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Groundwater Management, Conservation and Storage Interventions in Rural Communities in Ghana (A Case Study in Keta Municipality)

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Abstract:
The quality of the source protection measures is an important component in controlling whether pathogens may be present in the final drinking water. All the respondents agreed that water resources are indispensable and resources to the survival of all living things and generally ought to be protected from pollution or contamination. The need to judiciously and sustainably use water, an indispensable resource to the global ecosystem, is increasingly being recognized globally by governments, policy planners, civil organizations and individuals. About 30% of the respondents said that there exist water management associations in the communities to ensure the judicious utilization of water and to help manage the available water facilities. However, 31% expressed a contrary view on water conservation in their communities. They contended that there were no existing water management associations in their communities. However, 39% believed that regulating the use of water would go a long way to promote the sustainable use of water. It was recommended that restricting access by both humans and animals to the headworks is also important to reduce risks of contamination and thus all sources should be enclosed by a fence.

Keywords: *Water management, sustainability, conservation, protection, contamination*

1. Introduction

Managing water supplies and sanitation is a fundamental dimension of sustainability. However, water resources in general are poorly protected and managed, especially in the developing world lending credence to the fact that water supply issues cannot be sustainably resolved without also providing proper sanitation. The protection of groundwater sources used for domestic supply requires actions at both the wellhead and the wider aquifer. Increasing population and population density can increase the risk to groundwater from pollution and unsustainable abstraction. Balancing the needs for protection of resources against demands from rapidly increasing populations is a key element in groundwater protection and management. Population growth often provides an impetus for improving protection strategies as the need to secure and conserve high-quality water resources for domestic supply becomes increasingly important. This can provide a strong argument for the need to protect groundwater against pollution. It should be noted, however, that the protection of particular groundwater resources is also dependent on whether it is considered as a key source of domestic water in the long-term.

2. Literature Review

The effectiveness of wellhead or sanitary completion in reducing risks of all pathogens is profound as it provides a barrier to direct contamination of the source (Robertson and Edberg, 1997). The degree, to which risks will be reduced, however, varies between pathogen types and aquifer types and there is a need for multiple interventions to act as barriers to most pathogen types.

Most countries have developed and implemented policies for preventing the pollution of groundwater. These commonly involve regulatory control of activities such as the concept of 'zone of protection' which generate or use polluting materials, or control of the entry of potential pollutants into vulnerable surface and underground waters. However, protection zones are not applied in all countries, despite recognition of their desirability (Bannerman, 2000). This may be due to a number of factors, including the lack of sufficiently detailed information regarding the hydrological environments (Bannerman, 2000; Taylor and Barrett, 1999), or existing land uses that impede enforcement of such a concept.

Another method of water quality management placed a great emphasis on the routine monitoring of water quality. This method focuses attention on end-product standards rather than ensuring that the water supply is managed properly from catchment to consumer. However, an experiment carried out by Helmer *et al*., (1999) to compare the results of analysis against acceptable concentrations in order to evaluate performance of the water supply and to estimate public health risks has been shown to be

ineffective for microbiological quality of water, as evidence has emerged of significant health impact from the consumption of water meeting national standards (Payment *et al*., 1991). In part this is because most national standards have been set using bacterial indicators, which are very different from viral and protozoan pathogens.

The quality of the source protection measures is an important component in controlling whether pathogens may be present in the final drinking water. For instance, one study concluded that the degradation of surface water catchments was an important factor in waterborne disease transmission (Hellard *et al*., 2001). The outbreak of *E. coli* 0157:H7 and *Campylobacter jejeuni* from drinking water in Walkerton, Ontario, appears to have resulted from a combination of improper protection of the groundwater source and a failure to maintain adequate chlorination (O'Connor, 2002). The example from Walkerton particularly emphasises the need for multiple barriers in water quality management.

