individuals, trading, mining and timber companies and small communities were responsible for their own water supplies. Dug-wells, ponds, dug-outs, streams and rainwater harvesting from roofs were the main sources of these supplies at the time. The colonial government, however, assumed some responsibility for public water supply in the urban and rural areas as a result of periodic droughts, population growth and the emergence of larger communities later in about 1900. Consequently, a Public Works Department (PWD) was formed to explore urban water supplies. As a result of frequent droughts in the northern sector, the Geological Survey Department was established in 1937 was detailed with dealing with the severe water supply problems in northern and the south-eastern parts of the country. The provision of water to both rural and urban areas of Ghana was then put under the responsibility of the Water Supply Department (WSD). The WSD was later separated from the PWD and put under the Ministry of Works and Housing (MWH) following Ghana’s independence in 1957. Later a number of challenges occurred in the institutional set up for water supplies in the country and as a way to revamp the sector it necessitated the change of WSD to Ghana Water and Sewerage Corporation (GWSC) in 1965 by the legal Act (Act 310) GWSC

was set-up as a mandated public utility in charge of the provision of urban and rural water supply for public, domestic, and industrial purposes as well as the provision, operation, and control of sewerage systems. The policy of GWSC was to supply potable water to rural communities based mainly on groundwater sources (Gyau-Boakye & Dapaah-Siakwan, 1999).

To address the problems that confronted the Ghana water sector, the government took a decision to restructure the sector; hence various reforms have been adopted since 1993. The main aims of the reforms were to separate rural and urban water supply services, to introduce independent regulatory agencies, as well as to include private sector participation (CWSA, 2004). In line with the reforms, the Community Water and Sanitation Division (CWSD) was introduced in 1994 as a semi-autonomous division of GWSC to be responsible for the water supply and sanitation in rural areas. In 1998, it was transformed into Community Water and Sanitation Agency (CWSA) by Act 564, and became fully independent (GWRESP, 2008; TREND, 2007). In the same vein, the GWSC was also replaced by the publicly owned Ghana Water Company Limited (GWCL) in 1999. The responsibility for rural water supply and sanitation was then decentralized to the District Assemblies (Water Aid, 2005a)[57]. These later developments mandated GWCL to remain responsible only for urban water supply, whilst the water systems in over 110 small towns were decentralized to District Assemblies, which receive support from the CWSA. As a way of instilling responsibility in the people, demand–driven and community–managed approach was introduced in the latter case (UN, 2004). The other development has been the shift of the regulation of water supply from the government to independent agencies. The Public Utilities Regulatory Commission (PURC) and the Water Resources Commission (WRC) were two commissions created in 1997 to regulate the sector (CWSA, 2004). The PURC was mandated to be responsible for formulating as well as approving appropriate pricing mechanisms aimed at full cost recovery, as the subsidization of water services was being phased out by the government in 2003 (OECD, 2007). The PURC regulates only the services of GWCL and for that matter has no hand in the services of community-managed water systems. The Water Resources Commission (WRC) on the other hand only regulates water resources. In other words, it takes the responsibility of licensing water abstraction and waste water discharges (Water Aid, 2006). The other institution created under the sector, restructuring process is a Water Directorate at the Ministry of Water Resources, Works and Housing to coordinate water sector activities (Water Aid, 2006).

In Ghana, the challenge of adequate potable water supply to the people is of concern to government, individuals and the general public even before independence. A brief look at the summary of historical trends of various attempts made to improve adequate supply of water could be useful here.

Table 1. Status of Water Regulations from 1928 - 2004

YEAR	INTERVENION
1928	First development of public water supply systems, operated by the
	Hydraulic Division of the Public Works Department
1965	Ghana Water and Sewerage Corporation (GWSC) established to be
	responsible for urban and rural water supply
1986	Removal of operational subsidy on water supply
1991	GWSC efficiency increased by cutting 1400 jobs and recruiting more
	qualified personnel
1994	The operation of Rural and Small Town Water supplies moved from
	GWSC to be community managed. Semi-autonomous Community
	Water and Sanitation
	Division established to be responsible for facilitating the community
	water supply management
1995	Stakeholder meeting selects the ‘lease option’ for restructuring the
	urban water sector
1996	Water Resources Commission established

1997	Public Utility Regulatory Commission established
1999	GWSC replaced with the publicly owned Ghana Water Company Ltd
	(GWCL) in urban areas and the Community Water and Sanitation
	Agency (CWSA) in rural areas. Responsibility for urban sanitation
	transferred to ministries of local
	Government
2003	Modification of water sector restructuring project so that management
	contract option is also available to urban water project
2004	Preparation of a National Water Policy

2.4.2 National Water Policy

There are a number of agencies in Ghana that provide water under statute law. However, the most important ones for purposes of providing water for domestic consumption are the Ghana Water and Sewerage Corporation, (GWSC) and the Community Water and Sanitation Agency (CWSA). By practice and orientation, GWSC has concentrated on the provision of water and sewerage services in urban areas, whilst the CWSA facilitates the provision of water in rural areas. The CWSA works in close collaboration with District Assemblies. Recently, a number of regulatory institutions (The Water Resources Commission, The Environmental Protection Agency. The Public Utilities Regulatory Commission) have been established to regulate the delivery of water to consumers and also to protect the environment and conserve water resources. The new national water policy was launched in October 2005. The National Water Policy of Ghana aims at providing a framework for the sustainable development and utilization of Ghana's water resources. It is targeted at all water users, water managers and practitioners, investors, decision-makers and policy makers within the central and decentralized government structures such as the district assemblies, non-governmental organizations and international agencies. The policy outlines the various cross-sectoral issues related to water-use and the links to other sectoral policies such as relating to sanitation, agriculture, transport and energy (Roseemma G. et al 2007) pg Ghana's Water Vision for 2025 is to "promote an efficient and effective management system and environmentally sound development of all water resources in Ghana" (Ministry of Works and Housing, 2005). Three important development frameworks inform Ghana's water policy namely: The global - Millennium Development Goals (Ministry of Works and Housing, 2003) [62]; The African region - New Partnership for African Development (NEPAD, 2001)[63]; and The national – Ghana Poverty Reduction Strategy (GPRS I) and Growth and Poverty Reduction Strategy (GPRS II)

