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Assessment of Water Handling Practices among Rural Communities of Dire Dawa Administrative Council, Dire Dawa, Ethiopia

Desalegn Amenu[1*], Sissay Menkir[2] and Tesfaye Gobena[3]

[1]College of Natural and Computation Science, Wollega University,Post Box No: 395, Nekemte, Ethiopia

[2]Department of Biology, Haramaya University, Post Box No: 337, Dire Dawa, Ethiopia

[3]College of Health Sciences, Haramaya University, Post Box No: 337, Dire Dawa, Ethiopia

Abstract

The aim of this study was to assess the impact of knowledge and hygienic practices of the community on bacteriological quality of drinking water at the source and point of use. A community based cross-sectional study was conducted using interviewer administered questionnaire, inspection check list to observe the condition of water sources, and bacteriological water quality examination of sources and household containers. The study was conducted during February-May 2011 in rural Communities of Dire Dawa Administrative Council. Three hundred eighty four households were selected using systematic random sampling method to assess the knowledge and hygienic practices of the community and gathered by health extension worker under strict supervision of principal investigator and supervisors. Bacteriological examination of six water sources systematically selected household containers was carried out by using Oxfam DelAgua water testing kit. Almost all of the water sources were subjected to contamination of faecal coliform with high sanitary risk score. There is a significant variation between the bacteriological analysis of source water and household drinking water samples. Educational status was the only variables which was significant after adjustment of other socio demographic, Knowledge and practices variables. However other variables like: types of household containers, washing of containers before transferring, methods of water withdrawal, duration of stored water and cover of container during transportation and storage were significant in bivariate analysis but not in multivariate analysis. This may be due to confounding effects of different variables. Protected springs with high sanitary risk score were highly subjected to bacteriological contamination and its load of feacal coliform almost tripled at household level, because of poor household management.

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***Corresponding Author:**
Desalegn Amenu
E-mail:
desalegnsore@gmail.com

INTRODUCTION

Water is the essence of life and safe drinking water is a basic human right essential to all, and for sustainable development. It is known that water is our most precious resource, vital to our economy, our daily lives and to the health of our environment. Water and sanitation inadequacies hinder economic and social development, constitute a major impediment to poverty alleviation and inevitably lead to environmental degradation (WHO, 2004). A community ravaged by diarrheal diseases, dracunculiasis or schistosomiasis cannot look beyond its immediate problems towards social and economic welfare. Safe water is the door way to health and health is the pre-requisite for progress, social equity and human dignity (WHO, 2004).

Access to safe water alone does not reduce diarrheal diseases significantly. Even if the source is safe water become faecally contaminated during collection, transportation, storage and drawing in the home. Inadequate hygiene practices must be targeted as well when implementing water and sanitation projects, to decrease morbidity and mortality especially in rural area. Along with building or improving water points therefore we should provide hygiene education for all user groups. Hygiene Promoters inform community members about the correct use and storage of water, the need for safe sanitation facilities, personal and environmental hygiene and diarrhea transmission

and management, aiming at sustainable behavior change (Teferi Abegaz, 2007).

Protection of water supply from contamination is the first line of defense against disease. Because of the essential role water plays in supporting human life, it has if contaminated, great potential for transmitting a wide variety of disease and illnesses. Source protection almost invariably is the best method of ensuring safe drinking water. However, failure to provide adequate protection, poor site selection, and unhygienic practices of the consumers and deterioration of construction materials may contribute the contamination of water sources and resulting water borne diseases (Teferi Abegaz, 2007).

In Ethiopia, water supply and sanitation situation is inadequate. Most of the populations in urban and rural areas do not have access to safe and adequate water supplies and sanitation facilities. Regarding food, water and personal hygiene, only few households show sufficient understanding of environmental sanitation or hygienic practices. As a result, three-fourths of the health problems in Ethiopia are due to communicable diseases attributable to unsafe/inadequate water supply, and unhygienic/ unsanitary waste management, particularly excreta (UN-WATER/WWAP- National Water Development Report for Ethiopia, 2004).

