HOUSEHOLD ACCESS TO WATER AND SANITATION FACILITIES:

A CASE STUDY OF THE OFFINSO SOUTH MUNICIPALITY

BY

AKOSUA BOAKYEWAA ASIEDU

OCTOBER, 2012

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

COLLEGE OF SCIENCE

DEPARTMENT OF THEORETICAL AND APPLIED BIOLOGY

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DECLARATION

Candidate's declaration

I hereby declare that this dissertation is the result of my own original work and that no part has been presented for another degree in this University or elsewhere.

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ABSTRACT

Good water and sanitation promote good health and enhances national development. This study was conducted in Offinso South Municipality to investigate the challenges households faced in accessing good drinking water and sanitation facilities. The study depended on primary data collected from the field through questionnaire administration and secondary data from the Offinso South Municipal Assembly. Water samples were collected for three consecutive months from hand-dug well, pipe-borne water from GWCL, mechanised boreholes, spring and river for water quality analyses. The results revealed that only 29.9% of the households have access to pipe-borne water with greater majority (40%) depending on mechanised boreholes for drinking water. The low income earners spend more of their income on water (30%) than the high income earners (15%). The results also indicated that only 20% of the households have access to good sanitation in their homes whereas a greater majority of the household (80%) use pit latrine outside their homes. It is therefore recommended that the Municipal Assembly must focus on extending pipe-borne water to the communities and also educate households to provide toilets in their homes.

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LIST OF ACRONYMS AND ABBREVIATIONS

CBOs	Community Based Organizations
CDR	Committees for the Defence of the Revolutionary
cfu	Colony forming units
CWSA	Community Water and Sanitation Agency
GoG	Government of Ghana
GPRS	Growth and Poverty Reduction Strategy
GPRS	Committees for the Defence of the Revolutionary
GWCL	Ghana Water Company Limited
GWSC	Ghana water and Sewerage Corporation
IWA	International Water Association
KVIPS	Kumasi ventilated improved pits
LAC	The Latin, American and Caribbean
MDGs	Millennium development goals
NGOs	Non-Government Organisations
NTU	Nephelometric units
PURC	Public utilities regulatory commission
TNTC	Too numerous to count
UN	United nation
UNDP	United Nations Development Programme
UNFPA	United Nations Population Fund
UNICEF	United Nations Children Fund
WHO	World Health Organisation
WRC	Water resource commission
WUP	Water Utility partnership
VIP	Ventilated Improved Pit

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CHAPTER ONE

INTRODUCTION

Water is the essence of life. Safe drinking water and sanitation are indispensable to sustain life and health and fundamental to the dignity of all. Yet, worldwide 884 million people do not have access to improved sources of drinking water while 2.5 billion lack access to improved sanitation facilities (WHO, 2008). While these numbers shed light on a worrying situation, the reality is much worse, as millions of poor people living in informal settlements are simply missing from national statistics. The roots of the current water and sanitation crisis can be traced to poverty, inequality and unequal power relationships, and it is exacerbated by social and environmental challenges accelerating urbanization, climate change and increasing pollution and depletion of water resources (UNDP, 2006).

In order to address this crisis the international community has increasingly recognised that access to safe drinking water and sanitation must be considered within a human rights framework. The Millennium Development Goals (MDGs 7) put particular emphasis on the importance of improved coverage of water supply and sanitation and have a global target to reduce by half the proportion of people without sustainable access to safe drinking water and basic sanitation by the year 2015. For many countries in Africa, achieving the targets will entail various challenges and pose a continuous up-hill struggle. As a result of rapid growth in urbanization with increased rural urban migration and informal settlements, population growth, and growing poverty, African governments will need to be able to provide access to safe water to 210 million and sanitation to 211 million additional urban residents over the next 15 years (UNICEF/WHO, 2000). It is also estimated that almost 300 million Africans will be living in slums and informal settlements by the year 2020 (WUP, 2003). This implies that investments in water supply and sanitation would require injections of large amounts of capital (World Bank, 2004). Similarly with regards to the MDGs, UNICEF and WHO assert that if governments are to maintain current levels of water supply and sanitation provision, under the projected growth scenario, access to these services should increase by 10 million a year for a 10 year period.

Since the beginning of the 1980's, the government of Ghana has introduced a number of policy reforms in the water sector specially intended to improve efficiency in rural, urban and irrigation water, as well as attain some measure of environmental protection and conservation.

In 2002, following a series of broad consultations, a draft of Ghana Water Policy was prepared by the Water Resource Commission (WRC) under the auspices of the then Ministry of Work and Housing. With the establishment of water directorate, a wider consultative process was initiated in 2004 to update the policy. As part of the process, policies specific to urban water and community water and sanitation services were developed and incorporated. The policy objectives were to facilitate and improve access to potable water without discrimination; and to enhance the management and development of water resources in a manner which, as first priority safeguard that, the entire population particularly the poor and the vulnerable will have access to adequate and potable water.

1.1 PROBLEM STATEMENT

Despite the fact that water is an essential for life, and poor sanitation brings about diseases, access to improved water and sanitation facilities still remains a problem in many developing countries. About 50% of the developing world's population –about 2.5 billion people– lack improved sanitation facilities, and over 884 million people still use unsafe drinking water sources (WHO, 2008)

Majority of households in the Offinso-South Municipal Assembly in the Ashanti Region of Ghana lack access to safe drinking water sources and adequate sanitation facilities. The sources of drinking water in the District are mainly from boreholes, springs, wells, rivers and treated water supplied by the Ghana Water Company. Water supplied by the Ghana Water Company does not flow regularly, hence making the indigenes resort to alternative water sources. Women and children, especially girls, are the ones who suffer the burden of keeping wake to fetch water from these sources.

The sanitation situation is no different, many of the houses in the Municipality do not have toilet facilities, and these putting pressure on the few existing public toilets available. In the mornings, for example, there are long queues at these public toilets, so people who cannot wait for their turn to use the facility, defecate indiscriminately In the case of the refuse dumps, there are a few of them but these are not patronized by those who live far away from it. Refuse is dumped indiscriminately and this can be seen in the few drains available when it rains, and around the sources of their drinking water.

1.2 JUSTIFICATION

In both rural and urban areas of low income countries, millions of people lack access to improved water and sanitation services. The Offinso Municipality is no exception to this, in that there are few sanitation facilities and also the majority of the people do not have access to safe drinking water source. This research is therefore intended to provide baseline information to assess the performance of the Offinso Municipality in the Millennium Development Goals targets (Goal 7, target.3. Population and access to safe drinking water and basic sanitation)

It is hoped that the findings from the study will not only benefit the managers of Offinso Municipality but other districts with similar situations

1.3 OBJECTIVES

The main objective of this study was to investigate or assess the accessibility to improved water and sanitation facilities by households in the Offinso South Municipality. This is to be achieved through the following specific objectives:

i. To identify the type of water and sanitation facilities available in the area.

ii. To determine how far the facilities are from the household and how much it costs to access the facilities.

iii. To determine the quality or state of facilities available to the communities.

CHAPTER TWO

LITERATURE REVIEW

2.1 ACCESS TO WATER

Access to safe drinking water is a fundamental precondition for the enjoyment of several human rights, including the right to education, housing, health, life, work and protection against cruel, inhuman or degrading treatment or punishment. It is to eradicate discrimination. For example with regard to the right to education, where no toilet block is set aside for girls in education, parents will often not allow their daughters to attend school especially once they have started menstruating(UN-Water, 2009).

A household is considered to have access to improved water source if it gets drinking water primarily from a pipe borne water supply system, a public standpipe, borehole and dug well with pump, a protected spring, a well-developed rain water harvesting system, a reliable water vendor or water tank truck. Sources such as direct from surface waters –i.e. rivers, lakes, ponds, etc. and unprotected wells and springs are regarded as unimproved water sources. (UNICEF and WHO, 2008)

Worldwide, the percentage of people without access to treated water and sanitation has been virtually constant at about 17%, despite the increase of infrastructure during the 1990's (UNFPA, 2003a). Bremner and Bilsborrow (2005) pointed out that, given the population increase that will occur until 2015, the additional number of people to be served is in the order of 1.6-2.2 billion. What makes matters worse is that. if per capita consumption continues its current upward trend, about two thirds of the world population will face moderate or severe water scarcity. The Latin, American and Caribbean (LAC) countries are undergoing an intensive process of expansion of coverage for drinking water, according to WHO/UNICEF (2005). In 1990 coverage for drinking water was 83% and 89% in 2002. There is an important differential in terms of rural and urban distribution of access to water. According to Lenton (2003), in 2000 the urban population of the LAC region not served by improved water was only 6 million, compared to 34 million in rural areas. For sanitation, these numbers were 14 and 48 million, respectively. However, these numbers change dramatically once population change is taken into account. Due to the fact that all population growth in coming years will be urban, the need for providing water and basic sanitation in the cities actually exceeds that of rural areas. In urban areas, 121 million people will require improved water supply and 132 million improved sanitation, compared to 20 and 29 million, respectively, in the rural areas (UNFPA, 2003a). These projections are based on aggregate trends that do not take into account population growth in under-served urban areas that may be higher than in areas that already have adequate infrastructure. If this difference is factored in, then the urban requirements may even be higher, but to our knowledge, no such scenarios have been carried out so far (UNFPA, 2003).

According to International Water Association (IWA, 2004), "access to good, safe and reliable drinking water is one of the most basic needs of human society and as such requires integrated approach, close cooperation and partnership between all stake holders". Again, research has shown that access to good, reliable and sufficient water supply increases the health status of people. However, many people in the world today lack this basic need.

In 2000 Global Water Partnership observed that most countries give first priority to satisfaction of basic needs for water, one fifth of the world's population is without access to safe drinking water and the service deficiencies primarily affect the poorest segments of the population in developing countries. It goes on to say that: 'water supply and sanitation for both urban and rural areas in these countries represents one of the most serious challenges in the years ahead".

As the amount of water accessed every day is largely determined by the distance to the water source and the collection time, a reasonable distance is one that allows everyone to collect sufficient water to cover personal domestic uses. According to WHO, in order to have a basic access to 20liters per day, the water source has to be within 1,000 metres of the home and collection time should not exceed 30 minutes. When water is piped into the home, access is optimal and at least 100 litres per person per day is likely to be ensured. In this respect, UNDP confirms in its human development report 2006 that having a regular supply of clean water piped to the household is the optimal type of provision for human development. Access to a regular supply of water within the home also eliminates the need for women and children to spend time and physically exert themselves to collect water from distant sources.

2.2 ACCESS TO SANITATION

The UN millennium project defined basic sanitation as: Access to, and use of excreta and waste water facilities and services that provide privacy and dignity while at the same time ensuring a clean and helpful living environment both at home and in the immediate neighbourhood of users

An improved sanitation facility is defined as a facility used for excreta disposal whereby the human excreta are hygienically separated from human contact or their immediate environment, thus reducing the risk of faecal-oral transmission to its users. Facilities meeting this condition include:

-Toilet with sewer connection/septic tank

- Pour flush toilet/pour flush latrine to sewer, septic tank/ pit

- Ventilated improved pit (VIP) latrine and

- Latrine with a slab. (UNICEF and WHO, 2008)

Good sanitation is foundation for health that affords protection from a wide range of infection including diarrhoea, a leading cause of child deaths, yet 2.6 million people still do not have a safe means of excreta disposal at home (WHO and UNICEF, 2004). A target to have this number was added to the Millennium Development Goals in 2002. The enormity of the challenge, however, comes with the acknowledgement that public resources alone are unable to solve this global problem and new demand-oriented approaches are needed (Mehta and Knapp, 2004; WSSCC and WHO, 2005)

Lack of sanitation facilities compound the situation by contaminating water sources such as rivers as defecation along water banks introduces various helminth ova from infected person's excreta into the water bodies posing a serious public health problem. If sanitation is not provided within the home, privacy and physical security are also an issue. If there are no adequate sanitation facilities within the home, women and children often have to go to shared latrine or open spaces to defecate.

