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Assessment of the Impact of Water Supply and Sanitation on Health: A Study in the Savelegu/Nantong District of the Northern Region, Ghana

ZIBLIM SHAMSU-DEEN
DEPARTMENT OF ENVIRONMENT AND RESOURCE STUDIES, UNIVERSITY FOR DEVELOPMENT STUDIES, WA, UPPER WEST REGION, GHANA.
Contact: Phone: 00233244202759, Email: zshamsu@yahoo.com

Abstract
This paper examines the health implications of inadequate water supply and sanitation in the Savelegu/Naton District in the Northern Region of Ghana. A sample of 200 respondents was drawn from eight communities in the district using a systematic random sampling technique. Data collection tools were questionnaires, personal observation, interviews and focus groups discussions. The research found that, inadequate water supply and sanitation, together with socio-economic and cultural conditions, robbed the people of Savelegu/Nanton District of good health. Diseases associated with water and sanitation still top the top ten causes of morbidity and mortality. A Chi-square analysis shows a significant association between water and sources and guinea worm and diarrhea. Skin diseases were however found to be associated with inadequate water for personal hygiene. The research reveals that inadequate provision of portable water and safe disposal of excreta and other waste are fundamental to reducing the myriad of health problems that the people in the district are saddled with. This must however, be supported with vigorous public health education programme. For the success of water and sanitation programmes an integrated approach involving poverty reduction, women's empowerment, and basic education, health care and widening job creation is recommended.

INTRODUCTION

Domestic water supply is one of the fundamental requirements of human life. Without water life cannot be sustained beyond a few days, and a lack of access to adequate water supply leads to the spread of disease. The quality of water that is consumed is well-recognized as an important transmission route for infections diarrhoeal and other diseases (WHO 1993). The importance of water quality continues to be emphasized because bad water can cause epidemics and contribute to endemic disease from pathogens (Payment and Hunter, 2001). The effects of poor quality of water supply are felt in most developing countries, although the greater part of the health burden is carried by children and women in developing countries (WHO, 2000).

Around 1.1 billion people in the world do not have access to improved water supply sources, while 2.4 billion people do not have access to any type of improved sanitation facility (WHO, 2010). According to the World Health Organization (WHO) and United Nations Children's Fund (UNICEF) joint monitoring Programme for Water Supply and sanitation (JMP), 28 percent of the population of sub-Saharan Africa defecates in the open, and an additional 23 percent uses unimproved sanitation facilities that do not ensure hygiene separation of human excreta from human contact (JMP, 2008).

Unsafe water, inadequate sanitation and insufficient hygiene account for estimated 9.1 percent of the global burden of disease and 6.3 percent of all deaths according to the World Health Organization(PrÜss- Üstin et al., 2008) Nearly half of all people in developing countries have infections or disease are associated with inadequate water supply and sanitation (Bartram et al., 2005). Diarrhoeal diseases attributed to poor water supply and sanitation and hygiene account for 1.73 million deaths each year and contributed over 54 million Disability Adjusted Life Years, a total equivalent to 3.7 percent of the global burden of disease (Howard and Bartram, 2003). This makes diarrhoeal disease due to unsafe water, sanitation and hygiene the 6th highest burden of disease on a global scale, health burden that is largely preventable. Other diseases related to poor water, sanitation and hygiene such as trachoma, schistosomiasis, ascariarasis, trichuriasis, hookworm disease and malaria constitute an additional burden (ibid). About 2 million people die every year due to diarrhoeal disease s most of whom are children less than 5 years of age. According to Esrey and Andersson (1999), nearly three million children five years of age or younger die of diarrhea annually. The most affected are the population s in developing countries living in extreme conditions of poverty, normally peri-urban dwellers of rural inhabitants (WHO 2010)

