Research Article
Volume 11:12, 2021

Journal of Civil & Environmental Engineering

ISSN: 2165-784X

Open Access

Water Supply Management and Sustainability in Afgoi District, Somalia

Abdullahi Mohamed Sheikh Ali*, Abdirahman Mohamed Ahmed, Ali Warsame Hassan Arale and Abdulshakur Abdullahi Di'iso

Department of Civil Engineering, College of Engineering and Technology, Abrar University, Hodan district, Mogadishu, Somalia

Abstract

The civil war in Somalia that erupted in 1990 has destroyed totally the major water resources infrastructures including boreholes. Hence, The main purpose of this research was to analyze sustainability and management of the water supply systems (Tadamun/Hawa tako, Tadamun/ If & Akhiro, Dudublaha, Maskaxey, and Wanjel) managed by water users committee implemented in Afgoi district, Somalia; In addition, this research also studied the water supply systems and its sustainability. This reseach focuses primarily on the assessments carried out in the field, observations, household survey, and water tests; Results shows that all the studied schemes are financially and technically sustainable and able to delivered good quality of water to the users. Though, the water schemes are self-reliant, regularly provide major technical assistance. Hence all of the water supply system seems to be smoothly operating without financial, technical or institution problems with in water supply system and the community. Thus, it can be concluded that five water supply systems are providing quality drinking water to the people.

Keywords: Water supply • Management of water supply • Sustainability of water supply • Sources of water supply • Demand of water supply

Introduction

Water is basic need and human right of people. People need water for various domestic purposes like drinking, cooking, sanitation, irrigation and generating of an Electrical power. Besides domestic use people also need water for other diversified livelihood including livestock, the water in our bodies is essential for life. Water is the most essential nutrient for livestock production and is needed for numerous process, such as the regulation of body, temperature, growth, etc [1]. There are many of water sources in this global world and these water sources are the rain water, seas, rivers and wells. Generally, Somalia situated in the Horn of Africa, and has a total area of 637657 km^2. It shares the border with Kenya, Ethiopia and Djibouti, and also Somalia has an arid and semi-arid climate. About 60% of the country is under savannah woodlands, used mainly as rangelands. Somalia's land boundaries extend to about 2,340 kilometers; 58 kilometers of that are shared with Djibouti, 682 kilometers with Kenya, and 1,626 kilometers with Ethiopia. Its maritime claims include territorial waters of 370 km. The northern part of the country is mountainous, while the south and eastern sections are characterized by narrow coastal plain and interior plateau.

Being located in an extremely water-scarce area, the environmental, social and economic development of Somalia is to a large extent dependent on improved water security through effective management of water resources. Water resources in Somalia are limited both in quantity and quality, with frequent droughts and floods further worsening the water security situation in the country [2-5]. Lower Shebelle is an administrative region in southern Somalia that is named after the Shebelle River which emerges from the eastern Ethiopian highlands and passes for 150 kilometres [6]. The region covers an area of around 29,761 sq. km and it is bordered to the south by the Juba region, to the east by the Indian Ocean and Mogadishu, the Middle Shebelle region to the north and the Bay region to the west, The region comprises eight districts: Merka (the regional capital), Afgoi, Wanle Weyn, Koryoley, Sablale, Brava, Kurtun Warrey and Audegle. It has an estimated population of 800,000 to 900,000, the population is classified under four categories; nomadic agricultural, agricultural, nomadic, and urban sedentary [7]. Lower Shebelle is thereby the most populated region in Somalia after Benadir (Mogadishu and the surrounding area); Afgoi is a town in the south-western region of Somalia, about 25 kilometres west of the capital Mogadishu; and its coordinate location is (2.1426°N, 45.1167°E). Afgoi is popular for its wonderful beauty and the ancient traditions of Somalia [2]. Where major water supply schemes were constructed and others under construction by partners that involve international and local NGOs; the district is sharing borders with Merka, Koryoley, Wanle Weyn, jowhar, Bal'ad and Benadir. Many of Afgoi communities are depending on the water of river Shebelle and they are suffering from inadequate and unsustainable drinking water. These communities don't get enough water for their daily use during the dry seasons of Somalia, also the water is not good in the wet seasons for the various domestic purposes; and also they don't have enough water supplies and water treatment systems that provide them an adequate drinking water [8].