The Ghana Poverty Reduction Strategy (2003 – 2005), which was later revised stated inter-alia that "increasing access to potable water…is key to achieving health outcomes and sustained poverty reduction." The GPRS envisages improving provision of water to rural, peri-urban and unserved poor urban areas. A Strategic Environmental Assessment (SEA) conducted on the GPRS showed that water, as a cross-cutting thematic issue is highly relevant to promoting livelihood, health and vulnerability issues in Ghana. Though the GPRS I was reviewed and replaced by the Growth and Poverty Reduction Strategy (GPRS II 2006-2009), the goals articulated in GPRS I generally remain central to Ghana's development strategies.

2.4.2.1 Policies

General water sector policies for both rural and urban areas are set by the Water Directorate within the Ministry of Water Resources, Works and Housing (MWRWH). Furthermore, the ministry solicits funding from external support agencies, monitors, and advises the Cabinet (Water Aid, 2005b). The Water Sector Restructuring Secretariat, created in 1997 in the MWRWH, oversees the process of private sector participation in the sector (Doe, 2007). Although the sector has made substantial progress, a lack of coherence in policy formulation resulted in a multitude of implementation strategies which led to new problems. The existence, of a multitude of institutions with overlapping responsibilities is one main new problem which partly arose from the recent reforms. To overcome the lack of coordination between the numerous institutions which were created since 1993, a National Water Policy (NWP) was launched in February 2008, to introduce a comprehensive sector policy and

focus on three strategic areas: (i) water resources management; (i) urban water supply; and (iii) community water and sanitation (GWRC, 2008).

In other words, the aim of the NWP was to formulate a comprehensive sector policy which includes all relevant actors in the sector. According to the MWRWH, the NWP could make it easier for development partners to provide the necessary support to the sector (Appiah, 2008). The NWP has been prepared by the Ghana Water Resources Commission (WRC) since 2002 and is based on the Ghanaian Constitution of 1992, the Ghana Poverty Reduction Strategy (GPRS), international agreements and conventions, and other national programmes (GWRC, 2008). For the rural water sector, the National Policy is operated on the Demand Responsive Approach (DRA) where acquisition of potable water supply starts with the application for assistance filed by communities through the District Assemblies (DA). This mostly applies to point sources. One of the key principles of the National Community and Sanitation Policy is the requirement that beneficiary communities pay 5-10% cash contribution towards the capital cost of the least-cost, technically feasible water facility option with the intent of involving the beneficiary communities to demonstrate their commitment, sense of ownership and responsibility (Water Aid Ghana, 2003). Some of the project strategies has been Decentralization, Private Sector Participation and Women Participation.

2.4.2.2 Problems

Clean water is essential for human life. In developing countries, many people do not have access to clean water. In Ghana 85 % of people living in rural communities regularly use water which is unsafe (Halcrow Consultancy Report 1995), and about 28% of the urban poor have no running water in their homes (Rakodi C., 1996 p). As clean water is a basic necessity of life, one would have thought that governments would ensure that every citizen would be guaranteed a certain minimum amount of water at an affordable price. Making water available to all will result in substantial improvements in the conditions of life for all citizens, especially the poor. We shall call a position that argues that every citizen has a right to clean water and therefore it must be made available to all, the 'entitlement view' of water. There is a close relationship between entitlement and poverty alleviation. Consuming unclean water leads to water borne diseases. This affects productivity and economic well-being. A programme that increases access to water will reduce disease and thus poverty.

2.4.2.2.1 Institutional Problems

It is general accepted that institutions in charge of providing of water such as the GWSC has failed to fulfil its mandate. The question is the direction of future reforms. Donor agencies wish to see complete privatization of the water sector, whilst the government wishes to commercialize certain operation in urban water delivery whilst maintaining GWSC as a public corporation. There has been very little debate about the reforms in the media. It is unclear whether the general public understands what is going on or support the specific reforms that are being proposed.

The lack of consensus about the nature and direction of the reforms is creating another problem - uncertainty about the environment in which the delivery and regulation of water and sanitation should take place. Government policy in this area is changing constantly as a result of pressure from donor agencies. Until now, the general belief was that government was commercializing certain parts of the operations of GWSC. We are being told now that GWSC is to be completely privatized. Some of the institutional problems are Inadequate Political will, Lack of coordination between various institutions, Lack of Community Participation

2.4.2.2.2 Social Problems

The authorities responsible for the management of water came to the realization the social issues that was affecting the citizens thereby arises the need to regulate the water resource. Some of the problems that pushed them to come out with policies to regulate the water bodies most especially the rural areas, were outbreak of diseases and water pollution**.**

2.5 Preventing Social Problems through Effective Water Storage Technique

2.5.1 Temporal storage technique

Although water forms a major part of the earth surface, much of it is not available to humans in a form that can readily be used, as a source of drinking water or for other purposes. The human body is made up of over 70% of water. Where piped water supply to the household operates intermittently, storage facilities are commonly used to ensure that there is sufficient water for the family needs throughout the day. In Nyankpala, the discontinuity of water supply, in addition to the low water pressure in the distribution system, which hinders the delivery of water to upper floors, creates a need to use storage tanks. Water that is stored un-hygienically may be re-contaminated, and so result in a public health hazard. About 2,500 people die each day in the world due to diarrhoeal diseases

associated with faecally contaminated water. Other water related diseases such as cholera, malaria, filariasis, dracunculiasis (guinea worm), typhoid and onchocerciasis (river blindness), still represent the single largest cause of human mortality and morbidity (Koffie, 2006).