Davison *et al.* (2004) identify that the development of an effective WSP requires:

- Assembling a team that understands the system and can undertake an initial assessment of the system with regard to its capability to supply water meeting the specified targets.
- Identifying where contamination can occur and what measures can be put in place to prevent, reduce or eliminate contaminants from (control measures).
- Validation of methods employed to control hazards.
- putting in place a system for monitoring of and corrective action to ensure that safe water is consistently supplied, and
- Periodic verification that the WSP is being implemented correctly and is achieving the performance required to meet the water quality targets.

3. Methodology and Materials

The data collection techniques used in this study was a combination of stratified sampling which is a probabilistic sampling and incidental sampling techniques which is a non-probabilistic sampling procedure. These techniques took into consideration the objectives of the study and the questions were structured accordingly. In another vain, incidental sampling was done by picking samples by accident where there was no prior decision on the part of the researcher as to who to sample. In this technique the researcher interviewed anybody within the various strata he chanced upon since the vocation of respondents would not permit pre-selection randomly.

4. Results and Discussion

Preventive Measures	Percentage (%)
Coveringfood	13
Disinfection	2
Filtering and Boiling water	6
Covering food and water	3
Covering food, filtering and boiling water	9
All	2
Boiling and drinking safe water	1
Avoid contact with excreta	1
Boiling water	26
Covering water	2
Filtering water	1
Covering food and boiling water	17
Health Education	2
I Don't Know	6
Covering food and filtering water	8
Food safety	1
Total	**100**

Table 1: Prevention of Waterborne diseases

The survey conducted indicated that residents in the study area had their own preferences for sources of water for domestic (household) use. From Table 1. as much as 72% of the respondents noted that they would prefer to have pipe borne as their main source of water for domestic use to any other source. Similarly, 13%, 9% and 5% said that they would prefer hand-dug-well, borehole and rainwater as their main sources of water for domestic use to other sources respectively. Besides, various reasons were provided for the aforementioned preferences of water sources for household use. For example, 31% of the respondents noted that they would prefer pipe borne water to any other source of water for domestic use because chemical treatment associated with pipe borne water to help kill pollutants and germs in the water. On the basis of accessibility and cost, 4% of the informants said they would choose hand-dug-wells over other sources of water as they are readily accessible in their community and also affordable. Also, 1% believed that the hand-dug-well in the neighbourhood easily lathers with soap (soft water) and therefore would prefer it to other water source for domestic use.The popularity of the use of water from hand-dug-wells/borehole for domestic and farming in the Keta Municipality is a well-known fact to majority of the respondents. A much as 78% were of the view that the patronage of water from hand-dug wells was

high as compared to 11% who held an opposing view indicating that patronage of well water was Low. However, 9% described the level of popularity of well/borehole water usage as average. About 2% were indecisive (don't know) on the issue of level of well water usage in their communities. Figure 1; gives a graphical illustration of respondents' view on popularity of well water usage.

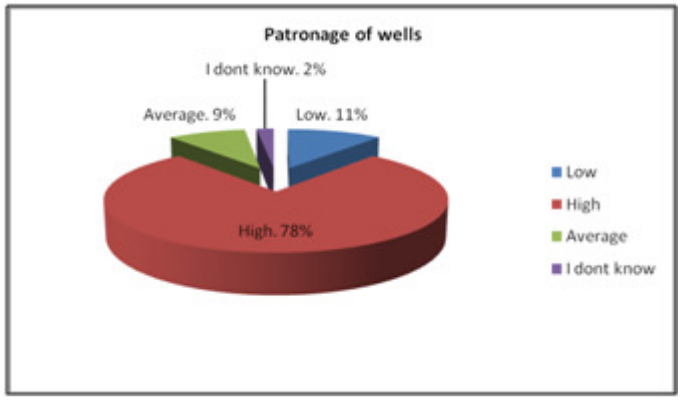

Figure 1: Level of patronage of water from hand-dug-wells/borehole

Reasons	Percentage (%)
Easily accessible	73
No Idea	3
Accessible andno levy	8
Saline	1
Low levy	1
High levy	1
Other sources available	8
No Levy	1
Not Saline	1
Accessible and low levy	3
Total	**100**

Table 2: Reasons for level of Hand-dug-well/borehole usage

Water resources, just like other natural resources like air and soils, are susceptible to pollution if harmful substances are introduced into them. Unlike surface water sources, the cost of cleaning underground water resources is extremely expensive and in some instances too difficult and costly to clean up once contaminated. All the respondents but 20% believed that water obtained from groundwater sources could be contaminated as shown in Figure 2.