2.3 URBAN WATER SUPPLY AND SANITAITON IN GHANA

The main sources of water supply to urban areas of Ghana are conventional treatment plants where surface water is taken from rivers. Generally, ground water sources are limited to only a few areas in the forest zone. Historically, major feature of these treatment plants has been their inability to produce enough water to meet growing urban demand. The Ghana Water Sewerage Corporation was not able to provide efficient and effective services to urban population and the public became frustrated, some even losing faith in the company. The corporation faced a number of challenges. These included high rates of water loss through leakages (about 40 percent), the inability of the supply to meet rising demand, non and low revenue returns as well as vandalizing of water pipes and other facilities by people who were tapping water illegally (Osumanu,2008).

Over the past decade, attempts have been made to address the constraints to the sustainable development and management of Ghana's urban water supply and sanitation services. These interventions have mainly been targeted at streamlining the role, functions, and decisions – making processes within the water and sanitation sectors. The first of these initiatives was the urban water reform, which transformed the Ghana Water and Sewerage Corporation in 1999 into limited liability company – Ghana Water Company Limited (GWCL), as an initial step towards the introduction of private sector operation and management of urban supply system. As part of the reform the regulation of urban water has been shifted away from government to independent body, the Public Utilities Regulatory Commission is responsible for the protection of investment, operation and maintenance costs of the water supply to encourage private sector involvement. This policy also shifted responsibility for sanitation and wastewater management to impoverished local government.

Metropolitan/Municipal/District Assemblies which are responsible for sanitation were required to promote aggressively the construction and use of domestic latrines and enforce by -laws on the provision of sanitation facilities by landlords. The construction of public latrines was to be restricted to public places. Simplified sewerage systems were to be introduced for poor areas with high population densities as well as technological options for the installation of KVIPs (Kumasi Ventilated Improved Pits) in the poor areas with unfavourable terrain.

As part of the reform, a water sector rehabilitation project was put in place. Its purpose was to revamp the country's major urban water supply, to restore broken down smaller urban systems and to provide spare parts, plant and equipment to ensure sustainable operations. Subsequent to this project, a Water Sector Retracting Programme (2003- 2009) was implemented to increase urban water availability. Current attempts by the government to reform the water sector focuses on public – private partnerships in the form of management contract arrangements. The Ghana Water Company Limited (GWCL) entered into a management contract arrangement with Aqua Vitens Rand Limited (AVRL), a private company formed by a merger between Vintex of Holland and Rand Water Company of South Africa (contract now terminated), to operate urban water systems. These contracts were required that tariffs be structured so that cost recovery and therefore financial sustainability was ensured. Even though reform of the urban water system is still underway, it has not yet had much of the desired results, and it is anticipated to have a negative impact on the poor by restricting their access to clean water supplies as a result of high tariffs (Amenga, 2003).

Whilst attempts are being made to improve water supply, sanitation has largely been neglected, in most instances, sanitation facilities are almost nonexistent. Even in informal settlements where they have been provided by communities themselves, local authorities refuse to extend disposal services due to reasons that may relate to the legality of the settlement, overcrowding or a lack of recognition in the city development plans. Sanitation has received far less attention partly because of a legacy of under- investment in the sector. Services are still provided either publicly via the city– wide sewerage system combined with informal self provision at the local level, or through various mixes of public – private partnership which can range from contracting- out delivery and franchising through to joint venture with companies or co- production with beneficiary – communities and user groups.

Policy on sanitation has been particularly affected by the political implications of changes in modes of provision. Since the early 1990s, local assemblies have been trying to reduce dependence on public latrines and move towards household facilities mainly through supporting families to construct private latrines in their homes. Most funding for this initiative has come from external source. A major development in the sanitation sector was the UNDP/World Bank Water and Sanitation Programme which, in 1985, began subsidizing the installation of KVIPs as the cheapest and most acceptable way to provide household level sanitation.

Public toilets, upon which the majority of the population is dependent, continue to be an important element of overall sanitation provision. This is despite the fact that privatization policies have turned public toilets into crucial revenue earners for beneficiaries of the city government's political patronage networks. Public pit latrines were originally provided free by city government throughout the country. In the mid 1980s, the toilets fell under the control of local revolutionary committees; the Committees for the Defence of the Revolutionary (CDR) a move which was thought would bring a more dynamic approach to their management and maintenance. The CDRs were able to charge user fees as a reward for the maintenance of toilets. With the formation of elected Metropolitan Assemblies in 1989, management of toilets was decentralized to elected unit committees. However as with any other kind of service which provides a revenue the management of toilets became a source of conflict between CDRs and elected Assembly members as the former continuously blamed the later for inefficient management and refusal to pay monthly levies to local assemblies (Crook, 2002). To address these problems, toilet management and maintenance was formally privatized in 1994, on the basis that only registered local companied which had the requites capacity could be given contracts for installing and running public toilets which included a revenue sharing agreement. This reform did not however, take political arena as CDR leaders and assembly members formed companies to take on the contract.

More recently, the latest phase of the USEP (urban environment sanitation project) has been extending simplified sewage systems (SSS) from a few middle class housing estates to the densely populated areas with multi-occupied large housing blocks. The maintenance of these systems requires partnerships between the residents' associations and the city government. But there has been very little success in the pilot areas as it is difficult to get either landlords or groups of households to agree on contributing to the cost. Landlords want the city to ease rent controls before they will invest in the project. Although rent controls in Ghana are not very effective, they are meant to ensure rent uniformly in the informal housing sector and they are used to determine taxes payable by landlords on rent. Under the SSS landlords are required to bear the cost of acquiring the KVIPs but there have been attempts to shift this burden to tenants. Unsurprisingly, these attempts have been resisted. House owners are asking local authorities to ease rent controls to allow them to finance the constructions of KVIPs in their homes.

In 2006, 76% of household in urban areas of Ghana had access to portable water (defined as reliance on any source apart from well or natural sources). The proportion of urban household having access to adequate toilet facilities (a flush toilet or KVIP toilet) was 56 % (Ghana Statistical Service, 2007). Table 1 shows the trends in access to portable water and adequate sanitation in urban Ghana between 1991 and 2006. The large increase in sanitation provision between 1991 and 1999 is predominately due to the increase in the use of KVIP toilets. Accessibility to improved drinking water and sanitation in urban areas in 2008 was estimated to be 90% and 18% respectively, (WHO/UNICEF, 2010).

Of concern is that those likely to be deprived of improved water and safe sanitation are poor and vulnerable groups living in neglected communities – those least able to cope with it. As a result new approaches using community based micro – enterprise and community based joint ventures have emerged to provide water and sanitation for deprived urban communities. Many NGOs and CBOs are currently involved in several initiatives to improve urban water and sanitation provision in the country. Notable amongst these are Water Aid, Action Aid, Christian Aid and Integrated Social Development Canter (ISODEC). Several low income urban dwellers have gained access to improved water supply and sanitation through these organizations' scheme.

Table 1: Urban households with potable water and adequate sanitation, (GSS, 2007)

Year	Potable water	Adequate sanitation
1991/92	68%	16%
1998/99	69%	54%
2005/06	76%	56%

Today, there are also many other initiatives to improve urban water and sanitation provision in Ghana. However, the role of the informal sector is crucial. Residents of deprived urban communities depend on private water vendors and toilet operators. On the negative side, the provision of water by vendors is expensive, irrespective of whether they obtain water from Ghana Water Company Limited (GWCL) or tanker supplies. Generally household served by vendors pay higher charges for water than those directly connected to piped system. Beyond price considerations, water from vendors can be contaminated leading to health problems (WHO, 2004). The advantages are that it provides a valuable service for communities with no access to piped water. It saves a lot of time compared to fetching water from other sources. It also created jobs and the simple technologies used can be easily maintained at the local level.

Although the government of Ghana has incorporated the targets of the Millennium Development Goals (MDGs) in its Growth and Poverty Reduction Strategy (GPRS), the National Development Planning Commission, Ghana, reported in 2006 that it is highly unlikely that the country will come close to reaching these targets. According to the World Bank's Country Assessment report, to upgrade basic infrastructure in the urban water and sanitation sectors would require an investment of approximately US$75 million at today's cost, about US$80 per person. This situation presents daunting challenges to achieving the MDGs for Ghana. The importance of intervention by civil society, NGOs and CBOs to complement efforts by government to increase access to water and sanitation services in urban areas cannot therefore be over emphasized. Local action to improve urban water and sanitation provision is vital.

2.4 HISTORY OF WATER SUPPLY AND SANITATION IN GHANA

In 1928, the first piped water supply system was constructed at Cape Coast. The water supply Division of the Public Works Department was responsible for the service provision in the rural and urban areas of Ghana. After Ghana's independence in 1957, the division was separated from the Public Works Department and placed under the Ministry of Works and Housing. In 1965, it was transformed into Ghana Water and Sewerage Corporation (GWSC), a legal public utility responsible for the provision of rural and urban water supply for public, domestic, and industrial purposes as well as the establishment, operation, and control of sewerage system.

Since 1993, various reforms have been introduced to address the problem of the sector. The key objectives of the reforms were to separate rural and urban services, to introduce independent regulatory agencies, and to promote private sector participation (CWSA, 2004).

In order to pay more attention to water supply and sanitation in rural areas, the Community Water and Sanitation Division was founded as a semi-autonomous division of GWSC in 2004. Four years later, it changed its name to the Community Water and Sanitation Agency (CWSA) and became fully independent. In 1999, the GWSC was replaced by the publicly owned GWCL. At the same time, the responsibility for rural water supply and sanitation was decentralized to the District Assemblies (Water Aid, 2008). In addition, sanitation was separated from water supply and it became a responsibility of District Assemblies in urban and rural areas.

As a result, the GWSC remained responsible only for urban water supply, whereas more than 110 small towns' water system were transferred to District Assemblies, which receive support from CWSA. In terms of sanitation, District Assemblies are responsible in urban and rural areas (CWSA, 2004). In the latter case, a demand–driven and community-managed approach was introduced (UN, 2004).

The regulation of water supply has been shifted from the government to independent agencies. Two commissions were created in 1997 to regulate the sector. (CWSA, 2004) The Public Utilities Regulatory Commission (PURC) has been developed to formulate and approve appropriate pricing mechanism aimed at full cost in 2003. The PURC has no authority over community-managed water system and only regulates GWCL service. Besides the provision of tariff guidelines and the examination and approval of tariffs, it protects the interest of consumers and providers, promotes fair competition, and initiates, conducts, and monitors standards concerning the provided services.

When the PURC takes responsibility for economic regulation of urban water supply and sanitation, the Water Resource Commission (WRC) regulates water resource: it is in charge of licensing water abstraction and waste water discharge (Water Aid, 2007).

2.5 HOUSEHOLD WATER USE IN SUB-SAHARAN AFRICA

The right to water covers access to water ,to sustain life and health and to meet basic needs and does not entitle individuals to an unlimited amount of water. Access to 20-25 liters per person per day represents a minimum, but this amount raises health concerns because it is insufficient to meet basic hygiene and consumption requirements (Howard and Bartram, 2003). To WHO (1996) estimates that 20 litres of safe water per person per day is “the amount needed to satisfy metabolic, hygienic and domestic requirements”. On the average, 20 litres per person per day should be considered the minimum that is needed. Gleick (1998) estimates that, 25 litres per day is enough for personal consumption and sanitation. He also revealed that another 25liter per day is required for bathing and food preparation, producing a total daily requirement of 50 litres per person.