The main reason for these mortality rates is the limited access to safe water, inadequate treatment of water for drinking by households and lack of proper storage practices for drinking before consumption, which leaves rural communities with no other choice than to manage. In addition, the water-storage containers used in these rural households are often not cleaned and are exposed to faucal contamination due to children who put their hands into the water, unhygienic handling of the water-storage containers, and the use of dirty utensils to withdraw water, dust, animals, birds and various types of insects (Sobsey, 2002). There is a great deal of concern regarding in-house microbial contamination during handling and storage of water in developing countries. The prevalence of water related infectious diseases has been reported to be high among people in Ghana especially the northern sector. Generally, water for drinking is stored in containers by households with or without treatment after collection from a variety of sources (Koffie, 2006). The study finds out that effective water storage will help prevent various form diseases such as cholera and diarrhea which are mostly social problems in most part of the country.

2.5.2 Long-term storage technique

The study found that generally physical-chemical parameters of stored water measured were well within the WHO recommended limits, though they were higher than that of tap water. However, the physical-chemical parameters of stored water exhibited variations, but chemically, the water was potable for consumption, except in some cases where turbidity, colour and total iron levels were higher than WHO recommended values. Usually contamination occurs when water is regularly obtained by using a dipper (often a plastic/metal bowl or gourd). Hands are in regular contact with the local surroundings and acts as a potential conduit for transferring microorganisms from contaminated sites within the home (and compound) to the stored water, either via the dipper or through direct contact with the water. In addition, the transportation of water from the main source to household water storage tanks after fetching resulted in the presence of coliform bacteria. The presence of coliform bacteria in stored water for domestic use has health implications, since consumption of unwholesome water affect human health in many ways. Other possible cause for the presence of coliform bacteria observed in the different storage tank types may have resulted from water temperature inside the storage tanks.

2.5.3 Effective water use and avoidance of water pollution

This study come up that most of the water bodies within the study area are polluted due to its less availability. The few water sources are shared between animals and the people living in the community just as Mr. Bawah indicated during a face to face interview in one of the small villages within the study area. Form the entire country perspective, the main consumptive water uses in Ghana are for municipal, industrial and irrigation purposes. In 2000, about 652 million m3 were withdrawn for Agriculture (66 percent), 235 million m3 for Domestic (24 percent) and 95 million m3for the Industry (10 percent), giving a total water withdrawal of 982 million m3 (Table 4 and Figure 1). The combined withdrawal for municipalities and industry is 95 million m3 for rural and 235 million m3 for urban areas. Current water use for hydroelectricity generation (only at the Akosombo Dam), which is non-consumptive water use, is 37.843 km3/yr.

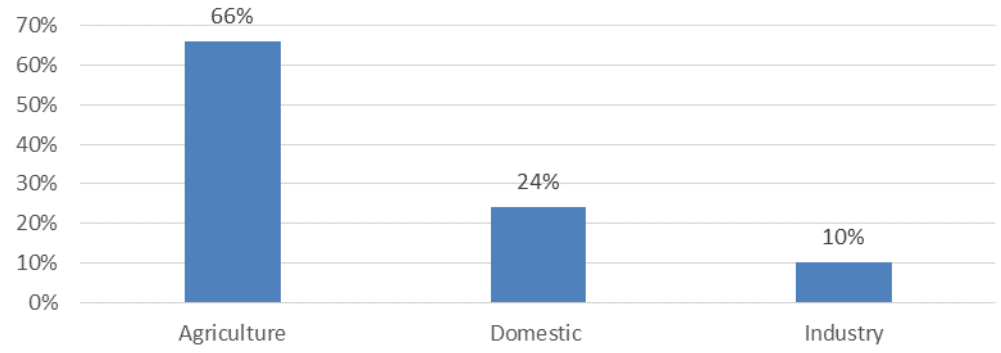

Figure 2. Share of water use in Ghana

Water Use Regulation: As part of its mandate, an initial focus of the WRC was to regularize water rights for existing water users and the granting of water rights to all users of naturally occurring water. Water use regulations and procedures for the issuance of rights to water uses by means of permits was prepared by the

Commission and passed by Parliament at the end of 2001 (L.I.1692). The regulations are currently being implemented.

2.5.4 Monitoring and Control from Government

Monitoring of water project also requires financial resources used thus far for Integrated Water Resources Management which could be obtained from external and local sources. The Government of Ghana's commitment has basically cove red personnel emoluments and administrative expenses, while inflows have been very austere in respect of services and investment. This gap has however been effectively made up by the support from DANIDA sources as the main contributor to this process. Many monitories teams have been sent to the Wa municipality to monitor and enhance the safety of rural water access in the municipality. However, studies have shown that they have really achieve less results in the Wa municipality as long as water safety and access is concerned despite the investments made coupled with population growth. On the average, investment levels in the water sector have been about 35% of the desired. While population is growing at about 2.6% and demand for water outstripping supply, sector expansion has on the average been around 1% per annum during the last decade. The major donors in this sector, apart from DANIDA, include CIDA, DFID, GTZ, World Bank, Caisse Francaise de Development. JICA, UN HABITAT etc. In terms of financial performance, studies have indicated that it cost the country about US$0.80/ one m3 to produce, transport and distribute potable water. Water tariffs have however been held at around US$0.20 perbm3. Water supply therefore met operating costs at a level constrained by the availability of funds without regard to actual operational needs. This is evidenced by the poor state of existing infrastructure, especially the distribution systems, contributing to high levels of non-revenue water.