With developing countries good water and sanitation facilities tent to be concentrated in the urban areas, although the neglected rural areas frequently carry more than 70 percent of the total national population. Most areas do not have such facilities at all, thus hindering safe collection, removal or disposal of waste in these areas. The results of the 2000 population and Housing Census of Ghana indicate that about 40% of the households in the country have to pipe-borne water and tankers provide water for 2% of households. One-third of the households obtained their drinking water from wells and boreholes while 25% of the remaining households depend on natural sources such as springs, rain water, rivers, streams, lakes and dugout wells (Ghana Statistical Services 2005). The urban-rural differentials are worthy of note. While nearly 68% of the urban households have access to pipe-borne water, only 25% of the rural unprotected sources on health are much more acute among rural residents than urban dwellers (Gaisie and Gyau-Boakye, 2007)

Water supplies and sanitation are crucial elements in a sustainable livelihood strategy being directly related to issues of access to and control over natural resources as well as basic infrastructure and services. Freshwater is a scarce resource and unless drastic improvements in water use efficiency and pollution control occur, four billion people- half the world's population- will live in countries with high water stress by year 2025 (Cosgrove and Rijsberman, 2000). Providing access to sufficient quantities of safe water and facilities for sanitary disposal of excreta and introducing sound hygiene behaviours are of capital importance in reducing the burden of disease caused by these risk factors. Successful improvements to water supplies and sanitation however require an understanding of the interconnectedness of water and sanitation. It is well established today that the benefits of water supply will not be forthcoming unless attention is also given to sanitation (Andersson, 1996). And there is growing awareness that improvements to sanitation can bring greater health benefits that improvement to water supply (Esray, 1996). There is also the recognition of the fact that, inadequate improvements to sanitation can be worse than no improvements at all, particularly in the case of sanitation approaches which use scare freshwater resources and risk contaminating water sources. A maxim gaining popularity is; Never consider water without sanitation and always consider sanitation with water.

EFFECTS OF WATER SUPPLY AND SANITATION ON HEALTH

There is a wide range of diseases associated with waste and sanitation. The transmission of water and sanitation-related disease may however be divided into four categories (White et. al, 1972). The first of these is the water-borne diseases caused by ingestion of water contaminated by human or animal faeces or urine containing pathogenic bacteria or viruses. Diseases in this category include cholera, typhoid, amoebic and bacillary dysentery, infectious hepatitis, gastro-enteritis and other diarrhoeal diseases caused by poor personal hygiene and skin and eye contact with contaminated water. It is the result of the use of inadequate volumes for personal hygiene. Diseases of this type are skin diseases such as yaws, scabies and leprosy; eye infections such as trachoma and conjunctivitis, as well as fleas, lice and tick-borne diseases. These infections decrease as the diseases caused by parasites found in intermediate organisms living in water. They include dracuncliasis (guinea worm), shistosomiasis and other helmiths which have aquatic host. Water-related diseases constitute words, they are caused by vectors which breed in water. In other words, they are caused microorganisms with life cycle associated with insects that live or breed in water. Diseases in this category are lymphatic filariasis, malaria, onchocerciasis, trypanonomiasis, dengue fever and yellow fever.

A study in rural Philippines (Johnson and Nelson, 19984) indicated negative correlation between child death rates and level of sanitation. Azurin and Alvero (1974), on the field evaluation of the effects of water supply and sanitation on cholera over five years, showed that the greatest reduction in cholera was achieved in a village with running water hygiene latrines. However, when the population began to depend on the facilities provided and to use them regularly the effect became more apparent. Another survey conducted in Pikine, a middle/low income suburb of Dakar, shows that mortality was 64% higher in households supplied by communal wells than in those a tap in the dwelling (Gould, 1998)

Worlanya (1984) assessed that relationship between sanitation and child mortality in Ghana based on data derived from the Ghana Supplementary Census Enquiry (a 5% stratified sample of the total population). The results showed that although better facilities such as piped water, water closets or private latrines are often associated with lower child mortality, the advantages of better sanitation facilities are severely limited when mothers are not educated. The study also showed that, providing as little as one six years of formal education results in considerable reduction in child mortality risks.