Diarrhoeal diseases caused by improper management of water and sanitation are among the major causes of infant and child morbidity and mortality. Water and sanitation programs have a direct bearing on the prevalence of diarrhoeal diseases in the population. Water and sanitation projects, which are properly designed and implemented, have the potential of reducing diarrhoea-caused deaths by 55 percent. The combination of safe water supply, sanitation facilities and hygienic practices has demonstrated a potential in contributing to a remarkable reduction in mortality (UN-WATER/WWAP- National Water Development Report for Ethiopia, 2004).

In Ethiopia over 60% of the communicable diseases is due to poor environmental health conditions arising from unsafe and inadequate water supply and poor hygienic and sanitation practices. About 80% of the rural and 20% of urban population have no access to safe water; which is the least among the continent. Three-fourth of the health problems of children in the country are communicable diseases arising from the environment, especially water and sanitation (MoH, 2007).

Although safe water supply services are available in most places, the national as well as the regional information on the water quality status and the household management of local water sources is not readily available. This research tries to identify feacal coliform loads of protected springs and household drinking water containers and the main contributing factor towards the contamination of drinking water and variation of quality at the source and household level. The findings of this study may provide important information for water and sanitation policy makers and program managers, NGOs and government bodies involved in the implementation of water and sanitation projects to improve the service in the future. The main aim of this study was to investigate knowledge and hygienic practices of the community with respect to bacteriological quality of water from source to home.

METHODS AND MATERIALS

Description of the Study Areas

The present study was conducted between February and May, 2011 in three purposively selected Peasant Associations (PA) which are found in Dire-Dawa Administrative Council: The Dire-Dawa town is located in Eastern parts of Ethiopia, which is 508 km away from Addis Ababa, capital city of Ethiopia.

All the three areas receive an average monthly rainfall of 55.71mm and have bimodal pattern; the big rains occur from July to September, and the small rains from March to April. The monthly average maximum and minimum temperatures are 32.4 and 19.1^{0}C, respectively and the mean annual relative humidity is 48.2% (NMSA, 2010). Legedini is located 28 km east of Dire-Dawa City, at 09^{0}37"57'.3 N latitude and 042^{0}02"44' E longitude and an altitude of 1100-1600 m.a.s.l. The area has nine villages with a total population of 4500-5000. Adada is located 18 km east of Dire-Dawa city. Geographically the area is located at 09°32"53'.6 N latitude and 41^{0}56"23'.7 E longitude and an altitude of 1506 m.a.s.l. The area has 15 villages with a total population of 14,000. Geographically; Legebira is located at 09^{0}31" 23'.4 N latitude and 41^{0}57"16'.5 E longitude with an altitude of 1646 m.a.s.l that is at 15km east of Dire-Dawa city. The area has 6 villages with a total population of 2500-3500 (CSA, 2006; NMSA, 2010).

Farmers in this study area are engaged in crop-livestock mixed agriculture and they are not food self-sufficient and most of the time they are dependent on donation from government and other donor organizations (Dawit, 2006). The major crops cultivated by the farmers are maize and sorghum. The livestock owned by the people are mainly camels, cows, donkeys, oxen, goats and sheep.

The above mentioned author further reported that in each study sites some people uses water from protected sources such as springs, boreholes, deep and shallow protected well, hand-dug wells, and others use from unprotected water sources such as surface water, river, seepage, unprotected well. The common problems of the three study sites are inadequacy of clean drinking water, lack of water for agricultural and household activities and insufficient sanitary facilities. As a result, waterborne and hygiene related diseases occur frequently (Dawit, 2006).

The Study Design

A cross-sectional survey was conducted to determine the microbiological quality of water sources and to assess the households' water handling practices among the communities in the surrounding areas of Dire Dawa Town. The design also includes laboratory investigation which was carried out by collecting water samples from different sources from February, 2011 to May 2011. The questionnaires survey were done to collect data related to the respondents' socio-demographic characteristics and their water handling practices. The questionnaires were pre-tested in a few selected households living outside of the present study area.