2.5.4.1 District level monitoring and Control

In communities within the WA municipality with fewer than 5,000 inhabitants, water supply systems are owned and managed by the respective community which includes Kpongpala, Danko and Kumfabiala on a demand-driven basis. According to the NCWSP, these systems do not receive any cross-subsidies and 5% of investment costs are paid by District Assemblies. Communities and in rural areas and small towns elect gender-balanced water and sanitation boards consisting of volunteers, including one or two village-based caretakers who received special training in repair and maintenance Communities can contract private companies or NGOs to provide technical assistance, goods, or services. According to an interview with some opinion leaders within the Danko, Local companies drill boreholes and build hand-dug wells, and local artisans are used to provide household latrines. The District Monitoring and Evaluation System (DIMES), Established by the CWSA, DIMES is a useful tool for capturing relevant sector data at community level, Priority actions for sector monitoring and evaluation including information on water and sanitation facilities from drilling works through to subsequent functionality. The tool can be used to gather information on urban systems as well but the sector has as yet been unable to adopt it for universal application. It is hoped that with the move towards a SWAP, this will be the tool of choice.

2.5.4.2 CWSA monitoring and Control

The CWSA was created in 1994 under the framework of the Ghana decentralization policy and became autonomous in 1998. The institution does not directly construct, operate, and maintain facilities for water supply and sanitation through effective monitoring. Instead, its role is to coordinate the work of a number of actors which carry out the services in rural areas, including public sector organizations, local beneficiary communities, private sector organizations, and NGOs. The CWSA is also expected to ensure that financial support from development partners is effectively used and the projects are monitored so that desire outcome is achieved. However, most studies have review that monitoring of projects in Ghana is not effective. This has had a spillover negative effect on investment into rural water projects by external donors and other private organizations. Maintenance units of CWSA have been privatized and the regional companies created through this process now perform major repairs on behalf of District Assemblies. Minor repairs are carried out by area mechanics. The Community Water and Sanitation Agency (CWSA) is in charge of coordinating and facilitating the implementation of the National Community Water and Sanitation Programme (NCWSP) in rural areas, which is carried out directly by the communities and their District Assemblies. The NCWSP focuses on three main objectives in order to achieve health improvements: safe water supply, hygiene education, and improved sanitation.

2.6 Conclusion and Recommendation

2.6.1 Conclusion

After thorough literature review, it was find out that The Public Utilities Regulatory Commission (PURC) and the Water Resources Commission (WRC) were two commissions created in 1997 to regulate the sector (CWSA,

2004). The other development has been the shift of the regulation of water supply from the government to independent agencies. Under LI 1233, the Corporation has enacted regulations through which water and sanitation facilities can be made available to Ghanaians which covers the people within the Wa municipality. The key regulatory tools utilized by the Commission in pursuance of its objectives are: rate setting, regulations, monitoring of public utilities and public awareness programmes (PAP) these regulations are meant to protect the environment, protect natural watercourses and provide for proper sewerage systems. There was greater indication from the related literature that government regulation on service assessment have positive effect on water safety within the Wa municipality. The findings is highly in support of the good governance theory as indicated by Ali-Nakyea (2006) who asserted that embracing the good governance theory in Ghana in terms of regulation and control policies especially in the northern region will eradicate water starvation among citizens in the northern part of Ghana.

On monitoring and control practice, the study find out that, an important functions of the Commission include providing guidelines on rates that can be charged by Utility companies; monitoring the performance of the utility service providers with the aim of ensuring that safe, adequate, reliable, and efficient service is delivered to consumers at reasonable cost and on a non-discriminatory basis; communicating every tariff review to the consumers to ensure transparency, advising consumers of their rights and responsibilities, conducting public education to help customers make informed choices; investigating consumer complaints and resolving service related disputes. Though, many monitories teams have been sent to the Wa municipality to monitor and enhance the safety of rural water access in the municipality. However, studies have shown that they have really achieve less results in the Wa municipality as long as water safety and access is concerned despite the investments made coupled with population growth. The District Monitoring and Appraisal System (DIMES), Established by the CWSA, DIMES is a useful tool for capturing relevant sector data at community level, Priority actions for sector monitoring and evaluation including information on water and sanitation amenities from drilling works through to subsequent functionality. The CWSA, have also achieve less in terms of its objectives. Hence, there is less productive impact of monitoring and control mechanisms on water safety at the rural level with the Wa municipality. Monitoring and control is defined as the ability of an institution to ensure the total function of an instituted program in safeguarding the initial purpose of the institution program under consideration. Monitoring and evaluation can take various forms in water safety such as the use of chlorine to ensure water safety, intermittent assessment of water plants, and asking feedback from water consumers on water safety etc. In Ghana, it is explicit that monitoring and control practices cannot be left only into the hands of public institutions. Based on this, the private sector ensures water safety by frequently visiting members of the rural areas to ask them about questions about water safety as well as providing them with water safety materials. In terms of water safety, the public institutions are mainly into the mass provision of safety materials as well as ensuring that plants and equipment are adequately maintained. In all, monitoring and evaluation is considered as one of the most effective tools in ensuring water safety by Akplom (2003), Aziz (2006) and Perch (2004).

Again, the study also find out from the management plan aspect that, for the rural water sector, the National Plan is operated on the Demand Responsive Approach (DRA) where acquisition of potable water supply starts with the application for assistance filed by communities through the District Assemblies (DA). This mostly applies to point sources. One of the key principles of the National Community and Sanitation Plan is the requirement that beneficiary communities pay 5-10% cash contribution towards the capital cost of the least-cost, technically feasible water facility option with the intent of involving the beneficiary communities to demonstrate their commitment, sense of ownership and responsibility (Water Aid Ghana, 2003). Especially in siting the facility, the community thinks the best known places that should be avoided since they know their own environment. Demeken (2009) revealed that most water facilities were sited without consultation or in some cases disregarding the community's suggestions. This has led to the abandonment of some facilities. For example, at Limo in the Gushiegu District, the respondents expressed concern that they had advised the providers not to site their boreholes at their current place not only because the place was waterlogged but also the water tasted salty. Unfortunately their suggestion was dismissed and the facility was sited there. This facility has since been abandoned due to the alleged high salt content of the water. This is an indication that the plan of management on issues of water safety should involve the community members in other to have positive effect on water safety. This findings is supported by the social capital theory as indicated by Akerlof (2003) that in Ghana, in providing a balance approach to solving issues regarding water safety, the social capital theory puts both the government and citizens in a pole position in curbing this issue.