Lindskog and Lundqvist (1989), for example, observed an average daily per capita use of 9.7 litres before community taps were installed and 15.3 litres after the taps arrived. There is great variation, however, between countries, between, and even between households within the same village. White et al (1972), for example, came up with an average of 9.7 litres per person day, but with a range from 1.4 litres to 48.5 litres per person per day. Zimbabwe had an average per capita daily use of 48.2 litres in 1990, while in Mali the average per capita daily use was just 8 litres (Gleick, 1998).

Within villages, household size is one of the most accurate predictors of per capita water use. White et al (1972), and Lindskog and Lundqvist (1989) found that per capita use consistently decreased as the number of people in the household increased. In eastern Africa, households with 4-5 members averaged a little over 10 litres per person per day, while those with more than 12 members averaged just 7 litres per person per day. In Malawi, two-person households used at least 20 litres per person per day, while those with members never exceed 10 litres. While some of the difference can be attributed to economies of scale in domestic hygiene, a limit to the number of adult women available to carry water (often just one) is probably the main reason for the lower per capita use in larger households. Lindskog and Lundqvist

(1989) observe, "This means that water consumption per household varies much less than water consumption per capita."

2.6 THE COST OF COLLECTING WATER

Almost all water for household use in rural areas of sub-Saharan African is carried by women and girls, who often begin carrying small containers of water when they are very young children. When water for household use must be collected from a source away from the household, women and girls incur three kinds of cost viz. health damages and expenditure of energy resulting from the physical process of carrying water, and the economic cost of water.

2.6.1 Health Cost of Collecting Water

The health of women and girls who fetch water from a source away from the household is threatened in three general ways:

(i) by exposure to water-based diseases at the source (e.g. schistosomiasis) and diseases with insect vectors at or near the source;

(ii) by exposure to accidents, drowning, attack, and assault at and on the way to and from the water source; and

(iii) by skeletal injuries caused by carrying heavy loads repeatedly over long periods of time.

Dufaut (1988) provided a qualitative description of range of injuries that can result from carrying water on the head or back. Limitations of flexion and increased incidence of arthritis (degenerative rheumatism) appear to be the most common injuries from carrying water on the head.

2.6.2 Energy Cost of Collecting Water

Studies have revealed that carrying of water had a toll on the energy intake of women. In 1991 studies conducted by UNICEF in Tanzania revealed that about 10% of daily calorie intake was used for carrying water. This was confirmed by Mehretu and Mutambirwa in 1992.

2.6.3 The Economic Cost of Water

Traditional poverty measures focus on income, but the rural and urban poor may not only have lower incomes, they probably face higher costs for water than the better off. The lack of network water connections for the urban poor, or of any water service for the rural poor, typically leaves them buying from water vendors at high per liter prices or waiting in long queues at, or walking long distances to, public sources; and incurring additional costs for storing and boiling water.

2.7 WATER QUALITY ANALYSIS

Water is not only needed in quantity, its quality must be acceptable for the purposes for which it is required. The quality of water used by a community can have adverse effect on the health of the population, the environment and even the efficiency of industrial machinery. Water quality for portable use was evaluated on the basis of pH, turbidity, conductivity, total dissolve solvent, sulphate, total hardness, total alkalinity, iron, calcium, total and faecal coli forms.

2.7.1 Turbidity

Turbidity, which is caused by scattering of light by suspended particles in the water, is an indication of the concentration of undissolved substances in the sample. Suspended particles may or may not be harmful when ingested, the main concern being its aesthetic impact on the water; to be acceptable it should not exceed 5 Nephelometric units (NTU).

2.7.2 pH

The hydrogen concentration in water, which is measured as pH, is a very important parameter in water quality (Eaton et al., 1995). The WHO (1993) recommends a pH range of 6.5 – 8.5, either side of this range may be too corrosive for both potable use and, particularly, for equipment especially in water supply.

2.7.3 Electrical conductivity and Total dissolved solids.

Electrical conductivity (EC) is a measure of the ability of water to convey electrical current as a result of the ionization of the dissolved salts. It is therefore an indication of the mineralization of water. Total dissolve solids (TDS) is a measure of the amount of dissolved solids in water, and it is known to affect taste, hardness, and cause corrosion. (Eaton et al., 1995)

2.7.4 Chloride and nitrate

Chloride is highly distributed in natural waters. Large amount of it acts corrosively on metal pipes and also gives a salty taste (WHO, 1987). Common sources of chloride ion in water are seawater and connate water. Natural water contain minute amount of nitrates, however, human waste and other activities of man – e.g. the use of fertilizers in farming can introduce considerable amount of nitrate to the ground water . When they are present in excessive amounts in drinking water, nitrates cause methemoglobinemia, especially among infants. (Theroux and Eldridge 1935 and Eaton et al., 1995)

2.7.5 Iron

Iron occurs in natural waters in the form of ferrous (Fe^{2+}) iron. Its presence is normally attributed to the dissolution of mafic minerals in rocks. It is considered an objectionable constituent of water because it converts to the insoluble ferric hydroxide precipitate when exposed to the air, and settles as rust- coloured silt thus staining clothes. Again, micro-organisms derive energy from the oxidation of iron thus depositing a slimy coating on pipes. (Theroux and Eldridge 1935)

2.7.6 Alkalinity

Alkalinity of water is defined as the acid- neutralizing capacity of water. The alkalinity of water is primarily a function of carbonate (Co_3^{2-}), Bicarbonate (HCO_3^{2-}) and hydroxide (OH-) content and is taken as indicator of the concentration of these constituents. Alkalinity measurement is used in the interpretation and control of water and waste water treatment (Eaton et al., 1995)

2.7.7 *Escherichia coli*

This species is a member of the group of faecal coliform bacteria. *Escherichia coli* has the important feature of being highly specific for the faeces of man and warm-blooded animals. For all practical purpose these bacteria cannot multiply in any natural water environment and they are, therefore, used as specific indicator for faecal pollution. They are generally distinguished from other thermo tolerant coliforms by the ability to yield a positive indole test within 24 hours at 44.5°C. More recently, *Escherichia coli* is also identified by possession of the enzyme β - glucuronidase. This hydrolyses the flurogenic substrate 4- methyl-umbelliferyl –β-D- glucuronide (MUG) with release of the fluorogen which can be observed in liquid media under ultraviolet light. (Eaton et al., 1995)

2.7.8 Coliform Bacteria (Total Coliforms)

The term ‘’coliform bacteria’’ refers to a group of Gram-negative bacteria which have a long history in water quality assessment. In outdated literature these bacteria go by all sorts of names, including coliforms. Some of the bacteria included in this group are of faecal origin, while other members may also replicate in suitable water environments. Recently, coliform bacteria are also indentified by their possession of the enzyme B-D galactosidase, which hydrolyses chromogenic substrates such as ortho-nitrophenyl-B-D galactopyranoside (ONPG), resulting in release of the chromogen and a colour change in liquid media. (Eaton et al., 1995)

The primary purpose of coliform tests is not to detect faecal pollution but to screen the general sanitary quality of treated drinking water supplies

2.8 BACTERIOLOGICAL EXAMINATION OF DRINKING WATER

Water is essential for all forms of life; it is indispensable in the maintenance of life on earth and also essential for the composition and renewal of cells. Despite of this, human beings are continuing to pollute water sources provoking water related illnesses (Ethiopian Federal MOH, 2004; WHO, 2008).

Diseases related to contamination of drinking-water constitute a major burden on human health. The most common and widespread health risk associated with water is microbial contamination. Up to 80% of sicknesses and diseases in the world are caused by inadequate sanitation, polluted water or unavailability of water. World Health Organisation (2006) reports that, approximately 60% of people in developing countries do not have access to safe drinking water, and only about 25% have any kind of sanitary facilities. Water may play a role of pathogens which are not faecal excreted. Contamination of a drinking water with a type of *Escherichia coli* known as O157:H7 can be fatal. Many microorganisms are found naturally in fresh and salt water (WHO, 1996; Amira and Yassir, 2011). The microbiological quality of drinking water has attracted great attention worldwide implied public health impacts (Amira and Yassir, 2011). Total and faecal coliforms have been used extensively for many years as indicators of determining the sanitary quality of water sources. Water born out breaks is the most obvious manifestation of waterborne diseases.

Microbiological examinations have several roles in the investigation of waterborne outbreaks. In Ethiopia over 60% of the communicable diseases are due to poor environmental health conditions arriving from unsafe and inadequate water supply. Frequent examinations of faecal indicator organisms remain the most sensitive way of the hygienic conditions of water. Faecal coliform has been seen as an indicator of faecal contamination and are commonly used to express microbiological quality of water and as a parameter to estimate disease risk. Most Portable Number (NPN) is a typical test for faecal coliform (Mengesha et al., 2004).

In 2007, 74% of Ethiopia's population lacked of safe drinking water; although urban coverage was around 80%, the majority of the population (89%) lives in rural areas, where most reports suggest that fewer than 12% have access to potable water. Even the Government's report that 19% of the rural populations have access to safe drinking water supplies is not good enough (Government of Ethiopia, 2007).

2.9 DRINKING WATER POLICY

One of the objectives of drinking water policy is to ensure accessibility to safe drinking water by low-income and peri-urban consumers. Two strategies are mentioned in the policy. One strategy is to adopt a tariff rate structure that provides an optimal benefit to consumers including low-income consumers. Another strategy is to encourage cooperation between GWCL and small-scale independent providers, rather than grant exclusivity to either party, to facilitate adequate and affordable provision of safe drinking water to un-served and underserved areas.

2.9.1 Ghana Water Company Limited Act

The Ghana Water Company Limited (GWCL), successor of the Ghana Water and Sewerage Corporation (GWSC) is the organization responsible for urban water supply delivery in Ghana. GWCL is a statutory corporation created by parliament under the Ghana Water and Sewerage Corporation 1965 (Act 310). GWCL is required to supply water to all the inhabitants in its catchment areas. However, GWCL is only able to serve about 60% of its potential customers.

2.9.2 Public Utilities Regulatory Commission

The Public Utilities Regulatory Commission (PURC) was established by the PURC Act, 1997, Act 538 to regulate the water and electricity services in Ghana (GoG, 1997). For water supply the mandate covers only urban water supply. PURC's key tasks include the following:

- Provide guidelines for setting rates for the provision of utility service.
- Protect the interest of consumers and utility service providers
- Monitor and enforce standards of performance for provision of utility services
- Promote fair competition among public utilities
- Initiate and conduct investigation into standards of quality of service given to consumers.

The Act also gives PURC the power to make regulations that are necessary for the implementation of its mandates. The commission has issued two regulations: the Public Utilities (Termination of Service) Regulations 1999. LI 1651 and Public Utilities (Complaints procedure) Regulation 1999, LI 1665.

2.10 ENVIRONMENTAL SANITATION POLICY

Environmental Sanitation Policy is essential factor that contribute to health, productivity and welfare of the people of Ghana. National Environmental Sanitation Policy (1999) seeks to define systematic approach and framework within which national resources can be used most efficiently.

The policy is aimed at developing a clean, safe and pleasant physical environment in all human settlement to promote the social, economic and physical well being of all section of the population. It comprises of a number of complementary activities including the construction and maintenance of sanitary structures, provision of sanitary services, public education, community and individual action, regulation and legislation.