***Address for Correspondence:** Abdullahi Mohamed Sheikh Ali, Department of Civil Engineering, College of Engineering and Technology, Abrar University, Hodan district, Mogadishu, Somalia, E-mail: marwaanka9@gmail.com*

Received 25 November, 2021; **Accepted** 15 December, 2021; **Published** 22 December, 2021

Materials and Methods

Study area

This is study was conducted in Afgoi, lower Shebelle in Somalia and we took Five water samples from different wells Tadamun/Hawa tako well, Maskaxey well, Tadamun/If & akhiro well, Dudublaha well and Wanjel well; and this study area was selected purposively (Figure 1).

Methodology of the Study

When designing the data collection methods for this study, the research team faced serious challenges due to very limited access to the population. Considering the security constraints in the area, household questionnaires could not be administered to collect primary level data. However the 'usual' key informant interviews and questionnaire had to be conducted through enumerators [2]. The fieldwork for the study was conducted between 27th of March to 10th of April 2019 and covered five study area of Afgoi district (Hawa tako, If & Akhiro, Dudublaha, Maskaxey and Wanjel) of lower Shebelle. A detail investigation of five water supply systems in five different user communities, here after called cases and/or projects, was made to facilitate comparative

Figure 1. Lower Shebelle region in Somalia.

analysis of the project's development situation and its impact on system sustainability. The analysis also focused on empirical investigation of the determinants of water use pattern at household level and ways by which this affects system sustainability. The overall approach of the study follows the method of triangulation. It employed both quantitative and qualitative methods of data collection and analysis. To keep its validity and reliability, the study was guided by the principles of multiple sources and subsequent cross-checking of information as well as by applying various data collection instruments. It was intended to conduct investigation of the selected water supply scheme with the issue of participation and system sustainability. Besides, practical exploration of factors 13 affecting household level water consumption practices has been carried out, and the extent of its contribution towards the project sustainability has been measured. Characteristics of community participation were assessed in accordance with ensuring system sustainability. Factors associated with the interaction and degree of participation among the target community and other stakeholders in materializing water supply schemes under investigation have been assessed. The study has involved quantitative and qualitative methods of data collection and analysis. In order to ensure the validity of the quantitative data collected from the field.

Data collection methods

The functionality of water supplies was assessed by questionnaires and field observations. The questionnaire was used to evaluate the degree and type of participation, and to evaluate the institutional support during design, construction and maintenance phases. The questionnaire included questions about community contribution (capital, labor and material), female participation, technical factors (design of construction), financial factors, environmental factors (the sustainability of the water source), and health factors. Information was verified using cross check questions. In addition to the questionnaire focus groups discussion were arranged to obtain relevant information about the water supply systems. Questionnaires were also completed with study area experts concerning water supply assessment and their technical support and with community water committees about women 14 participation and water service management. To understand the realities of the water supply system field visits were conducted.

Sampling frame of the study

Out of the existing water supply schemes in Afgoi district, water schemes constructed with in the last 30 years were selected based on the type of technology used, management practices and system of operation. Accordingly, five water supply schemes were identified as unit of analysis for this research [3]. These water supply schemes are located at five different location such as the water supply system of Tadamun's water supply systems is located at Hawa tako and the other water supply system of Tadamun is located at (If & Akhiro); while the Dudublaha water supply system is located at (Dudublaha), Wanjel water supply system is located at Wanjel and Maskaxey water supply system is located at Maskaxey. All these water supply schemes are selected in order to represent extension of piped water supply services from adjacent district in the respective communities.

Sample population

As per the sampling design, the proposed design has involved Stratified sampling techniques that need to be administered in order to select respondents that constitute the representative sample population. Beneficiaries are the main primary data sources in this study. Therefore, the number of the sample population is selected based on their usage of the water supply that the researcher is investigating Afgoi district water [4].

Respondents are picked using stratified sampling in the near distance of every water supply systems that the researcher collecting the primary data to increase representativeness of the study. A total sample size of 24 participants is interviewed from 5 selected water supplies for primary data collection; the number of the people that the researcher has chosen were 24 as a sample from the number of target population that the researcher want to ask was 25 and the formula the researcher used was Slovene Formula for sample selecting.

$$n = \frac{n}{1 + 25(0.05)^2}$$

$$n = \frac{25}{1 + 25(0.05)^2}$$

$$n = \frac{25}{1 + 25(0.0025)^2}$$

$$n = \frac{25}{1 + 0.0625} = 23.529$$

Water quality sampling

For all water supply systems such as (Wanjel), (Dudublaha), (Tadamun/ Hawa tako), (Tadamun/ If & Akhiro) and (Maskaxey) water samples were collected from the source of the water supply systems, in the distribution system and at the consumer point. Samples were also collected on the sterilized bottles provided by the laboratory. One sample was taken from each water supply systems (Figure 2).