Finally, it is evidence from this study that, on the average, investment levels in the water sector have been about 35% of the desired. While population is growing at about 2.6% and demand for water outstripping supply, sector

expansion has on the average been around 1% per annum during the last decade. The major donors in this sector, apart from DANIDA, include CIDA, DFID, GTZ, World Bank, Caisse Francaise de Development. JICA, UN HABITAT etc. In terms of financial performance, studies have indicated that it cost the country about US$0.80/ one m3 to produce, transport and distribute potable water. Water tariffs have however been held at around US$0.20 perbm3. Water supply therefore met operating costs at a level constrained by the availability of funds without regard to actual operational needs. This is evidenced by the poor state of existing infrastructure, especially the distribution systems, contributing to high levels of non-revenue water. CWSA investment figures have been noted to be on the low side as the CSO2 costing puts the combined rural water supply and sanitation requirement at US$388 million per year. Thus whilst the rise is appreciated, this still falls far short of the likely requirements. Hence, government release funds fall short of its budget and does not necessary work as planned within the Wa municipality. Literatures as to the use of government released funds on its intended purposes is debatable (Akplom, 2003). Other researchers argue in favor to the notion that government released funds are used for their intended purposes whiles others disagree to this notion. Most government officials and Ghana Water Corporation agree to this notion whiles members of the traditional council in rural areas disagrees to this notion. In all, both parties agree to the fact that if government released funds are used for their right purposes, it will help alleviate water related diseases as well as ensuring the safety of water. Just last year, the government of Ghana release $2 million for the purchases of water safety materials. Over the years of 2000-2015, a total figure of $20 million have been spent on water safety nationwide. Yet, water safety challenges still persist especially in the rural areas in Ghana. Citizens from the study area indicated that indeed funds are used for water safety measures but lack service assessment and monitoring. They further argue that, after the treatment of water, workers of the Ghana Water Corporation do not institute appropriate monitoring and control measures to ensure their water safety. They further argue that the lack of infrastructure has caused massive pollution on water resources and reserves used in their daily operational activities.

2.6.2 Recommendations

To maximize achieving sustainable operation of community scale water supply systems, it is recommended that a lot of investment is made to support a range of capacity building activities targeted at all beneficiaries. Capacity building activities at the village/community scale need to be focused on empowering beneficiaries to gain a sense of ownership and responsibility for operating and managing their water supply projects. Secondly, there is the need to revise the Water Safety Regulations, and enforcement of the related regulations. Furthermore, the government of Ghana should adopt economic instruments like water pricing, waste water charge, waste water emission trade and quotas to Solve Social Problems on Water. Lastly, the study recommended the need to blend old way of Water Management with Modern Knowledge, provision of PVC pipes, protected well and Mandatory Rain Harvest, as well as encouraging community participation in the provision of safe water.

2.7 References

1. WHO. A commentary on recent water safety initiatives in the context of water utility risk management. *Environ Int*. 2006;32(8):958-966. doi:10.1016/j.envint.2006.06.001.
2. UN. *United Nations E-Government Survey 2010*.; 2008.
3. Swyngedouw E. UN Water Report 2012: Depoliticizing Water. *Dev Change*. 2013;44(3):823-835. doi:10.1111/dech.12033.
4. WHO. *Water Quality and Health Strategy 2013-2020*.; 2012.
5. Botting MJ, Porbeni EO, Joffres MR, Johnston BC, Black RE, Mills EJ. Water and sanitation infrastructure for health: The impact of foreign aid. *Global Health*. 2010;6(1):12. doi:10.1186/1744-8603-6-12.
6. Hamidu A, Rafaat H, Eddie B, Mark S. GIS Based Mapping and Analysis of Municipal Solid Waste Collection System in Wa, Ghana. *J Geogr Inf Syst*. 2015;7(April):85-94. doi:10.4236/jgis.2015.72008.
7. Gunnarsdóttir, M.J., and Gissurarson, L.R.2008.HACCP and water safety plans in Icelandic water supply: preliminary evaluation of experience. J. Water Health, 3(6): 377–382.
8. Byleveld PM, Deere D, Davison A. Water safety plans: Planning for adverse events and communicating with consumers. *J Water Health*. 2008;6(SUPPL. 1):1-9. doi:10.2166/wh.2007.019.
9. Prüss-Üstün A, Bos R, Gore F, Bartram J. Safer water, better health. *World Heal Organ*. 2008:53. doi:ISBN 9789241596435.
10. Dorea CC. Comment on " Emergency water supply: A review of potential technologies and selection criteria." *Water Res*. 2012;46(18):6175-6176. doi:10.1016/j.watres.2012.07.062.
11. Gleick P, Miller RW. The World's Water: The biennial report on freshwater resources 2002-2003. *Electron Green J*. 2003;(18). doi:Doi 10.1080/14486563.2012.677216.