The principal components of Environmental Sanitation include:

- collection and sanitary disposal of wastes
- storm water drainage
- cleansing of thoroughfares, markets and other public spaces

CHAPTER THREE

STUDY AREA AND RESEARCH METHODOLOGY

3.1 STUDY AREA

The Offinso South Municipal District is one of the 27 districts of the Ashanti Region; its capital is Offinso, about 24 km north of Kumasi, the Regional Capital (Map.1). The Municipality is dissected by the main trunk road from Kumasi to Tamale. This is part of the trans-Africa Highway, which serves as the main gateway to the Ashanti Region from the Northern Regions through to Accra, the National Capital.

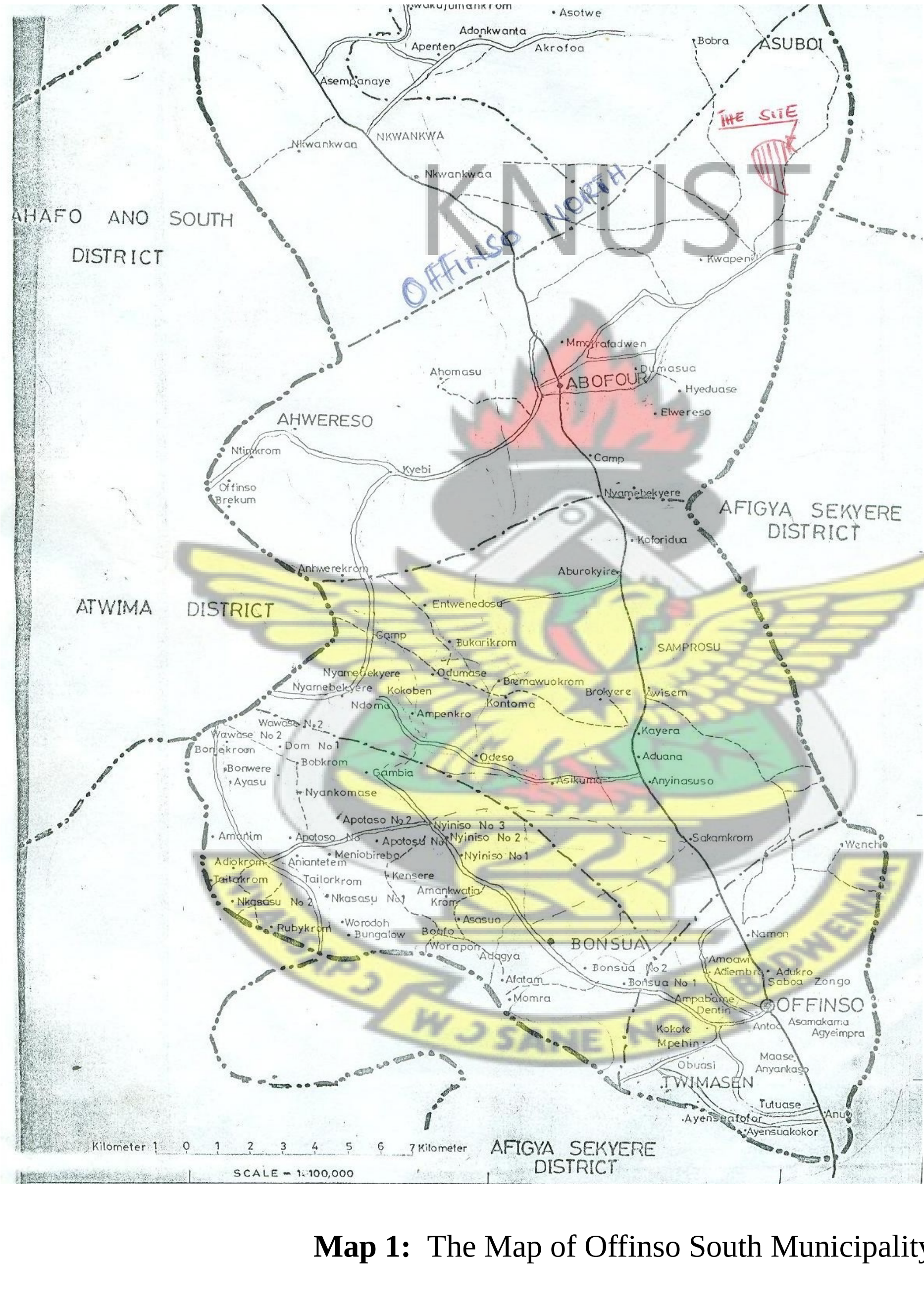
Offinso South Municipality is one of the new Municipalities created in Ashanti Region in 2007. It was part of the then Offinso District Assembly which was split into two -Offinso North District Assembly and Offinso South Municipal Assembly. It is located in the extreme north-western part of the Ashanti Region which lies between longitude 1˚ 65ʹW and 1˚ 45ʹE and latitudes 6˚ 45´N and 7˚ 25´S. The District covers an area of 1255km^2. One of the 26 districts in the region and about half of its boundary in the north and west is shared with the Brong Ahafo Region. It is also bordered in the east by Ejura-Sekyedumase District and in the south by Kwabre, Sekyere South, Ahafo-Ano South and Atwima-Nwbiagya Districts.

3.1.1 Demographic Characteristics

Based on the 2000 population census the population of Offinso South Municipal Assembly in 2010 was estimated at 120,585 with a growth rate of 3.5%. The high population growth rate of the Municipality can be attributed to in-migration as a result of favourable climatic conditions and fertile soil which supports the cultivation of diverse food and cash crops. The high in-migration may not encourage the retaining of capital in the Municipality but rather would flow outside to the detriment of the Municipality.

3.1.2 The Built Environment

Majority of the settlements do not have layouts and this has led to haphazard development. The only settlement that is well laid out is the Municipal capital, Offinso New Town; even here, building regulations are not strictly enforced and this is posing serious problems on the land use pattern.



Map 1: The Map of Offinso South Municipality

The housing environment in the Municipality, especially Offinso New Town and Abofour townships is characterized by poor drains, heaps of surface dumps, unkempt surroundings, exposed foundations due to pronounced erosion and cracked walls especially in the rural areas. About 85% of the population use public toilets such as KVIP and pit latrines; only about 6% of houses in the Municipality have internal toilet facilities.

About 90% of households use the public waste dump to dispose of solid waste. The remaining households throw wastes elsewhere, or result to burning. This can be seen in communities like Offinso New Town and Abofour. This has a very serious financial and health implication. The Assembly uses large sums of money for cleaning of gutters which could have been used for other development needs of the assembly.

The prominent method of liquid waste disposal is spilling in the open, bushes and in gutters. Indiscriminate disposal of solid and liquid waste tends to create filthy environments leading to the prevalence of avoidable diseases including malaria, typhoid fever, diarrhoea and cholera.

Potable water supply in the Municipality is highly inadequate. Apart from New Offinso which has access to pipe-borne water from GWCL, the other communities rely on boreholes and hand-wells, ponds and streams for drinking and domestic use.

Electricity coverage in the Municipality is about 53%. The Volta River Authority (VRA) and Electricity Company of Ghana (ECG) are responsible for power supply in the Municipality.

3.1.3 Household Size and Characteristics

The average household size in the Municipality is about 5.5, which is in conformity with the national average of 6; however, the quality of houses is below average. The composition comprises persons from the nuclear family, extended family and persons outside the extended families. Children constitute about 37% of the average household. Heads of household are mainly male; female heads are usually in households where they are either single or single parent household.

3.1.4 Health Facilities in the Municipality

The Municipality is served by 8 health institutions provided by both the public and private sectors. Table 2 shows the types of health facility, location and management in the Offinso Municipal area.

3.1.5 Water and Sanitation

The main sources of water supply in the Municipality are pipe-borne water from GWCL, rivers/streams, hand-dug wells, boreholes, rain water and ponds. New Offinso is the only community that has access to pipe-borne water supply; even here, the coverage is not extensive. In some parts of New Town, although there is provision for piped water supply, the water does not run continuously. The percentage of households that depend on boreholes is about 36%. The rest of the population depend on unprotected sources; water supply in the Municipality is therefore inadequate.

Sanitation in the Municipality is generally poor; this is characterized by lack of drains, unclear refuse disposal sites, unkempt surroundings and inadequate toilet facilities in both private homes and public buildings. Only 5% of the houses in the Municipality have toilet

Table 2: Health Facilities in the Municipality

Type of Facility	Location	Management
St. Patrick's Hospital	Maase/Offinso	Roman Catholic
Abofour Health Centre	Abofour	Government
Bonsua MCH/FP Centre	Bonsua	Government
Offinso MCH Centre	Dentin	Government
Quality Health Care Clinic	Adukro	Private
Anyinasuso SDA Clinic	Anyinasuso	Mission
CHPS Centre	Kwagyekrom	Government
Amoawi Clinic	Amoawi	Private

facilities. Use of public pit latrine and defecating in bushes and open spaces (i.e. free range), continue to receive frequent patronage. The distribution of toilet facilities in the Municipality is shown in Table 3. Even though solid waste collection in the Municipality is organised, there are no definite final disposal sites.

Table 3: Toilet facilities in the Offinso South Municipality

	Household				Public		
Zonal Council	**VIP**	**WC**	**Pit**	**Pan**	**KVIP**	**WC**	**Pit**
Offinso	463	353	15	10	10	13	16
Abofour	243	3	6	-	1	4	28
Samproso	62	-	-	-	2	-	29
Bonsua	-	-	-	-	1	-	28

3.1.6 Relief and Drainage

Topographically, the land is generally undulating. Low lying areas or plains exist in the Nkenkaasu-Afrancho area with elevations between 200 and 300 m above sea level. The Municipality is drained by the Offin, Anyinasusu, Ode, Pro Rivers and their tributaries; the drainage pattern is principally dendritic.

3.1.7 Climate and Vegetation

The Municipality experiences semi-equatorial and tropical conventional climates characterised by a bi-modal moderate to heavy rainfall pattern annually. The major rains start from April and lasts until July, and the minor from September to mid November. The mean monthly rainfall is highest (about 170 cm) in the south, and declines northwards to about 150cm. The relative humidity ranges from 70 - 72% in the dry season to 75 - 90% during the rainy season.

The vegetation of the District is mainly moist semi-deciduous forest, which is inter-spaced with thick vegetation cover. There are a lot of tall trees such as odum, wawa, cedar, etc. The Municipal has about 705 km^2 of land under forestry. This is made up of eight forest reserves namely the Afram headwaters, Afrensu-Borohoma, Asubina, Mankrug, Asufu West, Asufu East, Kwamisa and Opro River Forest Reserves.

3.1.8 Geology and Soil

The Municipality is underlain mainly by granitic rocks of the Kumasi batholiths, which have also weathered into large deposits of sand and clay. Sand winning and stone quarrying are some of the economic activities practiced in the Municipality.

The soils of Offinso Municipal are mainly residual that have developed over the parent rocks. The soils developed from the granite are Kumasi-Offinso, Boamang-Suko, Bekwai- Oda, Adujamso-Bechem associations; these soils are porous, red, well drained and are suitable for both tree and arable crops. The soils developed over the Voltaian and Birimian rocks also support similar vegetation; the area is therefore a well known farming community growing crops like cocoa, plantain, etc.