Method data analysis and interpretation

This study used both quantitative and qualitative data as a primary data. and Experimental test will be used in this study by analyzing the Samples such as analyzing for bacterial contamination (total coli form), physiochemical parameters (PH, turbidity, electrical conductivity, total dissolved solids, smell, and color) in the Mumtaz engineering & general services company laboratory in Mogadishu, also the researcher used SPSS data analysis software which involves descriptive statistics has been administered in order to manage, interpret and analyze quantitative data collected from the field.

Results and Discussion

Demographic and Socio-economic situation

Gender: As can be seen Figure 3 above, 16.7% of the total respondents

Figure 2. Water supply systems such as (Wanjel), (Dudublaha), (Tadamun/ Hawa tako), (Tadamun/ If & Akhiro) and (Maskaxey).

were Female, while 83.3% of the respondents were male, and the dominance of male respondents is normal because there are few female than male in public area where the questionnaire is conducted.

Age: As can be seen Figure 4 above, 10 respondents constituting 41.7% of the total respondents are in the age category of 15-30, 50% of the respondents fall in the age category of 31-45, and respondents in the range of 46-60 constitute 8.3% of the total respondents.

Educational background: In the Figure 5 above shows that 54.17% of the respondents were illiterate, 33.33% the respondents were secondary level, where the 12.50% of the respondents were more than secondary level such as bachelor.

Occupation: The Figure 6 above demonstrate that 4.2% of the respondents were drivers, 12.5% were farmers and Traders, 4.2% were farmers, 4.2% of the respondents were jobless, 4.2% were students, 33.3% of the respondents were teachers, 25% were technicians, and 8.33% of the respondents were traders.

Location: As Figure 7 above show us that 16.67% of the respondents were from Dudublaha, 20.83% of the respondents were from Maskaxey, 20.83 of the total respondents were from Tadamun/if & Akhiro, where 20.83% of the respondents were from Tadamun/Hawa tako and as the table shows us that 20.83 of the respondents were from Wanjel.

Access to safe drinking water and water use practices at household

As can be seen from the Table 1 above, all the respondents has stated that they get the water from water supply point.

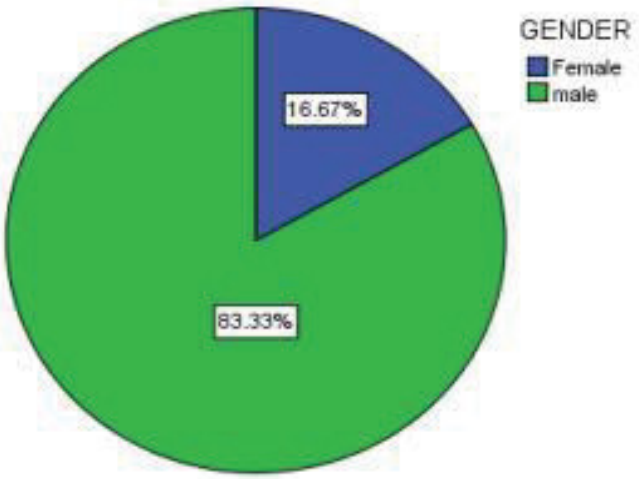


Figure 3. Gender of the respondents.

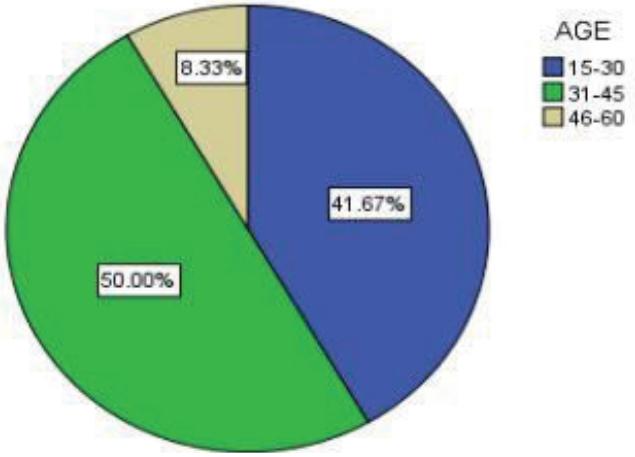


Figure 4. Age range of the respondents.