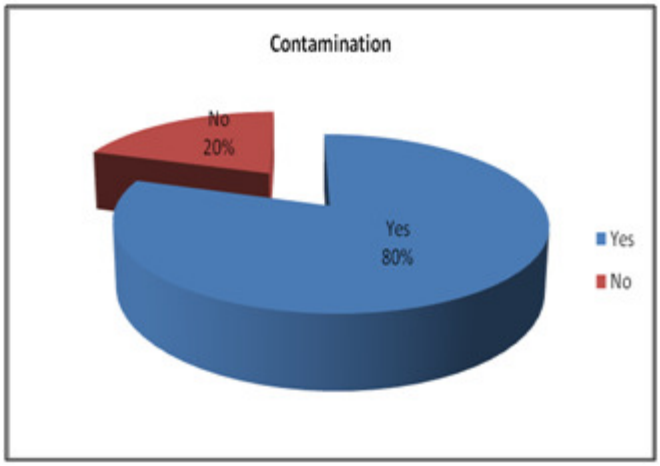

Figure 2: Contamination of Groundwater/wells

On the contrary, all the respondents agreed that water resources are indispensable and resources to the survival of all living things and generally ought to be protected from pollution or contamination.

Table 2 shows the summary of views expressed by the respondents on how to safeguard water resources/facilities from pollution or contamination. Apart from 30% of respondents who said they had 'No Idea' as to how to prevent pollution of water facilities, the rest (70%) gave at least one preventive measure to save water facilities from getting polluted. The measures suggested include the

following; Provision of cover slab for wells (21%), health/water education (10%), chemical treatment (4%) and siting toilets far away from water facilities (2).

Generally, it is a common practise for individuals who have no water facility in their private homes to fetch water from the nearby water facility using various kinds of containers. Such containers, ranging in various sizes, include pots, gourds, buckets, drums and among others. Unlike in the past, pots and gourds are no longer popular media for fetching water nowadays due to the advent of plastic and metallic containers which are more durable and more convenient to handle. From the survey as illustrated in Figure 3, about 76% of the respondents admitted that they used 'containers without cover' for fetching water from the water facilities for use in the homes. However, 19% noted that the containers they used for carrying water from the sites to their homes had lids or covers. Only 5% could not provide answers probably for reasons including having at least one of the water facilities at home and therefore had direct access to water at home.

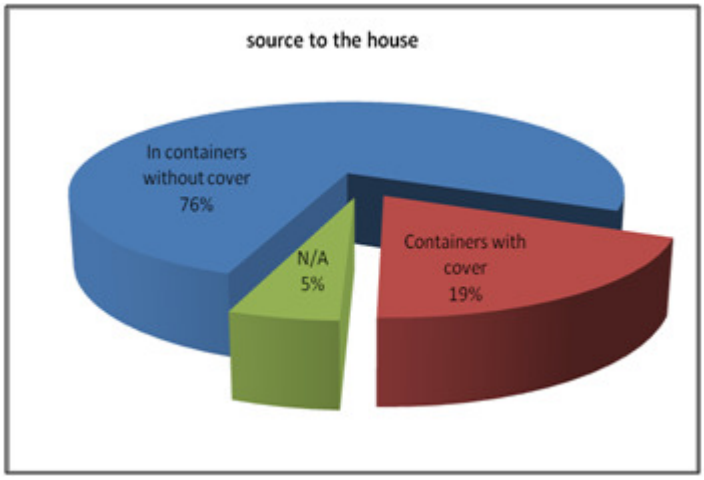

Figure 3: Nature of Container used in fetching water to the house

Similarly, 84% of the respondents said that they have separate containers that they use to home water for household use. On the other hand, 16% noted that they had no separate containers for storing water at home. Figure 4, shows the responses of respondents on whether they have separate containers for storing water at home.