Victoria et al. (1998) examined the issue of water supply, sanitation and housing in relation to the risk of infant deaths from diarrhea in metropolitan areas of Porto Alegre and Petotas in southern Brazil. Based on a logistic regression analysis, they observed that infants receiving untreated water were not at significantly higher risk than

to its quality. The point draws one's attention to the fact that, there are two principal justifications for providing good quality and easily accessible water supplies. The first is to improve accessibility to water thereby increasing the quality of water used and untimely decreasing the transmission of water-washed diseases such as scabies, conjunctivitis and trachoma. The secondly is to improve the quality of water available, which should decrease the transmission of water-borne diseases such as schistosomiasis and Guinea worm (Feachem, 1977)

MATERIA AND METHODS

Two main sources of data were used in this research. These are primary and secondary sources. The research employed questionnaires, structured and unstructured interviews as well as focus group discussion to collect data from respondents. Target groups include households, healthcare providers, patients and officials of the District's Community Water Supply and Sanitation Division. In addition, direct observation of sanitary habits was done.

RESULTS AND DISCUSSION

Water Supply: Sources and Access

The 2010 Population and Housing Census indicate that 19.4% of the district's population obtains water from wells. 8.2% from boreholes, 2.9% from springs and rain, 5.5% from dugouts and 61.3% on rivers and 61.3% on rivers and streams. Only 2.3% have access to pipe-borne water, with the remaining 0.4% patronizing tanker services and other sources. It is clear that, over 80% of the district's population obtains water from traditional sources and that, most of such water is contaminated at source. This is slightly higher than 78% obtained from this survey. A member in the Tampin community had this to say 'During dry season, water becomes a scarce commodity. We sometimes have to spend hours to fetch water from borehole while for greater part of the season we travel long distances for river water. It is very tiring and frustrating'

The first priority therefore is to ensure that households have access to an improved water source within one kilometer (Howard and Bartram, 2003). This corresponds to the current definition of reasonable access used in accessing progress in global coverage with water supply and sanitation (WHO and UNICEF, 2000).

Sanitation

The various excreta disposal systems identified in all the eight communities studied are household laterine (Open-pit), household latrine(KVIP), household flush latrine, communal latrine (KVIP) and free range system. In the main, four types of excreta disposal systems have in-house excreta systems have been identified- Communal Latrine- Open pit, communal latrine- KVIP, Household flush latrine- open pit and Free Range. Only 28 (14%) of the respondents have in-house excreta disposal facilities and 172 (98%) use facilities outside the house (either communal latrine (KVIP), communal latrine (open pit) or the free-range method.

Of the 28 respondents who have toilet facilities in the house, 25% use the open pit type, 60.7% use KVIP and 14.3 % of the respondents using the flush latrines come from Nanton. These respondents are those residing in government bungalows. Also KVIP and open pit latrine are the dominant types of toilet facilities. Of the 172 respondents from the eight communities who had no facilities at the household level, about the 6.4% of them use communal latrine- KVIP type, 68.9% use the free range system (where the bush is used) and 23.8% use communal latrines of the open pit type.

TABLE 1: Distribution of in-house Excreta Disposal Facilities by Settlements and Types

Settlement	Type of facility							
	Open pit		KVIP		Flush Latrine		Total	
	N	%	N	%	N	%	N	%
Libga	1	9.1	6	54.5	4	36.4	11	100
Moglaa	-	-	-	-	-	-	-	-
Dingoni	1	100	-	-	-	-	1	100
Tampin	1	20	4	80	-	-	5	100
Nantong	1	100	-	-	-	-	1	100
Zian	-	-	-	-	-	-	-	-
Jana	-	-	4	100	-	-	4	100
Savelegu	3	50	3	50	-	-	6	100
Total	7	25	17	60.7	4	14.3	28	100

Of the 172 respondents from the eight communities who had no facilities at the household level, about 6.4% of them use communal latrine-KVIP type, 68.9% use the free range system (where the bush is used) and 23.8% use communal latrines of the open pit type (see Table 2)

Settlement	Type of facility							
	Communal latrine (KVIP)		Free Range		Communal Latrine (open pit)		Total	
	N	%	N	%	N	%	N	%
Libga	11	37.9	18	62.1	-	-	29	100
Moglaa	-	-	20	100	-	-	20	100
Dingoni	-	-	1	7.1	13	92.9	14	100
Tampin	-	-	2	10	18	100	20	100
Nantong	-	-	-	-	9	100	9	100
Zian	-	-	30	100	-	-	30	100
Jana	-	-	26	100	-	-	26	100
Savelegu	-	-	23	95.8	1	4.2	24	100
Total	11	6.4	120	69.8	41	23.8	172	100

For the general public, the risk of falling prey to diseases associated with insanitary conditions is high. The few public KVIP latrines are nasty, unsafe and pose a lot of discomfort to users and non-users. These conditions have partly conspired to propel many to resort to the free-range. Age-long beliefs such as the one which holds that defecating on somebody else's faeces would retard progress, a belief which is still use free-range.