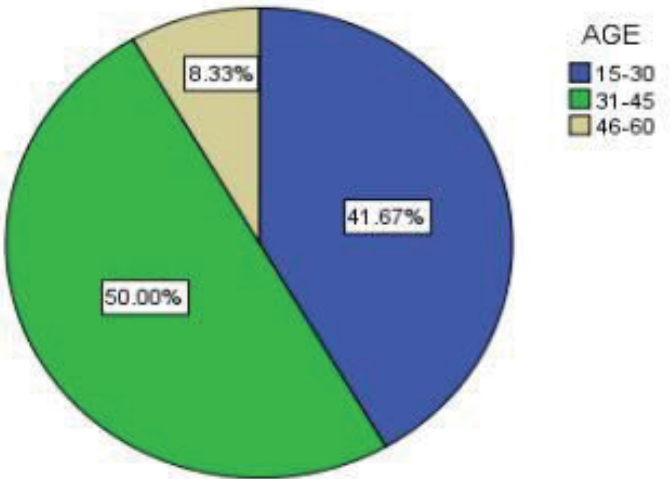


Figure 4. Age range of the respondents.

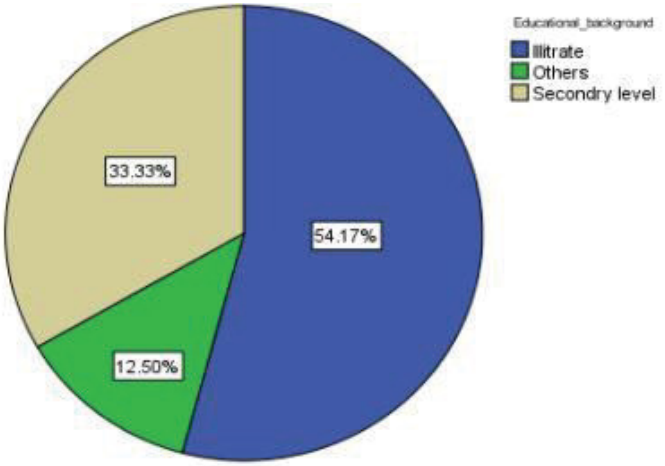


Figure 5. Educational background of the respondents.

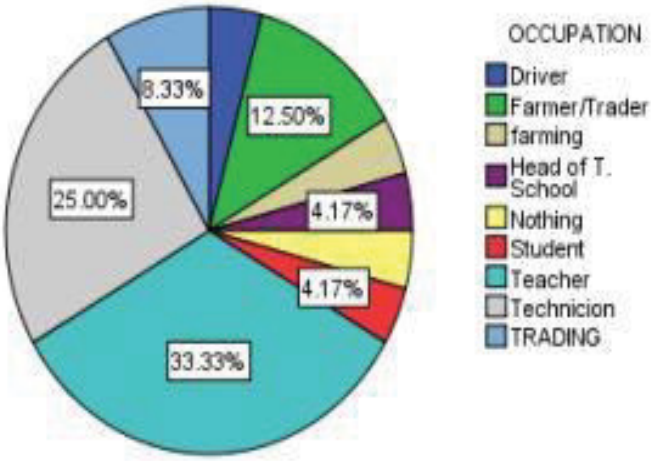


Figure 5. Educational background of the respondents.

8.33% of the respondents have states that they collect the water in their water tanks at afternoon, where 58.33% of the respondents stated that they collect the water at night, and 33.33% of the total respondents stated that they collect water at the morning (Figure 8).

As the Table 2 above shows that the respondents were stated that they get the water and collecting by using pipe lines.