12. Medema GJ, Payment P, Dufour a, et al. Safe Drinking Water : an Ongoing Challenge. *Helicobacter*. 2001:11-45. doi:10.1787/9789264099470-en.
13. Mahmud SG, Shamsuddin SAJ, Feroze Ahmed M, Davison A, Deere D, Howard G. Development and implementation of water safety plans for small water supplies in Bangladesh: benefits and lessons learned. *J Water Health*. 2007;5(4):585-597. doi:10.2166/wh.2007.045.
14. Dyck MG, Soon W, Baydack RK, et al. Reply to response to Dyck et al. (2007) on polar bears and climate change in western Hudson Bay by Stirling et al. (2008). *Ecol Complex*. 2008;5(4):289-302. doi:10.1016/j.ecocom.2008.05.004.
15. Gunnarsdóttir MJ, Gissurarson LR. HACCP and water safety plans in Icelandic water supply: Preliminary evaluation of experience. *J Water Health*. 2008;6(3):377-382. doi:10.2166/wh.2008.055.
16. Mayr, van der Ent RJ, Coenders-Gerrits AMJ, Nikoli R, Savenije HHG. The importance of proper hydrology in the forest cover-water yield debate: Commentary on Ellison et al. (2012) Global Change Biology, 18, 806-820. *Glob Chang Biol*. 2012;18(9):2677-2680. doi:10.1111/j.1365-2486.2012.02703.x.
17. Mullenger J, Ryan G, Hearn J. A water authority's experience with HACCP. In: *Water Science and Technology: Water Supply*. Vol 2. ; 2002:149-155.
18. Yang H, Bain R, Bartram J, Gundry S, Pedley S, Wright J. Water safety and inequality in access to drinking-water between rich and poor households. *Environ Sci Technol*. 2013;47(3):1222-1230. doi:10.1021/es303345p.
19. World Health Organization. Safe Drinking-water from Desalination. *World Heal Organ*. 2011;WHO/HSE/WS.
20. Wright JA, Yang H, Rivett U, Gundry SW. Public perception of drinking water safety in South Africa 2002–2009: a repeated cross-sectional study. *BMC Public Health*. 2012;12(1):556. doi:10.1186/1471-2458-12-556.
21. Yang H, Wright JA, Gundry SW. Water accessibility: Boost water safety in rural China. *Nature*. 2012;484:318-318. doi:10.1038/484318b.
22. Goldstein G, Bucci SJ, Scholz FG. Why do trees adjust water relations and hydraulic architecture in response to nutrient availability? *Tree Physiol*. 2013;33(3):238-240. doi:10.1093/treephys/tpt007.
23. Gill A, Williams P, Thompson S. 2009 Gill et al. Perceived water conservation attitudes and behaviours in second-home island settings. *Tour Hosp Res*. 2009;10(2):141-151. doi:10.1057/thr.2009.35.
24. Summerill C, Pollard SJT, Smith JA. The role of organizational culture and leadership in water safety plan implementation for improved risk management. *Sci Total Environ*. 2010;408(20):4319-4327. doi:10.1016/j.scitotenv.2010.06.043.
25. Martin-Moreno JM, Llinás G, Martínez-Hernández J. Response to "MacIntyre et al., 2014: Respiratory protection for healthcare workers treating Ebola virus disease (EVD): Are facemasks sufficient to meet occupational health and safety obligations?" *Int J Nurs Stud*. 2014;51(12):1693. doi:10.1016/j.ijnurstu.2014.10.005.
26. Who, Unicef. Progress on sanitation and drinking-water - 2014 update. … *Monit Program water supply Sanit* …. 2014:1-78. doi:978 92 4 150724 0.
27. Harbaugh, Arlen W. MODFLOW-2005 , The U . S . Geological Survey Modular Ground-Water Model — the Ground-Water Flow Process. *US Geol Surv Tech Methods*. 2005:253.
28. Zimmer and Hinkfuss. What youth know about water safety. *New Zeal Phys Educ*. 2007;40(2):15-18.
29. Lee J, Mubeen S, Ji X, Stucky GD, Moskovits M. Plasmonic Photoanodes for Solar Water Splitting with Visible Light - Lee et al. - Unknown - 2012.pdf. *Nano Lett*. 2012;12(9):5014-5019. doi:10.1021/nl302796f.
30. Mayr, Simon N, Tibshirani R. Comment on "Detecting Novel Associations in Large Data Sets" By Reshef Et Al, Science Dec 16, 2011. *Cornell Univ Libr*. 2011;(2009):1-3. doi:10.1126/science.1205438.
31. Sarpong (2005), Customary Water Laws and Practices: Ghana.
32. Viljoen FC. The World Health Organization's water safety plan is much more than just an integrated drinking water quality management plan. *Water Sci Technol*. 2010;61(1):173-179. doi:10.2166/wst.2010.792.
33. Qu X, Alvarez PJJ, Li Q. Applications of nanotechnology in water and wastewater treatment. *Water Res*. 2013;47(12):3931-3946. doi:10.1016/j.watres.2012.09.058.
34. Dyck A, Exner M, Kramer A. Experimental based experiences with the introduction of a water safety plan for a multi-located university clinic and its efficacy according to WHO recommendations. *BMC Public Health*. 2007;7(1):1-14. doi:10.1186/1471-2458-7-34.