Sample Size

The sample size for the questionnaire survey was determined based on the 5% error term and the 95% confidential interval and *P* was taken as 0.05. Since there were no previous related studies conducted in the area, 50% was assumed for the proportion of respondents who have good practices households (P). The sample size was calculated using a formula for a single population proportion.

$$n = Z^2 P (1-P)/d^2$$

$$n = Z^2 \alpha/2 (50\%) (1-50\%)/ d^2$$

Where,
n = sample size
P= proportion of households with good water handling practices
d= margin of sample error
Zα/2=P- value at 95% CI from table

Questionnaire Survey on Households' Water Handling Practices

Structured questionnaires were prepared by the investigator, which include the basic socio-demographic and the households' knowledge, awareness regarding water handling practices of households in the rural communities of the study area. The questionnaires were then administered to the selected study households at their respective residential places. A total of 384 questionnaires were administered. The questionnaires were originally developed in English and then translated to local language (Oromiffaa). The Oromiffaa version was later translated back in to English with the help of language professional. All necessary corrections were made for the actual questionnaire. The questionnaire was pre-tested in few selected household. The pre-test was conducted near the study area which had similar characteristics to the areas where the actual study was carried out. Vague terms, phrases and questions identified during the pre-test were modified and changed. Missing responses like "no response" and "others" were added, and skipping patterns were also corrected.

RESULT

Socio-demographic Characteristics

From the three study areas, majority of the respondents were women and mostly they were Muslim. Regarding occupational status of the respondent all were farmers. Concerning their educational status majority of them were illiterates (did not able to read and write) (Table 1).

Water Handling Practices Related to Collection and Transportation

Adada

Majority of the respondents were found to collect water from tap which is about 54(43.87%), 31(24.2%) of them will collect water from the well and 43(32.78%) of them will collect water from the springs. Maximum time required to fetch water was one and half hours and minimum of thirty minutes within above 50m distance. As the result indicated in this study, 90(70.3%) of the households were not aware to protect the water sources before use and 38(29.7%) of the respondents were admitted to protect the water sources before use (Table 2).

The study revealed that the most commonly preferred type of water collection container was Jerrican, which accounted 76(59.37%) followed by clay pots 52 (40.63%). From the total respondents, only 48(37.5%) of the respondents will clean their containers before collection. In addition, majority of the respondents were not cover the collection container during transportation (Table 2).

As designated in this study, 28(21.88%) of respondents were collect water once a day, 20 (15.5%) of the respondent were collected water three times a day and the remaining 80(62.5.9%) were collected twice a day. Daughters were highly responsible to collect water followed by mothers to fetch water from a source. Among the responsible children, majority of their age was below 10 years (Table 2).

Table 1: Socio-demographic characteristics of respondents from Adada, Legebira & legedini February 2011.

Questions items	Adada (n=128)		Legebira (n=128)		Legedini (n=128)		Total Respondents from all sites
	No.	%	No.	%	No.	%	
Age of the Respondents							
15-24 years	22	17.4	20	15.62	20	15.62	62
25-34 years	53	41	64	50	69	53.90	186
35-44 years	28	21.9	28	21.87	24	18. 75	80
>44 years	24	19.0	16	12.5	16	12.5	56
Gender							
Male	7	5.5	7	5.5	6	4.68	20
Female	121	94.5	121	94.5	122	95.31	364
Religion							
Christian	4	3.12	3	2.34	4	3.12	11
Muslim	124	96.88	125	97.65	124	96.87	373
Educational Status							
Illiterate	113	87.04	100	78.12	98	76.56	335
Read and write	13	10.5	23	17.94	10	7.8	33
Elementary	1	0.78	3	2.34	6	4.68	10
Secondary	1	0.78	1	0.78	4	3.12	6
Occupational Status							
Farmers	120	93.75	100	78.12	113	88.28	332
Merchant	4	3.12	12	9.37	16	12.5	32
Government Employs	2	1.56	8	6.25	0	0	10
Housewives	2	1.56	8	6.25	0	0	10

Table 2: Water handling practices related to collection and transportation in rural communities of DDCAC.