3.1.9 Aesthetic Features

The Municipal has a lot of sites of historical, scientific and aesthetic importance which have the potential of serving as tourist attractions. These sites include:

i. Abofour Virgin Forest and Asuboi Waterfalls;

ii. Kentaa rock (Onyina Siboso)

iii. Tutuase Shrine and Twumasen Caves

3.1.10 Conditions of the Natural Environment

The natural environment of the Offinso South Municipality has changed markedly due to human activities. The forests, rivers and soils, among others, have all been negatively impacted by human activities leading to land degradation. The slash and burn method in the shifting cultivation practices of farming and bush burning for other purposes leave the farm lands bare and exposed to sunshine and erosion. The method is also rapidly destroying the natural vegetation and altering the ecology of the Municipality; it has reduced most parts of the original dense evergreen forests to sparse secondary forests. Again, the use of wood and charcoal as the main source of domestic energy has also led to the depletion of the tree species; about 85% of households use firewood and charcoal for cooking. Lumbering and chainsaw operators also contribute immensely to the degradation of the original rain forest. Farming along river banks has resulted in rivers and streams drying out.

The extent of the degradation of the natural environment and its consequences on the natural resources such as land and water bodies cannot be over emphasized. The activities of the chainsaw operators have resulted in rapid depletion of economic trees; it is therefore very important to regulate these activities.

3.2 SAMPLING PROCEDURE

A survey was conducted across Offinso Municipality to collect and collate information on different types of water resources and sanitation facilities in the Municipality. A purposive random sampling was carried out among the various types of water resource and sanitation facilities making sure the exercise has about 80% coverage in the Municipality. In the collection of data, 106 people were interviewed with a structured interview questionnaire designed to elicit the information required (Appendix (F)).

3.3 METHOD OF WATER QUALITY ANALYSIS

Water samples were collected from five different sources viz. hand-dug wells, boreholes, piped bone water from GWCL, spring and river sources, for three consecutive months -February, March and April, 2012. From the individual water sources, 500 ml samples of water were collected with sterile bottles. These were stored in an ice chest and transported to the laboratory for quality analysis within 24 hrs. The water quality analysis was carried out at the Water Quality Assurance Unit of the GWCL in Kumasi. The laboratory is responsible for monitoring water quality for the Company in the Ashanti Region.

3.3.1 Bacteriological Analysis (Pour plate method)

Pour Plate Method: The method is simple to perform and can accommodate volume of sample or diluted sample ranging from 0.1 to 1.0 ml. The colonies produced are relatively small compact, showing fewer tendencies to encroach on each other than those produce by the surface growth. On the other hand, submerged colonies often are slower growing and are difficult to transfer.

Total coliform and Faecal Coliform: 500 ml of sample was aseptically collected in a sterile bottle; sample was stored in an ice-pack from sampling point to the laboratory for analysis. Each sample was inverted up and down for 10 times and a 1ml sterile pipette was used to take 1 ml samples into sterile Petri-dishes. 10 ml of molten Mconkey agar was poured over the sample in the dish. This was swirled up and down and back and forth for 10 times for even distribution of microbial population.

For the ***Total Coliform*** count the agar was allowed to settle at room temperature (ºC) and then incubated at 37ºC, while for the ***Faecal Coliform*** count it was incubated at 44ºC. The incubation was done in the Gallenkamph Economy Incubator for 24 hours. Growths on the plate were counted with the help of colony counter (Stuart Scientific colony counter); and results recorded as cfu/ml.

3.3.2 Physical Analysis

pH of the water samples were taken using 209pH meter (Hanna instrument); the pH meter uses a combined glass electrode which measures the (OH^-) and (H^+). Before each sample was tested, the probe was calibrated using laboratory box pH (pH: 4.01, 7.00 and 10.01). After calibration the probe was dipped into the beakers containing the water samples to be tested, reading taken and recorded

Conductivity is the measure of the amount of dissolved minerals in water; it is measured with the Jenway 4510 conductivity meter and calibrated using 0.01N KCl solution with a conductivity of 1412 µs/cm. After calibration the probe was inserted into the beakers containing the water sample and reading taken and recorded.

The **temperature** and total dissolved solids of the water samples were measured using Jenway 4510 conductivity meter following the same procedure above. Turbidity is measured by using Hach 2100p Turbidimeter. It was calibrated using Hach latex turbidity standards (0.1, 20,100 and 800NTU). After calibration the probe was inserted into the beaker containing the water samples, and reading was taken and recorded.

Colour: The colour of the water samples were tested using Hach Lang Spectrophotometer (DR 5000). It is self calibration. Tested method was selected (120). 1cm square cell was cleaned and 10 ml sample introduced. Spectrophotometer was zeroed with distilled water. After that, 1cm cuvette square cell was cleaned and 10ml sample introduced, and readings taken and recorded.

3.3.3 Chemical Analysis

Alkalinity: 50 ml of the water sample was measured into a clean Erlenmeyer flask and two drops of methyl orange indicator was added. The sample turned to yellow colour and titrated with 0.02N H_2S0_4. It was swirled gently until the colour changed from yellow to orange. The titre value (TV) was recorded, this is the endpoint of the titration and total alkalinity is calculated as:

$$\text{Total Alkalinity (CaCO3) mg/l} = \frac{V_A \times t \times 1000}{\text{Sample Volume}}$$

(Eaton et al., 1995)

Where V_A = ml standard acid used, and t = titre of standard acid, mg $CaCO_3$/ml.

Total Hardness: 50ml of the water sample was measured and added to 1ml of ammonia buffer was added. Few grams of the Eriochrome Black T indicator were added. The water sample was titrated against 0.01 N EDTA solutions. It was mixed gently until colour changes from red to blue. The titre value TV, was recorded and the concentration was computed using the formula:

$$\text{Total hardness mg/CaCO}_3 = \frac{A \times B \times 100}{\text{Sample}}$$

(Eaton et al., 1995)

Where A= titre value for sample

B= ml $CaCo_3$ equivalent of EDTA.

Calcium Hardness: 50 ml of the water sample was measured in Erlenmeyer flask. 1ml of IN NaOH solution was added. It was then titrated against 0.01M EDTA solution. It was mixed gently until the colour changes from pink to purple. The titre value Tv, was recorded and computed as follows:

$$\text{Calcium Hardness (mg/L CaCO}_3) \quad \frac{A \times B \times 100}{\text{Sample Volume}}$$

(Eaton et al., 1995)

Where A = titre value for sample

B = ml $CaCo_3$ equivalent of EDTAS

$$\text{Mg Ca}^{2+}/1 = \frac{A \times B \times 400.8}{\text{Sample Volume}}$$

Chloride: 50 ml of the water sample was measured into a clean Erlenmeyer flask.1 ml of 5% potassium chromate (K_2 Cr 0_4) was added as an indicator. It was then titrated against 0.0141N $AgNo_3$ solution. It was swirled gently until the colour changes from yellow to brick red. The titre value Tv was recorded the concentration was calculated using the formula:

Calculation:

$$\text{Cl (mg/L)} = \frac{(A - 0.2) \times N \times 35450}{\text{Sample Volume}}$$

$$\text{Cl (mg/L)} = \frac{(\text{A - 0.2}) \times 0.5 \times 1000}{\text{Sample Volume}}$$

(Eaton et al., 1995)

NB: 1ml of 0.0141N $AgNO_3$ solution = 0.5 mgCl-

Where A = titre value; N = normality of silver nitrate

Total Iron: 50 ml of the water sample was measured into a clean Erlenmeyer flask
The sample was acidified with 1 ml of 1:3 $HN0_3$ acid. About 1 ml 0.2N $KMn0_4$ solution was added in drop wise until a permanent pink colour was obtained. The sample was placed on a hot plate to evaporate to half the initial volume of the sample. The sample was allowed to cool to obtained room temperature and 2 ml of 10% ammonium thiocyanate solution was added
NOTE: The presence of iron in the sample will change the colour of the sample from pink to brown whilst a colour change from pink to colourless indicates the absence of iron in the sample upon the addition of the Ammonium Thiocyanate solution.

If iron was present, the sample was then topped up to 50 ml mark using distilled water. Blank was prepared using distilled water following the same procedure as above. The blank was then titrated against a standard iron solution comparing the colours until a matching colour to that of the sample is obtained. The titre value, Tv, which gives the matching colour was recorded.

CALCULATION

$$\text{Total Iron (mg/L)} = \frac{\text{TV} \times 0.05 \times 1000}{\text{Sample Volume}}$$

(Eaton et al., 1995)

Note: 1ml standard solution = 0.05 mg Fe

Nitrite: 50ml of each of the sample was measured into a clean Erlenmeyer flask

2 ml of Griess – Ilosays solution No. 1 was added. 2 ml of Griess – Ilosvays solution No. 2 was added, swirled gently and the mixture was allowed to stand for 15 minutes. The sample was transferred into a nesseler’s tube and the value of the matching colour using the nitrite disc and comparator was read.

NB: The marking on the disc represents the actual amount of nitrogen (N) present as nitrite.

$$N = \frac{\text{Disc Reading} \times 0.5}{\text{Sample Volume}}$$

Calculation (Eaton et al., 1995)

NO_2 (mg/L) = N (mg/L)*3.284

CHAPTER FOUR

RESULTS

4.1 GENERAL CHARACTERISTICS OF RESPONDENTS

4.1.1 Age of respondents

The age distribution of the respondents is shown in figure 1. 80% of the respondents aged between 21 and 40 years. Only 4% were above 50 years and 10% below 20 years

4.1.2 Marital status of respondents

Table 4 shows the marital status of the respondents. 55.7% of respondents were married and 3.8% had married before and 40.6% were singles.

4.1.3 Educational Level of respondents

Table 5 shows that 76.4% of the respondents had formal education and 23.6% had no education. 23% of the educated respondents had tertiary level education.

Figure 1: Age distribution of respondents

Table 4: Marital status of respondents

Marital Status	No. of Respondents	%
Married	59	55.7
Single	43	40.6
Divorced/ Separated	2	1.9
Widowed	2	1.9
Total	**106**	**100**

Table 5: Level of Education of respondents

Marital Status	No. of Respondents	%
No Education	25	23.6
Primary School	16	15.1
JHS / MSLC	14	13.2
Secondary (including Tech. And Vocations Institutions)	27	25.5

Tertiary	24	22.6
Total	**106**	**100**

4.2 ACCESS TO WATER SUPPLY FACILITIES

4.2.1 Distribution of Water point usage

The pie chart (figure 2) reveals that majority of the respondents (38.7%) have access to mechanised bore hole. This was followed by pipe borne water from GWCL (29.2%), protected hand dug well (21.7%), unprotected well (5.7%) and surface water (4.7%) in that order.

4.2.2 Water Quality Results.

The results of the water quality analysis are shown in Table 6. The ranking of the parameters indicated that pipe-borne water from GWCL had the best quality. This was followed by mechanized borehole, unprotected hand dug –well, unprotected spring and lastly river.

4.2.3 Level of education and water resources used by Households

Table 7 shows that more respondents in the educated category patronize pipe borne water and mechanised bore hole as source of water. However more respondents with little or no education patronize water from hand dug well and surface water.

4.2.4 Household income against expenditure on water

Table 8 shows household income against expenditure on water. 24% of the respondents get water free. 28% spend between 5 and 25 pesewas on a bucket of water, 42% spend between 30 and 50 pesewas and 11% spend over 50 pesewas.

4.2.5 Location of water sources and time taken to fetch water

Table 9 shows that 55.7% of the respondents get water from their neighbours' yard. and 0.94% from institutions. Majority of the respondents spend more than 41 minutes to fetch water.

4.2.6 Location of water point and average daily household water use

Table 10 shows that 22.7% of the respondents collect water from their own homes, 55.7% collect water from their neighbours and 21.7% from public places. 64% of the households use between 120 and 200 litres of water a day.