35. Gilbraith N, Jaramillo P, Tong F, Faria F. Comments on Jacobson et al.'s proposal for a wind, water, and solar energy future for New York State. *Energy Policy*. 2013;60:68-69. doi:10.1016/j.enpol.2013.05.006.
36. Hrudey SE, Conant B, Douglas IP, et al. Managing uncertainty in the provision of safe drinking water. *Water Sci Technol Water Supply*. 2011;11:675. doi:10.2166/ws.2011.075.
37. Onda K, Lobuglio J, Bartram J. Global access to safe water: Accounting for water quality and the resulting impact on MDG progress. *Int J Environ Res Public Health*. 2012;9(3):880-894. doi:10.3390/ijerph9030880.
38. Food and Agriculture Organization. *FAO/WHO Regional Conference on Food Safety for Africa*.; 2005.
39. Johnston D, Leader T, Sanitation E. Factsheet on water and sanitation. *Water Life*. 2005;(July).
40. WHO. WHO | Heterotrophic plate counts and drinking-water safety: The significance of HPCs for water quality and the human health. Drinking Water Quality. doi:10.2166/9781780405940.
41. Water Aid. Water for Life: The Impact of the Privatization of Water Services on Child Mortality. *J Polit Econ*. 2005;113(1):83-120. doi:10.1086/426041.
42. Oecd W& Water Aid. Assessing Microbial Safety of Drinking Water. *J Appl Microbiol*. 2002;85:429-440. doi:10.1016/S0048-9697(04)00275-X.
43. Rogers P, De Silva R, Bhatia R. Water is an economic good: How to use prices to promote equity, efficiency, and sustainability. *Water Policy*. 2002;4(1):1-17. doi:10.1016/S1366-7017(02)00004-1.
44. Water N, Strategy R, Edition F. National Water Resource Strategy, First Edition, September 2004. *Water Resour*. 2004;(September):55-135.
45. Bebbington P. The World Health Report 2001. *Soc Psychiatry Psychiatr Epidemiol*. 2001;36(10):473-474. doi:10.1007/s001270170010.
46. Shiklomanov I. World fresh water resources. *Water Cris a Guid to world's fresh water Resour*. 1996:13-24.
47. Boadu FO. Policy on private water sales in rural Ghana. *J Water Resour Plan Manag*. 1994;120(6):944-961. doi:http://dx.doi.org/10.1061/(ASCE)0733-9496(1994)120:6(944).
48. Davidson JS. United Nations Convention on the Law of the Sea Act 1996. *Int J Mar Coast Law*. 1997;12(3):404-412. doi:10.1163/15718089720491594.
49. Huat BBK, Ali FHJ, Low TH. Water infiltration characteristics of unsaturated soil slope and its effect on suction and stability. *Geotech Geol Eng*. 2006;24(5):1293-1306. doi:10.1007/s10706-005-1881-8.
50. Ieronutti L, Chittaro L. A virtual human architecture that integrates kinematic, physical and behavioral aspects to control H-Anim characters. *Proc tenth Int Conf 3D Web Technol Web3D 05*. 2005;1(1):75. doi:10.1145/1050491.1050502.
51. Akerlof (2003). Reasons for Water Starvation in the Northern Region of Ghana. Daily Guide: 14-17
52. UNICEF and World Health Organization 2011. Drinking Water Equity, Safety and Sustainability: JMP Thematic Report on Drinking Water 2011. *WHO Chron*. 2011;29(2):208-214.
53. WHO. *Guidelines for Drinking-Water Quality: Surveillance and Control of Community Supplies*. Vol 1.; 1997. doi:10.1016/S1462-0758(00)00006-6.
54. Gyau-Boakye P. Water and Sustainable Development in Ghana. *Water Int*. 1999;24(April 2014):189-195. doi:10.1080/02508069908692161.
55. AL-HMOUD RB, EDWARDS J. A Means to an End: Studying the Existing Environment for Private Sector Participation in the Water and Sanitation Sector. *Int J Water Resour Dev*. 2004;20:507-522. doi:10.1080/07900620412331319153.
56. Amanuma K. Trend of international safety standards. In: *Proceedings of the SICE Annual Conference*. ; 2007:2901-2905. doi:10.1109/SICE.2007.4421485.
57. WHO. Water Safety Plan Manual: Step-by-step risk management for drinking-water suppliers. *WHO Libr*. 2009:108. doi:10.1111/j.1752-1688.1970.tb00528.x.
58. Dicksons*: Local Action for Global Goals, by Un-Habitat, 2003*. Vol 24.; 2004. doi:10.1023/B:ENVR.0000046453.60617.63.
59. Brick T, Primrose B, Chandrasekhar R, Roy S, Muliyil J, Kang G. Water contamination in urban south India: household storage practices and their implications for water safety and enteric infections. *Int J Hyg Environ Health*. 2004;207(5):473-480. doi:10.1078/1438-4639-00318.
60. Ericson JF. An evaluation of the OECD 308 water/sediment systems for investigating the biodegradation of pharmaceuticals. *Environ Sci Technol*. 2007;41(16):5803-5811. doi:10.1021/es063043+.