Questions items	Adada (n=128)		Legebira (n=128)		Legedini (n=128)		Total from all sites
	No.	%	No.	%	No.	%	
From where did you get water?							
spring	43	32.78	56	43.87	40	31.25	140
well	31	24.2	41	32	68	53.12	140
Tap water	54	43.87	31	24.2	20	15.62	104
What is the approximate distance of water sources from your home?							
Below 30 min.	20	15.6	-	-	10	7.81	30
31-60 min.	40	31.5	54	42.18	40	31.25	134
More than 60 min.	68	52.9	74	57.81	78	60.93	220
What types of container do you use to collect water from sources?							
Clay pot	52	40.62	96	75	80	62.5	156
Jerrican	76	59.37	32	25	48	37.5	228
Do you cover the container while water collection?							
Yes	48	37.5	40	37.5	21	16.40	109
No	80	62.5	88	68.75	107	83. 59	275
Do you wash your container?							
Yes	48	37.5	40	31. 25	32	25	120
No	80	62.5	88	68.75	96	75	264
How many times do you collect water per day?							
Once a day	28	21.9	24	18.75	20	15.5	66
Twice a day	80	62.5	84	65.62	80	65.62	204
Three times a day	20	15.5	20	15.5	28	21.88	64

Legebira

As the result from the Legebira site shown that, majority of the respondents were collect water from springs which accounted 56(43.87%), 41(32%) of them are collect water from the well and 31(24.2%) of them are collect water from the tap. The maximum time required to fetch water was more than one hour and minimum of 30 minutes. The majority of the households, 98(76.57%) were not aware to protect the water sources before use, while only 30(23.43%) of the respondents were admitted to protect the water sources before use (Table 2).

The study revealed that the most commonly preferred type of water collection container was Jerrican, which is accounted about 32(25%) followed by clay pots 96 (75%). Only 40 (31. 25%) of the respondents cleaned their containers before collection. Majority did not cover for their collection container during transportation. Greater part of respondents, 84(65.62%) of the study subjects were found to collect water twice a day, 24 (18.75%) of the respondent once a day and the remaining 20 (15.5%) collect three times. Daughters were highly responsible to collect water followed by mothers to fetch water from a source. Among the responsible children, one majority of their age was below 10 years (Table 2).

Legedini

Majority of the respondents from the Legedini were compel to collect water from well (especially from unprotected one) which accounted 68 (53.12%), 40(31.22%) of them are collect water from the spring and 20(15.62%) of them are collect water from the tap water. Maximum time required to fetch water was more than one hour and minimum of 30 minutes. As the result of the questionnaires pointed out that, majority of the households were not attentive to protect the water sources before use, while only 20(15.62%) of the respondents were admitted to protect the water sources before use (Table 2).

The study revealed that the most commonly preferred type of water collection container was clay pots, which is accounted about 80(62.5%) followed by Jerrican 48(37.5%). Only 21(16. 40%) of the respondents cleaned their containers before collection. Majority did not cover for their collection container during transportation (Table 6). Majority of respondents, 80(65.62%) of the study subjects were found to collect water twice a day, 20(15.5%) of the respondent once a day and the remaining 28(21.9%) collect three times a day. Daughters were highly responsible to collect water followed by mothers to fetch water from a source. Among the responsible children, one majority of their age was below 10 years (Table 2).

Water Handling Practices Related to Storage and Usage by Households

Adada

Among the study inhabitants using separate container to store water, 8465.62%) the households preferred clay pots and the rest 44(34.36%) used jerrican and 68(53.12%) of them were will not wash storage containers before re-filling, similarly 70(54.65%) of households were use separate containers without cover materials. From the total selected households, 80(62.5%) of the households stored water for a day, 28(21.88%) for more than a day and 20(15.5%) for less than a day. According to the observation during the data collection, the sanitation of the area near the storage containers was poor. In addition, the storage container has a possibility of reaching animals (Table 3).

Pertaining to the way that the respondents' withdraw water from containers, 100(78.12%) of the respondents preferred pouring and the remaining 28(21.87%) by dipping. Among those respondent using dipping, cups without handle accounted 70(54.68%). In addition, 87(69.3%) of the respondents placing dipping or drinking utensils on the floor, the result was also consistent with the observation that was seen during data collection (Table 3). Majority of the households were not admitted to treat the water sources before collecting.