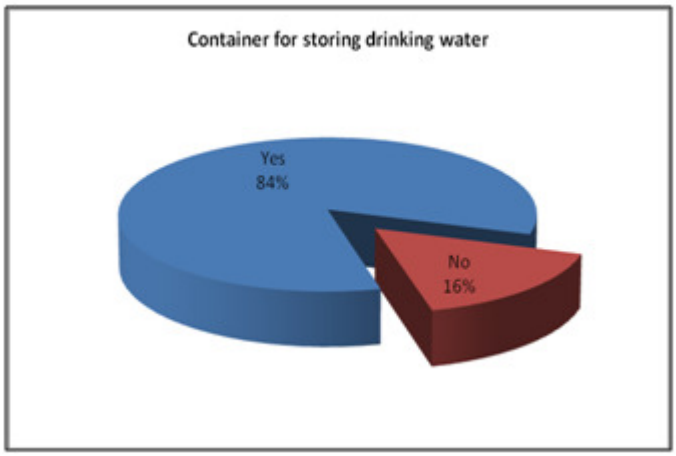

Figure 4: Container used in water storage at home

Analysis of results as shown in Figure 5 indicate that 19% of the respondents store water for use at home in containers without cover while 66% on the contrary store in containers that have lids. In addition, 6% noted that due to regular access to water directly at home, they do not store water for use later at home. About 5% said they only store purified water ((in sachets) for use at home while 4% were unable to indicate how they store water for use at home.

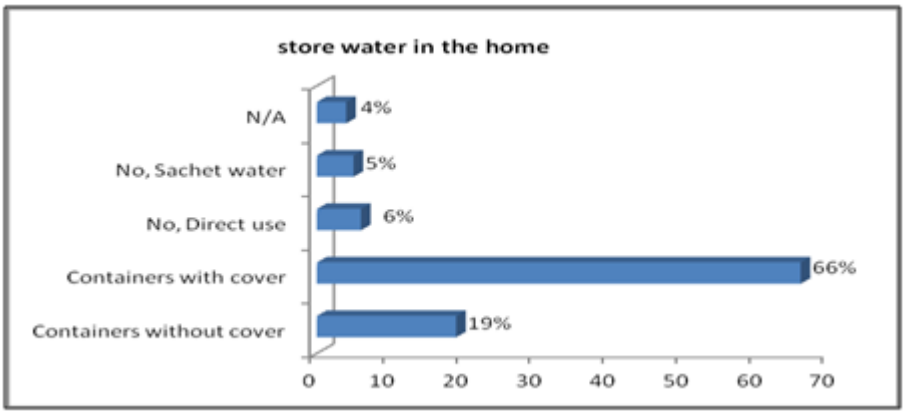

Figure 5: How do you store for use at home.

As shown in Figure 6 below, about 86% of the respondents stored water for domestic use in a place that was free from animal droppings and garbage or waste materials. On the contrary, 6% admitted that the place used to store water at home was not free from garbage and waste materials and thus suggests the possibility of contamination of the water stored with germs. The rest (8%) failed to describe the condition of the area used in storing water at homeprobably due to reasons such as having a readily accessible water facility at home and therefore had no need to store water for later use.