4.2.7 Level of education and average buckets used by household per day.

Table 11 indicates that, 3 out of 25 respondents without formal education use up to5 buckets and 20 out of 25 respondents use between 6 and10 buckets a day. On the contrary 14 out of 24 educated respondent use up 5 buckets a day and 7 out of 24 educated respondent uses between 6 to 10 buckets a day

4.2.8 Household water usage and time taken for collection

Table 12 is a cross tabulation of daily household water use and the time taken to collect the water. Eighty-three percent (83%) of the households spend between 41 and 60 minutes to collect 6 to 10 buckets a day.

4.2.9 Household total income per month and expenditure on water per day

Table 13 shows that, 17.9% of the respondents receive the lowest income of GH¢50.00 per month and 31% receive GH¢200 or more, 22.6% of the total respondents get water free. 26.4% spend between 5 and 25 GHp and 39.6% spend 30-50 GHp on water per day. Majority of those who spend between 5 and 20 GHp on water (39%) belong to the highest income bracket.

4.2.10 Household size against average buckets of water used by household per day

Table 14 shows that 73 out of 106 have a household size of between 4 - 6 persons. This is followed by the household size of 1 – 3 persons. Only 3 respondents have a household size of more than 10 persons. Those who use 6-10 buckets were in the majority and this was followed by those who use less than 5 buckets a day. Only 9 respondents use more than 10 buckets a day.

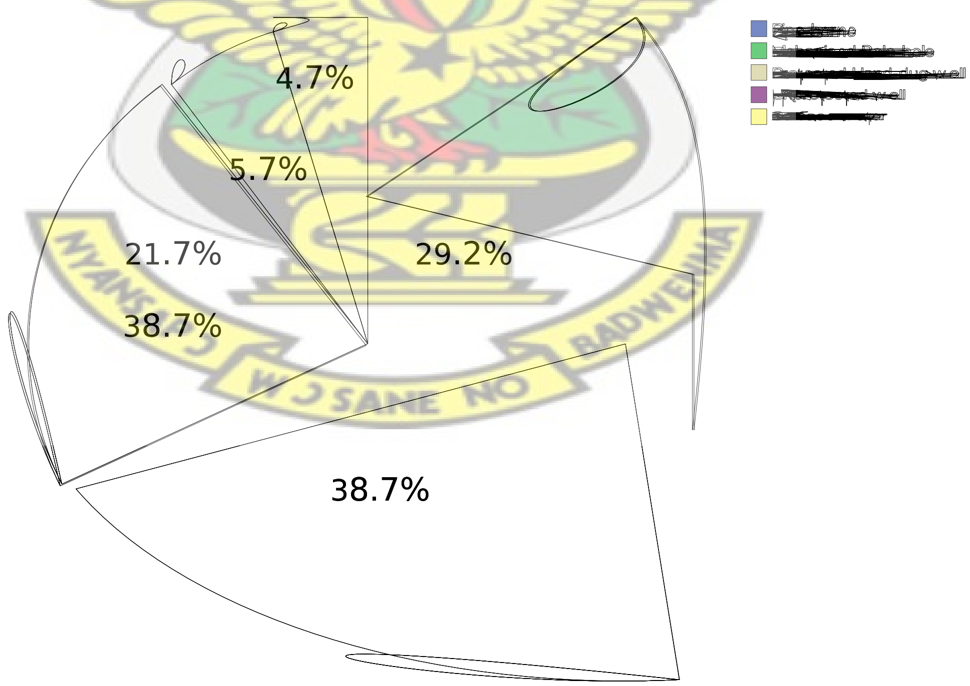


Figure 2: Distribution of water point usage in the Offinso South Municipality

Table 6: Average water quality results sampled from February to April 2012

Parameter	Unit	Unprotected Spring	River (Adukro)	Mech BH	GWCL Pipe	Unprotected HDW	Ghana Standards
pH		5.65	6.77	5.82	5.75	5.91	6.5-8.5
Colour	Hz	3.80	91.00	0.60	0.00	8.64	15
Turbidity	NTU	0.85	7.54	0.52	0.47	3.38	-
Conductivity	µs/cm	220.40	179.76	113.24	140.77	629.20	1000
TDS	mg/L	132.36	108.32	63.42	84.37	304.80	1000
Temperature	^0C	25.70	25.20	26.02	25.50	25.86	-
Total Hardness	mg/L	31.60	45.20	26.80	30.00	61.20	500
Ca Hardness	mg/L	14.80	27.20	18.00	26.00	46.60	-
Alkanity	mg/L	32.80	67.20	54.00	34.67	58.00	-
Chloride	mg/L	38.80	24.60	21.60	15.67	136.60	250
Nitrate	mg/L	0.01	0.02	0.01	0.00	0.03	3
Iron	mg/L	0.00	0.78	0.14	0.00	0.00	0.30
Total Coliform	Cfu/ 100ml	0.80	5.00	0.00	0.00	0.00	0
Faecal Coliform	Cfu/ 100ml	35.33	TNTC	6.25	0.00	11.75	0
WQ Ranking		**4**	**5**	**2**	**1**	**3**	**-**

NB

BH-Bore hole

HDW-Hand dug well

TNTC-Too numerous to count

Table 7: Levels of education and type of water resources

Levels of Education	Water sources used by household						
	Pipe-bo rne	Mech. BH	Protected HDW	Unprotected HDW	Surface water	Total	%
No Education	1	10	8	3	3	25	23.6
Primary	0	7	5	3	1	16	15.1
JHS/ MSLC	6	4	3	0	1	14	13.2
Secondary/Tech/ Voc/ Institute	11	10	5	0	1	27	25.5
Tertiary	13	9	2	0	0	24	22.6
Total	**31**	**40**	**23**	**6**	**6**	**106**	**100**

NB

BH-Bore hole water

HDW-Hand dug well

Table 8: Households income against expenditure on water

Households monthly income (GH¢)	**Monthly expenditure on water**						
	Free	**GH¢1-GH ¢5**	**GH¢6-GH ¢10**	**GH ¢11-GH ¢15**	**GH ¢16-GH ¢20**	**GH¢20+**	**Total**
0-50	8	2	3	5	0	1	19
51-100	7	1	3	7	5	3	26
101-150	4	4	2	5	0	1	16
151-200	2	1	5	3	1	0	12
200+	3	9	9	10	1	1	33
Total	**24**	**17**	**22**	**30**	**7**	**6**	**106**

Table 9: Location of water source used by households and time taken to fetch water

Location of water source used by surveyed household	Time taken to fetch water (min.)				Total
	1 - 20	21 - 40	41 – 60	Over 60	
In own house	13	6	0	5	24
In neighbors' house/yard	9	5	37	8	59
Public place	3	4	9	1	17
At an institution (mosque, church, school, etc)	0	0	0	1	1
Water vendor	1	0	1	3	5
Total	26	15	47	18	106

Table 10: Location of water points and average daily household water use

Location of water point used by household	Average amount of water per household per day (x 20 L)					Total
	1 – 5	**6 – 10**	**11 – 15**	**16 – 20**	**> 20**	
In own house	11	9	1	3	0	24
Neighbors' house/yard	15	40	2	1	1	59
Public place	3	14	0	0	0	17
Institution (mosque, church, school, etc)	0	1	0	0	0	1
Water vendor	0	4	0	1	0	5
Total	**29**	**68**	**3**	**5**	**1**	**106**

Table 11: Levels of education and average buckets of water used by household per day

Levels of education	Average buckets of water used by household per day					Total
	1-5	6-10	11-15	16-20	20+	
No Education	3	20	1	1	0	25
Primary	3	12	0	1	0	16
JHS/MSLC	3	9	2	0	0	14
Secondary School/SHS/ Tech/Vocational Institute	6	20	0	1	0	27
Tertiary	14	7	0	2	1	24
Total	**29**	**68**	**3**	**5**	**1**	**106**

Table 12: Household Water usage and Time taken for collection

Average buckets of water used by household per day	Time taken for collecting water (min)				**Total**
	1 - 20	21 – 40	41 – 60	Over 60	
1 – 5	16	5	6	2	**29**
6 – 10	7	8	39	14	**68**
11 – 15	1	1	1	0	**3**
16 – 20	1	1	1	2	**5**
Over 20	1	0	0	0	**1**
Total	**26**	**15**	**47**	**18**	**106**

Table 13: Households total income per month and expenditure on water per day

Household Monthly Income (GH¢)	Household expenditure on water per day (GHp)						**Total**
	Free	5 - 25	30 -50	55 – 75	80 - 105	Over 105	
0 – 50	8	5	6	0	0	0	**19**
51 – 100	7	4	10	2	3	0	**26**
101 – 150	4	5	6	0	1	0	**16**
151 – 200	2	4	6	0	0	0	**12**
Over 200	3	11	14	4	0	1	**33**
Total	**24**	**28**	**42**	**6**	**4**	**1**	**106**

Table 14: Household size against average buckets of water used per day

Household size	On average, how many buckets of water do your household use per day?					Total
	1-5	6-10	11-15	16-20	20+	
1 – 3	8	9	2	1	1	21
4 – 6	15	54	1	3	0	73
7 – 10	4	4	0	1	0	9
11 – 13	2	1	0	0	0	3
Total	29	68	3	5	1	106

4.3. ACCESS TO SANITATION FACILITIES

4.3.1 Types of toilet facility used

Table 15 shows that 65.1% of the 106 respondents use pit latrine, 31.9% use water closet and the remaining use other means.

4.3.2 User perception in terms of privacy and cleanliness

Table 16 shows that 25 of the respondents said private WC was either fair or good and 4 said it was poor. 4 of the respondents said public WC was their fair. 25 of the respondents said private latrine was either fair or good and 4 said it was poor. 30 of the respondents said public latrine was either fair or good and 5 said it was poor.

4.3.3 Hygienic Practices

Clean and adequate sanitation is vital in preventing the spread of water related diseases and essential for recovering from illness. Hygienic practices such as hand washing with soap, safe water storage, disposal of household and human water are all equally essential for all families. During the study, it was found that a total of 106 households, 80 (75.5%) reported that, they wash their hands without soap after visiting toilets. The rest of the respondents wash their hands with soap and water. It was observed that cleaning facilities were not available.

Table 15: Type of toilet facility used

Type of toilet facility	Frequency	Percent
WC	33	31.1
Pit latrine	69	65.1
Others	4	3.8
Total	106	100.0

Table 16: Type of toilet facility used against User perception in terms of privacy and cleanliness

Type of toilet facility	User perception in terms of privacy and cleanliness				
	Poor	Fair	Good	Not Applicable	Total
Private WC	4	14	11	0	29
Public WC	0	4	0	0	4
Private pit latrine	4	17	8	4	33
Public pit latrine	5	25	5	1	36
Others	1	1	2	0	4
Total	14	61	26	5	106

4.4. WATER QUALITY ANALYSIS

The result of the water quality analyses are presented in Table 18- 22.