The household pit latrines are by no means better. They are neither safe nor comfortable. By their open nature, they carry perpetual flies during the day which makes their usage uncomfortable for the users. Besides, faecal-oral transmission of diseases is likely. The 'free-range system is the worst in terms of safety, as faecal matter finds its way ultimately into streams, rivers and other unprotected sources of water, thus polluting them.

Modes of Garbage disposal

Respondents in the eight communities identified the following: household disposal points, community disposal points and indiscriminate disposal as the main systems. From the survey, 14.5% of the total respondents dispose of their garbage at the household disposal point, 20% at community disposal point while 65.5% dispose of their garbage indiscriminately. The various modes of garbage and waste water disposal are not ecologically friendly. Both household and community disposal points where not properly managed, may pose threat to the health of the residence. The situation is even more serious if one considers the fact that indiscriminate disposal of waste disposal in the study present pollution risks to the general environment, especially to surface and ground water resources, which in turn pose a threat to health.

Domestic Water Supply, Sanitation and Health in Savelegu/Nanton District

There is close relationship between quality and quantity of water, hygienic practices and the health of individuals. Those who depend on unprotected sources of water and unsafe means of excreta disposal are unprotected sources of water and unsafe means of excreta disposal are more likely to be exposed to Guinea worm, diarrhea, cholera and other diseases associated with water and sanitation. The search showed that households with high and multiple disease burdens are those whose main sources of water were traditional (e.g rivers, streams). Lack of formal education has been identified to the advantages to be derived from the use of the boreholes provided. The borehole water at source is clean, but the quality of this water is compromised by the way it is transported from the source to destination. The dirty fetching pans, the dipping of hands in water during the fetching and transporting process and the nature of water storage facilities are contamination of water in the district. In accord with Benneh et al (1993), the possible sources of contamination is that buckets or pans used for fetching water from boreholes or standpoints are open, and these containers are also used for bathing and for other household chores.

Domestic water supply and guinea worm disease in the District.

Guinea worm disease (dracunculiasis) is a parasite infection caused by the nematode Dracunculus medinensis. The infection manifests itself in one-meter long thin white worm that emerge directly and slowly through the skin on any part of the body. People are infected by drinking water that contains tiny water fleas that have ingested immature forms of the parasite spewed into the stagnant ponds from emerging adult worms. This infection is only transmitted by contaminated drinking water, and there is only one year lag between infection and the emergence of the adult worm. Dracunculiasis has no vaccine or cure and infection confers no immunity to reflection.

Cases of guinea worm disease are prevented at Kpasa, Sibi, Banakye and Alapkatsa. In the guinea worm prone communities, not only is access to clean water and reliable sources of water lacking, but also traditional sources of water supply are limited. Many of the communities depend on unsafe sources such as pond, shallows wells, dams and streams which are known to be potentially unsafe. The seasonal variation in the volume of streams serving as sources of domestic water has significant implications for eyelops density. Contamination occurs both at the source and at home. Most households keep two kinds of water ponds, wells or river water which is usually contaminated and borehole\ tap which is clean at source. The former is use for hygiene purposes, including basic needs for personal and domestic cleanliness, whiles the latter is use for consumption (cooking and drinking). Keeping two different kinds of water within the house rather compounds the problem. This is because it provides an avenue for contamination by dipping the same cup into barrels containing water of different quality.