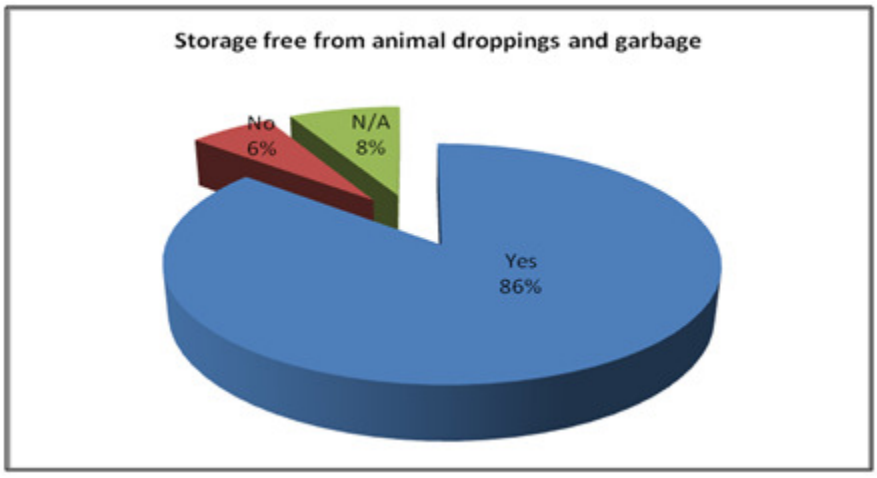

Figure 6: Condition of storage area

Respondents who stored water at home (86%) indicated that in order to keep the containers clean, they wash/clean them. About 72% noted that they wash the storage containers whenever they finished using the water in them (when empty). Two percent (2%) wash them whenever they found it necessary to do so. About 5% and 9% noted they wash their containers for water storage weekly and 'every three days' respectively. Figure 10; graphically shows the views of respondents on how often they clean their water storage containers.

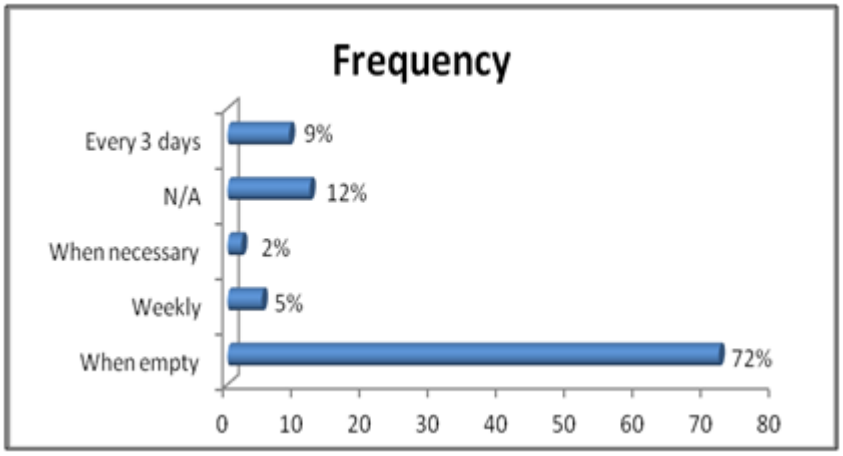

Figure 7: How often do you clean containers for water storage at home?

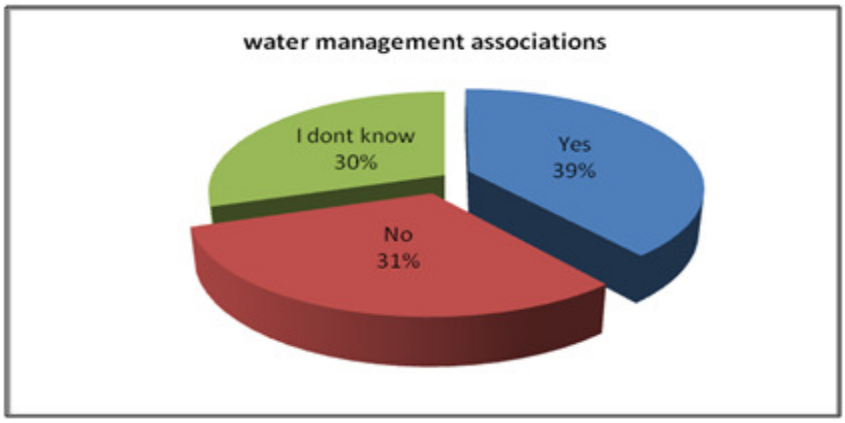

Figure 8: Availability of water management associations

Figure 8 illustrates the views of respondents on whether or not water management associations exist in their communities. About 39% of the respondents said that there exist water management associations in the communities to ensure the judicious utilization of water and to help manage the available water facilities. However, 31% expressed a contrary view on water conservation in their communities. They contended that there were no existing water management associations in their communities. The remaining 30% were undecided as they were not sure on the existence or not of such associations.