Table 17: Assessment of water quality in the Offinso South Municipality on 1st February 2012

Srl.	Parameter	Unit	Unpro-tected Spring	River (Adukro)	Mech. Borehole	GWCL Pipe borne	Unprotect-ed HDW	Ghana Standard
1	pH		5.73	6.62	6.17	6.40	6.04	6.5 - 8.5
2	Colour	Hz	0.00	79.00	0.00	0.00	1.00	15.00
3	Turbidity	NTU	0.92	7.16	0.53	0.39	3.09	-
4	Conductivity	µs/cm	206.00	120.00	240.00	155.40	583.00	1000.00
5	TDS	mg/L	121.20	71.50	121.00	92.90	356.00	1000.00

6	Temperature	ºC	21.60	21.80	23.60	22.70	22.70	-
7	TSS	mg/L	0.00	1.00	0.00	0.00	1.00	-
8	Total Hardness	mg/L	24.00	18.00	14.00	32.00	44.00	500.00
9	Ca Hardness	mg/L	18.00	14.00	4.00	32.00	46.00	-
10	Alkanity	mg/L	12.00	56.00	42.00	36.00	50.00	-
11	Chloride	mg/L	45.00	17.00	19.00	22.00	138.00	250.00
12	Nitrate	mg/L	0.01	0.01	0.00	0.00	0.00	3.00
13	Iron	mg/L	0.00	0.90	0.00	0.00	0.00	0.30
14	Total Coliform	cfu/100ml	0.00	0.00	0.00	0.00	0.00	0.00
15	Faecal Coliform	cfu/100ml	TNTC	TNTC	2.00	0.00	1.00	0.00

Table 18: Assessment of water quality in the Offinso South Municipality on 6th March 2012

Srl.	Parameter	Unit	Unpro-tected Spring	River (Adukro)	Mech. Borehole	GWCL Pipe borne	Unprotect-ed HDW	Ghana Standard
1	pH		4.83	6.41	5.08	6.15	5.40	6.5 - 8.5
2	Colour	Hz	7.00	64.00	0.00	0.00	6.00	15.00
3	Turbidity	NTU	0.82	6.46	0.26	0.46	1.27	-
4	Conductivity	µs/cm	209.00	134.10	77.80	155.10	619.00	1000.00
5	TDS	mg/L	125.10	82.80	46.70	92.90	373.00	1000.00
6	Temperature	ºC	28.00	27.80	27.90	27.80	27.90	-
7	TSS	mg/L						-

8	Total Hardness	mg/L	24.00	42.00	26.00	50.00	62.00	500.00
9	Ca Hardness	mg/L	18.00	36.00	22.00	42.00	50.00	-
10	Alkanity	mg/L	40.00	60.00	48.00	42.00	64.00	-
11	Chloride	mg/L	41.00	34.00	20.00	18.00	130.00	250.00
12	Nitrate	mg/L	0.000	0.001	0.000	0.002	0.024	3.00
13	Iron	mg/L	0.00	0.60	0.00	0.00	0.00	0.30
14	Faecal Coliform	cfu/100ml	4.00	25.00	TNTC	0.00	TNTC	0.00
15	Total Coliform	cfu/100ml	0.00	0.00	0.00	0.00	0.00	0.00

Table 19: Assessment of water quality in the Offinso South Municipality on 22nd March 2012

Srl.	Parameter	Unit	Unpro-tected Spring	River (Adukro)	Mech. Borehole	GWCL Pipe borne	Unprotect-ed HDW	Ghana Standard
1	pH		4.99	6.32	5.26	4.70	5.00	6.5 - 8.5
2	Colour	Hz	2.00	169.00	0.00	0.00	5.20	15.00
3	Turbidity	NTU	1.09	11.40	0.96	0.56	8.01	-
4	Conduc-Tivity	µs/cm	225.00	290.00	81.40	111.80	555.00	1000.00
5	TDS	mg/L	134.80	173.50	49.00	67.30	331.00	1000.00
6	Tempera-Ture	°C	26.30	25.80	26.70	26.00	27.00	-
7	TSS	mg/L						-

8	Total Hardness	mg/L	30.00	46.00	10.00	8.00	40.00	500.00
9	Ca Hardness	mg/L	6.00	20.00	6.00	4.00	18.00	-
10	Alkanity	mg/L	22.00	62.00	30.00	26.00	26.00	-
11	Chloride	mg/L	27.00	18.00	16.00	7.00	110.00	250.00
12	Nitrate	mg/L	0.02	0.01	0.00	0.00	0.01	3.00
13	Iron	mg/L	0.00	0.00	0.70	0.00	0.00	0.30
14	Total Coliform	cfu/100ml	0.00	0.00	0.00	0.00	0.00	0.00
15	Faecal Coliform	cfu/100ml	TNTC	TNTC	10.00	0.00	30.00	0.00

Table 20: Assessment of water quality in the Offinso South Municipality on 5th April 2012

Srl.	Parameter	Unit	Unpro-tected Spring	River (Adukro)	Mech. Borehole	GWCL Pipe borne	Unprotect-ed HDW	Ghana Standard
1	pH		6.41	7.39	6.29		6.63	6.5 - 8.5
2	Colour	Hz	8.00	79.00	1.00		25.00	15.00
3	Turbidity	NTU	0.76	6.92	0.32		3.19	-
4	Conduc-Tivity	µs/cm	234.00	183.10	85.10		682.00	1000.00
5	TDS	mg/L	141.10	111.40	50.80		41.00	1000.00
6	Tempera-Ture	°C	27.00	27.70	27.20		27.80	-
7	TSS	mg/L						-
8	Total Hardness	mg/L	30.00	40.00	32.00		60.00	500.00

9	Ca Hardness	mg/L	10.00	28.00	28.00		53.00	-
10	Alkanity	mg/L	20.00	32.00	20.00		30.00	-
11	Chloride	mg/L	26.00	16.00	11.00		140.00	250.00
12	Nitrate	mg/L	0.02	0.06	0.04		0.10	3.00
13	Iron	mg/L	0.00	0.80	0.00		0.00	0.30
14	Total Coliform	cfu/100ml	0.00	0.00	0.00		0.00	0.00
15	Faecal Coliform	cfu/100ml	60.00	TNTC	13.00		16.00	0.00

Table 21: Assessment of water quality in the Offinso South Municipality on 26th April 2012

Srl.	Parameter	Unit	Unpro-tected Spring	River (Adukro)	Mech. Borehole	GWCL Pipe borne	Unprotect-ed HDW	Ghana Standard
1	Ph		6.31	7.12	6.28		6.48	6.5 - 8.5
2	Colour	Hz	2.00	64.00	2.00		6.00	15.00
3	Turbidity	NTU	0.66	5.75	0.54		1.32	-
4	Conduc-tivity	µs/cm	228.00	171.60	81.90		707.00	1000.00
5	TDS	mg/L	139.60	102.40	49.60		423.00	1000.00
6	Tempera-Ture	°C	25.60	22.90	24.70		23.90	-
7	TSS	mg/L						-
8	Total Hardness	mg/L	50.00	80.00	52.00		100.00	500.00

9	Ca Hardness	mg/L	22.00	38.00	30.00		66.00	-
10	Alkanity	mg/L	70.00	126.00	130.00		120.00	-
11	Chloride	mg/L	55.00	38.00	42.00		165.00	250.00
12	Nitrate	mg/L	0.02	0.01	0.00		0.02	3.00
13	Iron	mg/L	0.00	1.60	0.00		0.00	0.30
14	Total Coliform	cfu/100ml	0.00	0.00	0.00		0.00	0.00
15	Faecal Coliform	cfu/100ml	46.00	TNTC	TNTC		TNTC	0.00

CHAPTER FIVE

DISCUSSIONS

5.1 GENERAL CHARACTERISTICS OF RESPONDENT

5.1.1 Gender and Age of Respondent

The Offinso community is nearly equally represented with respect to gender –i.e. 52% and 48% of the 106 randomly selected were females and males respectively Figure 1 shows that the age distribution of the respondents is skewed towards the youthful group –i.e. 20 to 40 years- who constitute almost 80% Less than 4% are above the age of 50. Since the respondents were selected randomly the Offinso population is generally a youthful community.

The survey also revealed that about 3 in 5 (59.5%) of the respondents are married (55.7%) or were married before (3.8%). This means that household accessibility to water would be very important to them. The details of the marital status are shown in Table 4

.5.1.2 Educational Level of Respondents

The survey showed that 76.4% of the respondents have had formal education at least up to primary school and 23.6% have had no education at all (Table 5).This shows that the knowledge of the people on potable water and good sanitation was not in doubt

5.2 ACCESS TO WATER SUPPLY FACILITIES

5.2.1 Type of water resource

. Mechanized borehole is the most readily available point source of water in the area (Figure 2. Even though respondents would prefer the pipe-borne water from GWCL, its point sources are limited to a few places and not readily available to the poor. However, what is significant is that some households (4.7%) still rely on untreated surface water for their domestic needs. Apart from the sample from the Ghana Water Company Limited all the other sources had quality problems..

5.2.2 Level of Education and Water Sources Used by Household

There appears to be a clear correlation between the level of education and the quality of water that respondents use. Those with tertiary education will not want anything to do with surface water and unprotected hand-dug wells. In spite of the relative abundance of mechanized public boreholes majority of the educated elite use the GWCL treated pipe borne water. Conversely, those with education up to primary school (i.e. including those with no education) were least bordered about their source of water. This could be a case of affordability, but it does not appear to be fully supported.

5.2.3 Households income against expenditure on water

The study revealed that respondents with high income spend less on water per month as compared to those with low income. For instance respondents who earn above GH¢200 spend 7.5% of their total income on water per month whiles those who earn the least (GH¢50.00) per month spend about 30% of their total income on water per month. According to UNDP, (2006), water and sanitation services must be available and affordable for everyone especially the poor. The cost of water and sanitation service should not exceed 5% of household's income."The revelation above seems to suggest that the poor in the Municipality do not get access to water as water takes more than 5% of their income.

5.2.4 Location of water sources and time taken to fetch water

Table 9 shows that those who collect water from their own homes spend less than 20 minutes to fetch water and those who collect water from their neighbours' houses spend over 40 minutes to fetch water. This is expected since those who collect water from their neighbours have to walk some distance to fetch the water or may have to queue for the water.

5.2.5 Location of Water Point and Water Usage

The study revealed that majority of those who collect water from their own homes do not collect more than 5 buckets a day but those who collect water from their neighbors collect between 6 and 10 buckets. The reason for this situation is not clear. Presumably those who fetch water from their own homes do not calculate the quantity of water they collect a day.

5.2.6 Level of education and average amount of water per household per day

The results showed that majority of the educated people use less water than the uneducated or those with low education. This is expected since the highly educated people are more prudent in their approach to doing things.

5.2.7 Household Water usage and Time taken for collection

Table 12 showed that, those who collect 5 buckets spend less than 20 minutes and have water in their homes. Those who use 6-10 buckets spend more than 40 minutes and collect water from their neighbours'homes Those who have water in their homes will naturally face less or no competition from other users than those who collect water from their neighbors' homes.. Therefore the result is expected.

5.2.8: Household's total income per month and expenditure on water per day

Table 13 revealed that those in low income category spend higher percentage of their income on water as compared to those higher income brackets. Access to water is a problem for those in low income brackets according to UNDP standards.

5.2.9: Household size against average buckets of water used by household per day

Table 14 shows that household sizes 4 - 6 and 1- 3 were the two dominant household sizes in the community. Whereas 43% of household size 1 – 3 used more than 5 buckets a day, 74%

of household size 4-6 used the same quantity. It can therefore be deduced that household size 4-6 use more water than household size 1-3

5.3. ACCESS TO SANITATION FACILITIES

The study revealed that even though all the respondents had access to sanitation facilities only 20% had access to water closet toilet which is regarded as the safest sanitation facility. Majority of the households in the community use sub-standard sanitation facilities.

5.4. WATER QUALITY ANALYSIS

The result of the water quality analyses are presented in Tables 17- 21.