Table 3 indicates that, 64 (32%) of the 200 respondents had guinea worm disease. Of the 155 respondents who obtained water from ponds, dams, well and streams, 36.8% had guinea worm while of those who depended on borehole, 15.6% had guinea worm. Two hundred and sixty (260) cases of guinea worm victims were recorded and this was arrived at by actually counting the number of cases per households visited. In these areas, one came across victims with serious conditions. This results pain incapacitates victim for periods averaging two to three months. This often constrains agricultural productivity. As the muscle tissue of the knee is damaged the victim became permanently crippled.

Table 3: Guinea Worm disease distribution among households by main source of drinking water

Source of water	Guinea worm Disease		Total
	Infection	No infection	
Borehole/pipe	7(15.6)	38(84.4)	45 (100)
Ponds/Streams/Dam/Well	57(36.8)	98(63.2)	155(100)
Total	64(32)	136(68)	200(100)

Chi-square= 7.21 Critical Value=3.841 Df=1 significant level = 0.05

The null hypothesis (H_o) that there is no relationship between guinea worm infection and source of domestic water was tested. That is, the two is variables are independent. The alternative hypothesis (H^) was that there is the relationship between guinea worm infection and source of domestic water. The Chi-square statistic (X^2) was employed using information in the table 3. The decision rule was that at 0.05 levels, the difference is significant if X^2 with 1 degree of freedom is above the critical value. Since 7.21 (X^2 calculated) > 3.841 (critical value), H_o is rejected and H^ accepted. Thus there is a significant relationship between guinea worm disease infection and source of water supply. Those who consume water from ponds, wells, streams and other unwholesome sources tend to have higher guinea worm infection than those who use borehole or pipe-borne water.

The Guinea worm disease and social stigma

The presence of social stigma against guinea worm victims was observed in the endemic communities such as … where cases are high. This may cause serious psychological trauma. Since most people still attribute the disease to supernatural causes, people infected with the disease. People easily attributed the disease to punishment from gods because of some wrongdoing. Within the same community, those not infected. This is what Issah a guinea worm victim had to say in an interview with him at Mogla: "*Look at me, I am rendered immobile. My wife and my two children are also affected. Some of our friends would not like to mingle with us because we are suffering from guinea worm disease. Even some close relatives have abounded us. We need some help".* This social stigmatization often underlies the refusal of victims to report cases for treatment.

Water supply and diarrhea diseases among Children

There is an obvious linkage between quality of water and incidence of diarrhea. It is known that all the major infectious agents of dirrahoea are transmitted by the faecal-oral route, and all can be transmitted through contaminated water. In table 4. 66.8% of those whose main source of water is traditional complain about diarrhea among children. This represents 51%nof the total number of respondents. However, of the 45 respondents whose main source of water, 33.3% reported dirrahoea among children. This is 7.5% of the total number of respondents. Evidence from the field suggests that three types of water and excreta disposal improvements are necessary to reduce the ingestion of pathogens causing diarrhea: improved water quality; increased water availability and quantity associated with better hygiene practices; and improved excreta disposal facilities. One lesson that can be learned from above is that improving quality of water is a necessary but not a sufficient condition for reducing dirrahoeal infections to appreciable levels.

The null hypothesis (H_o) that there is no association between diarrhoeal disease and domestic sources of water was also tested. The alternative hypothesis ($H^{\wedge}$) was that there is an association between diarrhea and domestic sources of water. The chi-squared statistic (X^2) was employed using information in Table 4. The decision rule was to reject the null hypothsis if calculated chi-square is greater than the critical value. In other words, at 0.05 level, the relationship is significant if X^2 calculated is above the critical value,. Since 15.15 > 3.841, H_o is rejected and $H^{\wedge}$ accepted. The conclusion is that, there is a significant association between diarrhoeal disease and the source of domestic water, with a higher number of cases in households without access to portable water. This means that the source of water relates to the incidence of dirrahoea.