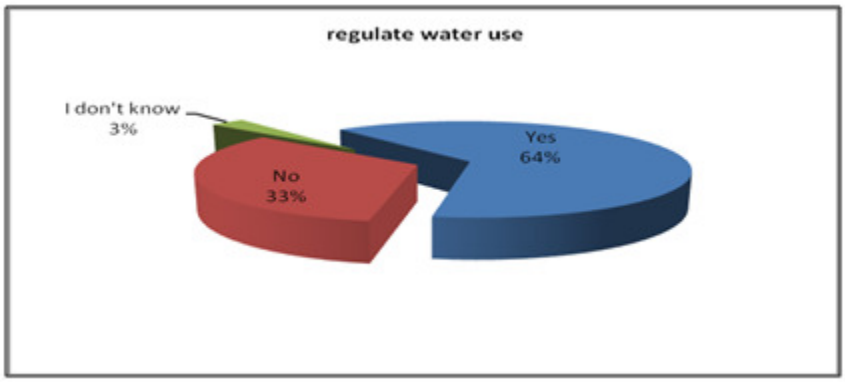

Figure 9: Regulation of water usage

Various reasons were provided as to why or not water use should be regulated in the sampled communities. About 33% were of the notion that since most wells/boreholes were owned by private individuals, there was no need to regulate the use of such privately-owned water facilities as illustrated in Figure 9. However, 64% believed that regulating the use of water would go a long way to promote the sustainable use of water. In order to reduce the incidence of waterborne diseases and address issues of poor sanitation, about 5% contended that regulating the use of water was important. A further 3% were of the view that since water use regulations were instituted by Watsan committees, such measures were meant to promote efficiency in water usage and sustainability of the water facilities and therefore they ought to be respected.

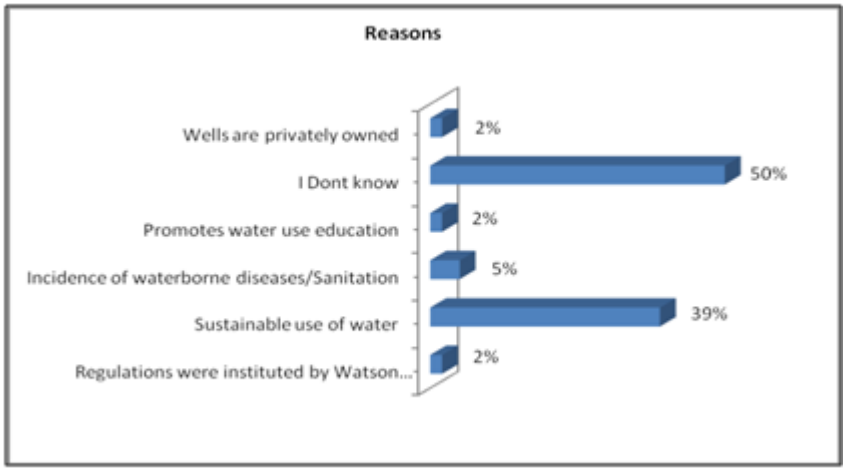

Figure 10: Reasons for the need to regulate water usage

As a measure that minimizes and possibly avoids negative anthropogenic activities on water resources, 37% proposed public education to sensitize the general public on why and how to keep water resources safe from destruction. Similarly, 1% suggested the prompt prosecution of culprits to deter others from engaging in activities that destroy water resources or pose threats to them. Furthermore, 28% advised that instituting by-laws on water resources could help reduce to the barest minimum, human activities that destroy or harm water resources. As shown in Figure 11 below, a significant percentage (27%) of the respondents were unable to suggest at least one measure that could help prevent destruction of water resources through human activities.