5.4.1 River

The pH of the river water changed with the time of analysis. From February to March, 2012 the values were 6.62 and 6.4 respectively but it rose to 7.3 in April, 2012. This indicates that the river water was slightly acidic during the dry season and slightly alkaline during the onset of the rains. The colour of the river sample increased from 79Hz in February to 116.5Hz in March and dropped to 71.5Hz in April. This is above the interim guideline limit set by WHO (1993) for drinking water. The presence of colour in water may be due the presence of iron, humus and peat material, plankton and weeds in the water. The turbidity values were 7.16 mg/L, 8.93mg/L, and 6.34 mg/L for the months of February, March, and April respectively. This may be due to the presence of particulate matter such as clay or silt, finely divided organic matter, plankton or other microscopic organisms. These cause light to be scattered and absorbed rather than transmitted in straight lines through the sample. Also, turbidity may impart a brown or other colour to water and may interfere with light penetration and photosynthesis reaction in the river. The presence of iron in water has got little concern as a health hazard but it still considered as a nuisance in excessive quantities. Long time consumption of drinking water with high concentration of iron can lead to liver disease (hemosiderosis). It promotes the growth of iron-bacteria. This gives a rusty appearance to the water. Colonies of these bacteria may also form a slime which causes problems in water closets, pipes, pumps and distribution systems.

The other physico-chemical parameters were within WHO guidelines for drinking water.

The bacteriological results of the river sampled revealed a high faecal coliform contamination. This may due to human and animal wastes

5.4.2 Spring

. The pH of the water was 5.73 in February, 2012 dropped to 4.91 in March, 2012 and shot to 6.36 in April, 2012. This indicates that the spring water was acidic at the end of the dry season and onset of the rain. The colour of the spring averaged between 0 to 5 Hz. This figure was below 15Hz which is the interim guideline set by WHO (1993) for drinking water. This may be attributed to the absence of iron in the spring water. The turbidity of the spring water increased from 0.98 in February to 0.98 mg/L in March and dropped to 0.71 mg/L in April. This may be due to the fact that, soil and plant particles entering the spring from runoff and bank erosion was minimal. There was no presence of iron in the spring water during the period of analysis. The other physico-chemical parameters were within WHO (1993) guidelines for drinking water. The bacteriological quality was however, generally poor, which indicates the spring water may be receiving sewage effluent

5.4.3 Hand-dug well

The results revealed that the physico-chemical parameters were within WHO (1993) guideline values. However, the bacteriological quality was generally poor.

Analysis of unprotected well demonstrated that all the samples were contaminated by faecal coliform, which is E. coli. This means that the well is receiving sewage effluent. The well was dug by hand and lined with blocks. The well has large opening and casings that are not well-sealed. This makes it easy for insects, rodents or animals to enter.

5.4.4 Mechanised bore-hole

The pH of the mechanised bore-hole ranged between 5.17 and 6.29. This may due corrosion of metals was to build the pump. The values of colour ranged from 0 to 2Hz. From February to March, 2012 the level of colour was zero. During the onset of rains, the colour level rose from 1 to 2Hz and this may be attributed to seepage. The turbidity values were 0.53mg/L and 0.61 mg/L in February and March respectively. It dropped to 0.43 in April mg/L. This may be due to the presence of sand and clay in the water. The values for iron values were 0 mg/L and 0.7 mg/L. The presence of Iron in water may be due the corrosion of the metals. The results indicate of the other physico-chemical parameters fall within the WHO (1993) standards.

Generally, the bacteriological qualities of the mechanised bore-hole were noted to have fairly high coliform organisms; it could be due to pollute from either public latrine or a refuse dump improperly sited.

5.4.5 Pipe-borne water

The results indicate that the physcio-chemical parameters and bacteriological quality of the pipe-borne water were satisfactory during the period of study. Pipe-borne water from GWCL was found to be the best among the sources studied as it met the Ghana standards.

Supply of water that poses no threat to consumer's health depends on continuous protection. Because of human frailty associated with protection, priority should be given to selection of the best sources. Polluted sources should not be used unless other sources are unavailable. Ensuring bacteriological quality of drinking water sources in vital to public health. On the other hand, regular monitoring of water quality should provide information on the level of the safety of the water. Frequent examination of faecal indicator organisms remain the most sensitive way of assessing the hygienic conditions of water (WHO, 2003).

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1 CONCLUSIONS

Increased access to clean water and sanitation form an integral part of Ghana's economic development and poverty reduction policy. Despite the increased support provided to the sector, there are many people still depending on unsafe drinking water source, especially in the rural areas of the country.

The study revealed that 29.9% have access to safe drinking water. The major source of water in the Municipality was the borehole with about 40% of the population patronizing it. On the average the households use between 41 and 60 minutes to collect 10 buckets a day which costs about GH¢15 a month. The low income earners spend more than 5% of their income on water which is above the UNDP recommendation. It also showed that those with high levels of education use water more judiciously.

With regard to sanitation, 20% have access to good sanitation. Over 50% of the population use the pit latrine which is sited outside their homes and about 3% of the population patronize free range or open system. Also, about 30% have WC at their disposal.

The laboratory analysis on water samples available to the Municipality revealed that with exception of pipe borne water from GWCL, the other sources had unacceptable levels of faecal coliform.

6.2 RECOMMENDATIONS

The following suggestions may be useful in achieving more efficient provision of water and sanitation supply in Offinso South Municipality as well as in the entire country

1. GWCL should conduct periodic bacteriological appraisal of drinking water source
2. The Municipal Assembly must focus on providing pipe-borne water to the people.
3. The Municipal Assembly should educate and encourage landlords to provide toilets in their homes
4. The Municipal Assembly should intensify education on environmental hygiene to discourage people from defecating outside.

5. Donor nations and institutions should continue to support the developing countries like Ghana, with funds, expertise and other logistics to help meet the water supply and sanitation needs of the populace.
6. The nation should work harder towards the achievement of MDGs.
7. Making water and sanitation services accessible should be a core responsibility of both national and local governments but not be considered as one target of MDGs.
8. Government should ensure that tariff levels and structures benefit all consumers including low-income ones, by selecting appropriate pricing systems such as the increasing block tariff and uniform volumetric charge
9. Measures should be taken to increase water quality rather than quantity, such as water purification, which at least reduced the risk of water-borne disease.
10. Water and sanitation programmes should engage with communities in finding acceptable ways of subsiding and providing access to water and sanitation.

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APPENDIX A

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

COLLEGE OF SCIENCE

ASSESSMENT OF HOUSEHOLD ACCESS TO WATER AND SANITATION FACILITIES: A CASE STUDY OF THE OFFINSO MUNICIPALITY.

QUESTIONNAIRE FOR THE GENERAL PUBLIC

The questionnaire is intended for a research into Assessment of Household Access to Water and Sanitation Facilities: A Case Study of the Offinso Municipality.

The question below is part of a project being conducted in connection with the above-stated topic at the College of Science, KNUST. I shall be most grateful if you answer them to the best of your ability. This is a purely academic exercise and every information provided will be treated confidential. Moreover, your anonymity is guaranteed. Thank you.

Please, tick √ or ***circle*** your answer as appropriate mark,

Personal Data

Q1. Sex: (1) Male (2) Female

Q2. Age: (A) 10 - 20 (B) 21 - 30 (C) 31 - 40 (D) 40 - 50 (E) 50+

Q3. Marital Status: (1) Married (2) Single (3) Divorced/ Separated (4) Widowed

Q4. What is your household size?

(A)1-3 (B) 4- 6 (C) 7- 10 (D) 11 - 13

Q5. What is your level of education?

(A) No education (B) Primary (C) JHS/Middle

(D) Secondary School /S.H.S / Tech/Vocational Institute (E) Tertiary

Q6. What do you do for a living or what is your occupation? ………………………………...

Q7. Which part or area of Offinso do you stay? (Your area of residence in Offinso):

………………………………………………………………………………

ECONOMIC ACTIVITIES

Q1. For how long have you been living in this house?

(A) Less than one year (B) One year (C) More than a year

Q2. Who own the house you live?

(A) Family (B) Personal (C) Rented (D) Other, (specify)……………………..

Q3. What was your reason to move to this house?

(A) Look for employment (B) Join parents/relatives (C) Join couple

(D) Previous rent expired (E) Others (specify) …………………………….

Q4. What is your household's total income per month? GH₵……………………………..

ACCESS TO WATER SUPPLY

Q1. (i) What is the main type of water source used by household?

(A) Piped (b) Borehole installed with pump (c) Protected Hand-dug well

(d) Unprotected well (e) Surface water (f) Covered rainwater tank

(g) Uncovered rainwater tank (h) Other (specify)………………………………

(ii) Is the water point (A) Private (B) Public

Q2. Where is the location of the water point used by your household?

(A) In own house (B) In neighbours' house/yard (C) Public place

(D) At an institution (mosque, church, school, etc.) (E) Water vendor

(f) Other (specify)

……………………………………………………………………………….

Q3 (i). Does your main water source last throughout the year? (A) Yes (B) No

(ii) If No, how often does it run out? …………………………………………………

Q4. (i) Do you pay for water used? (1) Yes (2) No

(ii) If yes, what is the cost of a 20 liter bucket of water?………………………………

Q5. How much do spend on water? Per day………………………………………… GH₵

Per month ……………………………………….. GH₵

Q6 On average, how many buckets of water do your house-hold use every day? ……….

Q7 . What is the maximum time spending for collecting water? ………hr(s)………min(s)

Q8 How far does it take you to walk to where you draw or fetch water?

(A) Less 50m (B) 50 – 100m (C) 101 – 200m (D) over 201m

Q9. Do you think there are problems with water supply and delivery in your areas?

(A) (B) No (C) Don't know

Q10 . What will you say about the following issues of water supply in your area?

……………………………………………………………………………………

……………………………………………………………………………………

Tick (/) as appropriate in the columns under

Water issues	**Severe problem**	**Minor Problem**	**Not a problem**	**Don't know**
(a) Slowing down of domestic & commercial activities				
(b) High water prices from water vendor				
(c) Too much time is wasted in search of water				
(d) Long queues in fetching water, sometimes resulting in quarrels				
(e) Children are usually are either late to or absent from School				
(f) Children risk their lives crossing roads in search of water				
(g) Prices of food items increase due to shortage of water				
(i) Risk in drinking untreated water from hand-dug wells or rivers				
(j) Work load of women in the households becomes very heavy				
(k) Other (specify)				

Q11 What will you say about the quality of the water that you drink?

(A) Good (B) Salty (C) Coloured (D) Has some particles inside

(E) Other (specify) ……………………………………………………….

SANITATION ACCESS

Q1 What toilet facility does this household use? (Circle any that applies)

(A) Private WC (B) Public WC (C) Private Pit Latrine

(D) Public Latrine (E) other (specify) ……………………………………

Q2. Is the toilet located within your dwelling, or yard or compound?

(A) Yes (B) No

Q3. If it is a pit latrine, is the hole covered? (A) Yes (B) No

Q4. If the toilet facility is a pit latrine what improvements have been made to the latrine?

(A) None (B) Lined/stabilized pit (C) Cement slab (D) Vent pipe

(E) Durable shelter

Q5 How many household shares the toilet? ……………………………………

Q6. How would you describe the quality of toilet in terms of privacy and cleanness?

[User perception]

(A) Poor (B) Fair (C) Good (D) Not applicable

Q7. How many times has this toilet facility flooded in the last six months? (If never writes O) ……………………………………………………………………………………

Q8. What do you do, when your toilet is full?

(A) Empty (B) Construct another toilet (C) Switch to another chamber

Q9. Do you wash after visiting the toilet? (A) Yes (B) No

Q10. What facilities do you use for hand washing?

(A) Soap (B) Ash (C) None (D) other (specify)…………………….

Q11 .Have you ever had any of the following diseases for the last 12 months?

(A) Diarrhoea	(1) Ye	(2) No	How many times?......................
(B) Typhoid	(1) Yes	(2) No	How many times?......................
(C) Tuberculosis	(1) Yes	(2) No	How many times? ……………..
(D) Cholera	(1) Yes	(2) No	How many times?......................

Thanks for your assistance and valuable time.