Table 4: Dirrahoeal Cases among Households by main source of Water

Source of water	Diarrhoea		Total
	Present	Absent	
Borehole/pipe	15 (33.3)	30(66.7)	45(100)
Ponds/Streams/Dam/Wells	102(66.8)	53(34.2)	155(100)
Total	11758.5)	83(41.5)	200(100)

Chi-square=15.15 Critical Value=3.841 DF=1 Significant level=0.05

Water sources and the incidence of Skin diseases

In the study area, skin disease infections were observed at Tampin the areas with perennial water problems. Skin infection by its very nature was easily identified through direct observation, which was supplemented with a questionnaire survey. Eczema, yaws, and skin rashes were directly observed and recorded during the field survey. Where no observable case existed in a household, questionnaire was used to elicit information on the incidence of the disease. The distribution of responses regarding the presence or absence of the disease is indicated in Table 5

Table 5: Skin Infection Distribution among Households indicated by main source of water

Skin Disease	Borehole/pipe	Rivers/streams/Dam/Well	Total
Present	12(26.7)	53(34.2)	65(32.5)
Absent	33(73.3)	102(65.8)	135(67.5)
Total	45(100)	155(100)	200(100)

The research found that, the quality of water, rather than quality used explains the incidence of skin infections. Regular bathing is seen as having a direct relation with the ease with which people have access to water. Insufficient water is responsible for the reduced number of times people bath and wash their clothes, which predisposes them to various kinks of skin diseases. It is the quantity of water available for washing and bathing that significantly affects the skin. This does not however suggest that the quality of water used cannot cause skin infection. Dirty and contaminated water may contain pathogens which, when in contact with the skin, could cause skin infection. Since borehole water is not easily accessible, water for washing and bathing. Besides, people rarely use borehole water for washing or bathing, since they complain it does not lather readily with soap.

Conclusion

The majority of the inhabitants depend on unprotected ponds, dugouts, streams and rivers as their main sources of water supply, but most of these have been found to have a lower bacteriological quality at source compared to borehole water (Moe et al., 1991). Owning to lack of sanitation facilities such as latrines (both private and public), there is open air defecation around river courses, bush and streets. However, a number of these pumps have fallen into disrepair due to poor management, a phenomena attributed to lack of needed skilled manpower and requisite material and financial resources.

Thus the diseases associated with water and sanitation still constitute the most serious ones in view of the fact that they collectively exert by far the greatest health burden than any other causes of morbidity and mortality in SAVELEGU/NANTON DSITRICT.

In addition to direct health effects of inadequate water supply on the population, there is an additional cost in time and energy expended in carrying water from the sources of supply to residential areas. This is particularly burdensome for drawers of water, most of whom are women and young daughters who have travel several kilometers for water with negative implications for their labour productivity in all aspects of socio-economic activity.

Recommendation

1. More boreholes or other protected sources of water and toilet facilities should be provided through collaborative efforts between the water supply and sanitation Agencies and the communities
2. Boreholes and latrines should be sited within the reach of the majority of people in the community. this is because the observation made is that there has been gross under utilization of such essential facilities because they are not easily accessible
3. The community Water and Sanitation Agencies should use their expertise to choose appropriate places where the hydrological condition would ensure that boreholes continuously generate water for the community. This necessary because some boreholes that were drilled have been abandoned due to the fact they yield little or no water in the dry season. This situation therefore demands that, before boreholes are drilled, more reliable hydro-geological surveys must be carried out
4. Public education about the causal linkages between water quality and quantity and poor sanitary habits, on the one hand, and most of the diseases they suffer from, on the other should be intensified in the communities. For instance Guinea worm disease should be seen as a water-based disease that is medically curable. The government, chiefs, opinion leaders and other stakeholders have a role to play in this direction
5. For the success of water and sanitation programmes, an integrated approach is necessary. Poverty reduction through broad-based poverty reduction programmes; women's empowerment through formal education, among other things; basic education promotion; expanded health care and employment opportunities are critical
6. More controlled dumping sites should be created and more refuse dump bins made available through the various agencies and the District Assembly. This would bring to an end the indiscriminate or uncontrolled dumping of refuse, as evident in most parts of the district. For a breakthrough, the project must, with the collaboration of District Assemblies develop a set of bye-laws for the WATSAN Committees.
7. The cutting down of trees along the course of rivers and their catchment areas should also cease. It was observed that such activities accelerate the dwindling volume of most important rivers and streams in the study area. Their prevention can be achieved through public education. Tree planting along water courses should be embarked upon. Traditional leaders, the district Assembly educational institutions and other stakeholders must get involved.

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