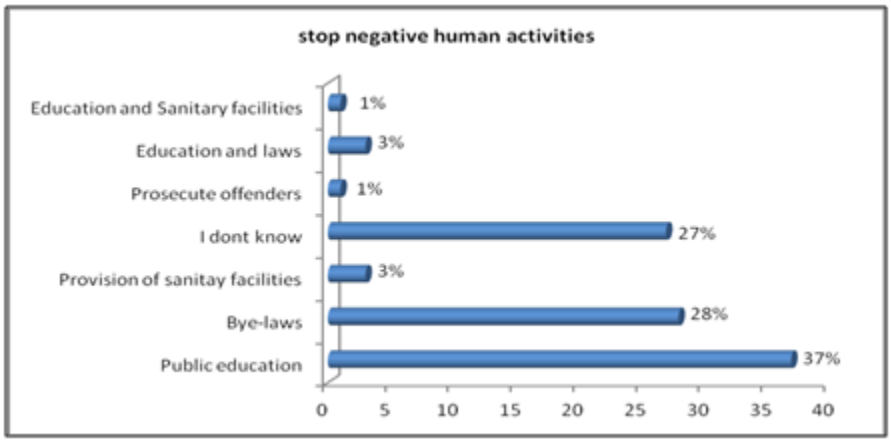

Figure 11: Measures to help prevent harmful human activities to water resources.

5. Conclusion and Recommendation

Water conservation and resource management is very important in sustaining water for future use in rural areas in Ghana but it's clear that proper attention is not paid to water resources in most rural communities hence the possible shortage of water in the near future if not a total lost.

A general rule of thumb is a minimum of 6 metres and preferably 10 metres for boreholes and dug wells and up to 20 metres for protected springs (Morgan, 1990). Diversion ditches should lead water into a larger drainage network or if not possible then collection boxes can be placed at the end of the diversion ditch. Restricting access by both humans and animals to the headworks is also important to reduce risks of contamination and thus all sources should be enclosed by a fence.

6. References

i. Bannerman R.R, (2000), Conflict of technologies for water and sanitation in developing countries, In Chorus I, Ringelband U, Schlag G and Schmoll O (eds.), Water, Sanitation and Health, IWA, London, UK: 167-170.
ii. Davison, A; Howard, G.; Stevens, M.; Callan, P.; Fewtrell, L.; Deere, D. and Bartram, J. (2004). Water Safety Plans: Managing drinking-water quality from catchment to consumer. IWA Publishing, London
iii. Hellard, M.E, Sinclair, M.I, Forbes, A.B and Fairley, C.K. (2001). A randomised, blinded, controlled trial investigating the gastrointestinal health effects of drinking water quality, Environmental Health Perspectives, 109 (8): 773-778.
iv. Helmer, R, Bartram, J and Galal-Gorchev, H, (1999). Regulation of drinking-water standards. Water Supply, 17(3/4): 1-6.
v. Morgan, (1990) Rural water supplies and sanitation – A text from Zimbabwe's Blair Research Laboratory, Macmillan Publishers, London, UK.
vi. O'Connor, D. R. (2002). Report of the Walkerton Enquiry: The events of May 2000 and related issues. Queen's Printer for Ontario, Toronto, Canada.
vii. Payment, P. and Hunter, P.R. (2001). Endemic and epidemic infectious intestinal disease and its relationship to drinking water. In Fewtrell L and Bartram J (editors): Water quality: guidelines, standards and health. IWA Publishing, London, pp 61-88.
viii. Robertson, J.B. and Edberg, S.C. (1997). Natural protection of spring and well drinking water against surface microbial contamination. I hydrogeological parameters. CRC Press.