Legebira

As of the result of survey conducted at Legebira sites, along with the study population using separate container to store water, 78(54.68%) preferred clay pots and the rest of them 50(36.88%) were used Jerrican, and 68(53.12%) of them were not wash storage containers before re-filling, similarly 88(68.75%) of the separate containers were without cover materials. Majority, 90(70.31%) of the households stored water more than a day, 24 (18.75%) for less than a day and 14(10.93%) for more than a days (Table 7). In accordance with the observation during the data collection, the sanitation of the area near the storage containers was poor. In addition the storage container has a possibility of reaching animals.

Concerning the way that the respondents' with-drew water from containers, 68(53.12%) preferred pouring and the remaining 60(46.88%) by dipping. Among those respondent using dipping, cups without handle accounted 88(68.75%). In addition 98 (76.56%) of the respondents placing dipping or drinking utensils on the floor, the result was also consistent with the observation that was seen during data collection (Table 3). All the respondents were not aware of protectingthe water sources.

Legedini

At the Legedini site, among the study population using separate container to store water 90(70.31%) preferred clay pots and the rest used jerrican, and 78(62.5%) of them did not wash storage containers before re-filling, similarly 79(61.71%) of the separate containers were without handle. Greater part of the respondents, 60(46.68%) of the households stored water for more than a day, 45(35.14%) for a day and the rest were for less than a day (Table 3). According to the observation during the data collection, the sanitation area near the storage containers was poor. In addition, the storage containers have a possibility of reaching animals.

In relation to the way that the respondents' withdrew water from containers, 8(6.25) preferred pouring and the remaining 120(93.75%)) by dipping. Among those respondent using dipping, cups without handle accounted 69(53.9%). In addition, 96 (75%) of the respondents placing dipping or drinking utensils on the floor, the result was also consistent with the observation that was seen during data collection (Table 3). Predominantly, the respondents were not aware of protecting the water sources before use.

Table: 3: Water handling practices related to storage and usage by households from Adada, Legebira and Legedini in February 2011.

Question items	Adada (n=128)		Legebira (n=128)		Legedini (n=128)		Total from all sites
	No.	%	No.	%	No.	%	
What type of storage do you use to store water?							
Clay pots	84	65.62	78	54.68	90	70.31	252
Jerrican	44	34.36	50	36.88	38	29.68	122
Do you cover of storage container?							
Yes	60	46.88	60	46.88	50	39.06	170
No	68	53.12	68	53.12	78	60.93	124
How do you collect water from the storage?							
Pouring	100	78.12	68	53.12	8	93.75	176
Dipping	28	21.88	60	46.88	120	6.25	208
What the dipping juck looks like?							
With handle	68	53.12	40	31.25	49	38.28	157
Without handle	70	54.68	88	68.75	79	61.71	227
Where did you put the juck?							
On a safe place	41	31	30	23.43	32	25	103
On the floor	87	69	98	76.56	96	75	281
For how many days do store water in the container?							
For a day	80	62.5	14	10.93	45	35.14	108
More than a day	28	21.88	90	70.03	60	46.68	208
Less a day	20	15.5	24	18.75	23	18.18	68
Which methods of water treatment do you prefer?	6	4.7	34	26.6	46	32.8	86
Chemical	7	5.5	9	7	-	-	23
Boiling	3	2.3	11	8.6	-	-	14
Filtration	112	87	70	57.8	79	67.2	261
No treatment							

DISCUSSION

The results of this study indicated that springs and wells water sources were subjected for the microbiological contamination in all sites and sources. Because community unhygienic practices increase the sanitary risk of the water sources, water sources with high sanitary risk score had unacceptable water quality (unprotected well and protected well, unprotected spring and protected spring and tap water) from the three sites (Adada, Legedini and Legebira). Specially, the water sources of Legedini, unprotected well and protected well had high unhygienic practices. In contrast, the water sources of Legebira had intermediate risk of sanitary practices and the Adada water sources have less sanitary risk than the left sites.