61. Essegbey G, Godfred F, Entsua-mensah RM, Engmann C. *Assessment of Community Water and Sanitation in Ghana*.; 2007.
62. Ltd H-ES. Republic of Ghana ,Ministry of Water Resources Works and Housing. *Natl RAINWATER Harvest Strateg Final Rep*. 2011;1:1-45.
63. Kanbur R. The New Partnership for Africa's Development (NEPAD) An Initial Commentary. *Cornell Univ*. 2001;1(October):1-14. doi:10.1080/0258934022014944352.
64. Whitfield L. Trustees of Development from Conditionality to Governance: Poverty Reduction Strategy Papers in Ghana. *J Mod Afr Stud*. 2005;43(4):641-664. doi:10.2307/3876322.
65. Wang B, Zhang Z. Water conditions monitoring system based on GPRS. In: *Proceedings of the International Symposium on Test and Measurement*. Vol 2. ; 2009:237-239. doi:10.1109/ICTM.2009.5413064.
66. Lewicki PP. Water as the determinant of food engineering properties. A review. In: *Journal of Food Engineering*. Vol 61. ; 2004:483-495. doi:10.1016/S0260-8774(03)00219-X.
67. Arnold G. Use of monetary wetland value estimates by EPA Clean Water Act Section 404 regulators. *Wetl Ecol Manag*. 2013;21(2):117-129. doi:10.1007/s11273-013-9283-9.
68. Levitt J. *Responses of Plants to Environmental Stresses. Vol. II. Water, Radiation, Salt and Others Stresses*.; 2002. doi:10.1016/0160-9327(81)90047-8.
69. World Health Organization. Heterotrophic plate counts and drinking-water safety. *Ed by J Bartram, J Cotruvo, M Exner, C …*. 2003:271.
70. Doe. International Performance Measurement & Verification Protocol: Concepts and Options for Determining Energy and Water Savings. *Handb Financ Energy Proj*. 2007;I(April):249. doi:DOE/GO-102002-1554.
71. Jayaratne A. Application of a risk management system to improve drinking water safety. *J Water Health*. 2008;6(4):547-557. doi:10.2166/wh.2008.061.
72. Davis P, Tagoe-Darko E, Mukuria A. Water, koko, and appetite: Complementary feeding practices in Kumasi, Ghana . *DHS Qual Res Stud No 6* . 2003.
73. Wwap. *The United Nations World Water Development Report 3: Water in a Changing World*.; 2009. doi:10.3390/w3020618.
74. McGuire MJ. Off-flavor as the consumer's measure of drinking water safety. In: *Water Science and Technology*. Vol 31. ; 1995:1-8. doi:10.1016/0273-1223(95)00448-V.
75. WHO. Global Advisory Committee on Vaccine Safety, 3–4 December 2009. *Wkly Epidemiol Rec*. 2010;85(5):29-36. doi:10.1016/S0140-6736(09)61877.
76. van Rensburg A. A framework for business process management. *Comput Ind Eng*. 1998;35(1-2):217-220. doi:10.1016/S0360-8352(98)00068-0.
77. Dawson DJ, Sartory DP. Microbiological safety of water. *Br Med Bull*. 2000;56(1):74-83. doi:10.1258/0007142001902987.
78. Gorchev HG, Ozolins G. WHO guidelines for drinking-water quality. *WHO Chron*. 2011;38(3):104-108. doi:10.1016/S1462-0758(00)00006-6.
79. UNDP. *Human Development Report 1995*.; 1995.
80. Gleick PH. Basic water requirements for human activities: meeting basic needs. *Water Int*. 1996;21(2):83-92. doi:10.1080/02508069608686494.
81. Gerba CP. The Role of Water and Water Testing in Produce Safety. In: *Microbial Safety of Fresh Produce*. ; 2009:129-142. doi:10.1002/9781444319347.ch7.
82. Asumadu-Sarkodie S, Rufangura P, Jayaweera Herath M, Owusu Phebe A. Situational Analysis of Flood and Drought in Rwanda. *Int J Sci Eng Res*. 2015;6(8):960-970. doi:10.14299/ijser.2015.08.013.
83. Asumadu-Sarkodie S, Owusu Phebe A, Rufangura P. Impact analysis of flood in Accra, Ghana. *Adv Appl Sci Res*. 2015;6(9):53-78. doi:10.6084/M9.FIGSHARE.3381460.
84. Boadi KO, Kuitunen M. Urban waste pollution in the Korle Lagoon, Accra, Ghana. *Environmentalist*. 2002;22(4):301-309. doi:10.1023/A:1020706728569.
85. Ratto A, Dutka BJ, Vega C, Lopez C, El-Shaarawi A. Potable water safety assessed by coliphage and bacterial tests. *Water Res*. 1989;23(2):253-255. doi:10.1016/0043-1354(89)90050-X.
86. Kessey K, Arko B. Small scale gold mining and environmental degradation, in Ghana: Issues of mining policy implementation and challenges. *J Stud Soc Sci*. 2013;5(1):12-30.
87. Yamazaki D, Trigg MA, Ikeshima D. Development of a global ~90m water body map using multi-temporal Landsat images. *Remote Sens Environ*. 2015;171:337-351. doi:10.1016/j.rse.2015.10.014.

88. Graham Tipple a, Korboe D. Housing policy in Ghana. *Habitat Int*. 1998;22(2):245-257. doi:10.1016/S0197-3975(98)00009-5.
89. Shiklomanov IA. Appraisal and Assessment of World Water Resources. *Water Int*. 2000;25(1):11-32. doi:10.1080/02508060008686794.
90. Opoku-Ankomah Y, Cordery I. Atlantic Sea Surface Temperatures and Rainfall Variability in Ghana. *J Clim*. 1994;7(4):551-558. doi:10.1175/1520-0442(1994)007<0551:ASSTAR>2.0.CO;2.
91. WHO. Silver in Drinking-water. *Guidel Drink Qual*. 1996;2:1-9.
92. Regulations T, Government N, Byelaws WS, Standards EC. *The Water Supply (Water Fittings) Regulations 1999*.; 1999.
93. Gleick P. Water in crisis: paths to sustainable water use. *Ecol Appl*. 1998;8(August):571-579. doi:10.1890/1051-0761(1998)008[0571:WICPTS]2.0.CO;2.
94. Zwart SJ, Bastiaanssen WGM. Review of measured crop water productivity values for irrigated wheat, rice, cotton and maize. *Agric Water Manag*. 2004;69(2):115-133. doi:10.1016/j.agwat.2004.04.007.
95. Jones PW. UNDP and educational development: An institutional policy analysis. *Int J Educ Dev*. 2006;26(6):605-617. doi:10.1016/j.ijedudev.2006.04.016.
96. Huang X-L, Shenker M. Water-Soluble and Solid-State Speciation of Phosphorus in Stabilized Sewage Sludge. *J Environ Qual*. 2004;33:1985-1903. doi:10.2134/jeq2004.1895.
97. Abascal JL, Vega C. A general purpose model for the condensed phases of water: TIP4P/2005. *J Chem Phys*. 2005;123(23):234505. doi:10.1063/1.2121687.
98. Granqvist M, Mattila J. The effects of turbidity and light intensity on the consumption of mysids by juvenile perch (Perca fluviatilis L.). In: *Hydrobiologia*. Vol 514. ; 2004:93-101. doi:10.1023/B:hydr.0000018210.66762.3b.