Study in Srilanka demonstrated that (65%) to (85%) of public water supplies mostly protected springs become microbiologically contaminated (Mertens, 1990). The higher hazard scores of water sources generally correlate with increasing magnitude of bacterial contamination (Lioud, 1992).

More than half of the respondents were doing laundry and bathing activities near the water sources. A similar study in rural Zambia and in South Wollo Ethiopia showed that poor community sanitary practices around the sources and near the catchment areas together with inadequate protection of water sources increased the sanitary risk scores of the springs and contributed to the microbiological contamination of water sources (Thomas and Cairncross, 2004; Seid *et al*., 2003).

In the present study, the wells and springs water sources were more contaminated than tap water. The reason behind the variation of sanitary risk scores between water sources may be due to its location and other factors (poor site selection, unhygienic practices near the water source, and inadequate treatment). Those sources having high sanitary risk score were found in a densely populated area and the number of households who practiced bathing and laundry activities are increasing near the water sources. The result of sanitary and quality monitoring in a pilot water quality surveillance study in Srilanka demonstrated water sources become contaminated because of poor site selection, protection and unhygienic management of facilities (Mertens, 1990).

From the total respondents, 66.2% of households used clay pots for household water storage while the remaining 33.8% stored water in Jerrican except in Adada, which was the majority of the respondents use Jerrican both for the collection and storage of the water. Respondents that preferred clay pots were revealed increasing of the risk of faecal coliforms than those of respondents using jerrican. This current result was harmony with the finding in Bangladesh that revealed that traditional pots increased the load of faecal coliforms (Spira *et al.,* 1980). Similarly, Mertens (1990) and Seid *et al.* (2003) reported that the water stored in clay pots was shown higher proportion of load of faecal coliform than that of narrow necked container.

As indicated from the result of the survey on water handling practices, (55.5%) of the respondents cleaned their container before transferring water from collection to storage containers and (44.5%) of them were not cleaned the container before water collection which was much lower than a study done in Jimma town 91% (Teklu and Kebede, 1998). Similarly, (52%) of the respondents covered their storage container, which was almost similar with the study conducted in Garmuleta district (60%), and Kidame Gebeya (58%), but much lower when comparing with a study done in South wollo, 92.7% (Seid *et al*., 2003). This difference may be due to inadequate and unhygienic practices related to water handling practices in the present study areas.

The main contribution for household water contaminations were unrestricted and unhygienic water collection and storage activities such as: selection household containers, lack of cover, ignorance of washing of containers before collection and transferring to storage containers, transfer of water out of storage container by dipping and placement of drinking or water drawing utensils on floor, because of this the feacal coliform load increases by two fold in household container than sources (Thomas and Cairncross, 2004).

In this study, 85.41% of the respondent dipped out water while 14.59% of the respondents poured water to collect from the storage container, which is a commendable practice. This was almost higher when comparing with studies conducted in Zambia with 80% and in south Wollo with 72% of the households was dipped out from the container (Sutton, 1989; Seid *et al*., 2003). The reason for these much difference is may be due to the use of narrow naked clay pots and jerrican, which is inconvenient for dipping in the study. Transfer of water out of storage containers by pouring showed statistically significant diminution on the concentration of faecal coliforms than dipping in the study area.

CONCLUSIONS

Source protection found to be necessary condition, but never be sufficient for the provision of safe water supply and in reduction of diarrheal diseases. Almost all protected springs were grossly polluted with faecal matter. The high sanitary risk score and presence of faecal coliforms in the existing water sources is attributed to constructional defects, lack of follow up, bathing and laundry activities undertaking near the source. There was a significant variation of bacteriological water quality between source water and household drinking water. Water obtained at household level is more bacteriological concentration than its origin. The main contribution for household water contaminations were unrestricted and unhygienic water collection and storage activities such as: selection household containers, lack of cover, ignorance of washing of containers before collection and transferring to storage containers, transfer of water out of storage container by dipping and placement of drinking or water drawing utensils on

floor, because of this the feacal coliform load increases by two fold in household container than sources. Health education in water handling and management improve the quality of drinking water.

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