As the Table 3 and the Figure 9 above shows that 58.33% of the respondents stated that the idea of building the water supply projects of the study area were initiated by the community residents, and the 41.67% of the

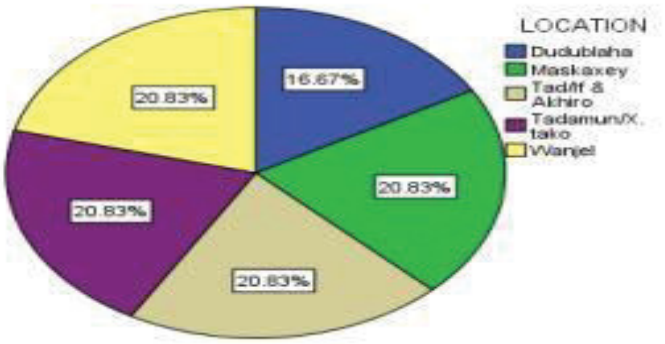


Figure 7. Location of the well.

Table 1. Main source of the water.

Valid	Frequency	Percent	Valid Percent	Cummulative %
From supply point	24	100	100	100

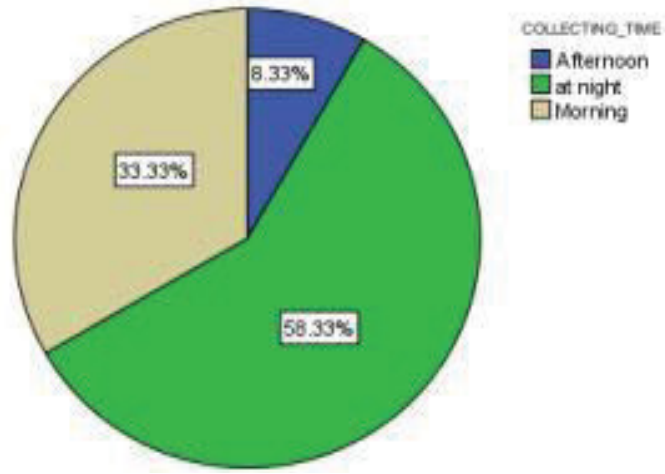


Figure 8. Collecting time of the water.

Table 2. Mechanism of the water collection.

Valid	Frequency	Percent	Valid Percent	Cummulative %
From pipe lines	24	100	100	100

Table 3. Respondents stated that the idea of building.

Valid	Frequency	Percent	Valid Percent	Cummulative %
Yes	24	100	100	100

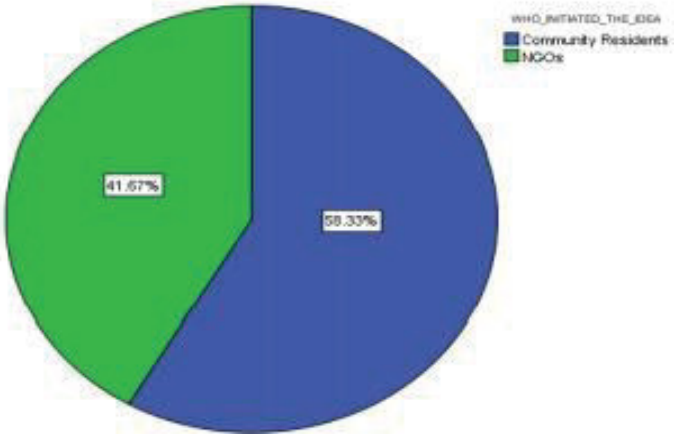


Figure 9. The person who initiated the idea of building the w. S. project.

total respondents stated that the idea was initiated by NGOs.

As the Figure 10 shows that 4.17% of the respondents collect 61-80 liters per day, where 87.50% of the total respondents collect 81-100 liters per day and 8.33% of the respondents collect more than 100 liters per day.

Purpose of using water from the well

As we see at the Table 4 above, all of the respondents stated that they use the water from the wells for their domestic purposes, such as cooking food, drinking and washing clothes.

All the respondents mentioned as the Table 4 above showing us that the water they get from the water source are enough for their domestic purposes.

Household and community attitude toward safe drinking water

Concerning the water safety of the study community; as the Table 5 above indicates, all the respondents stated that water they get from the water source is safe.

As we can see the Figure 11 above, 29.2% of the respondents stated that they pay $3-4 for the water per month, 54.2% of the total respondents pay $4-5 for the water per month, 4.2% of the respondents pay $4.5-5 for the water per month, 4.2% of the total respondents pay $5-6 for the water per month, 4.2% of the respondents pay $7-8 for the water per month, and 4.2% of the total respondents pay $7-10 for the water per month.

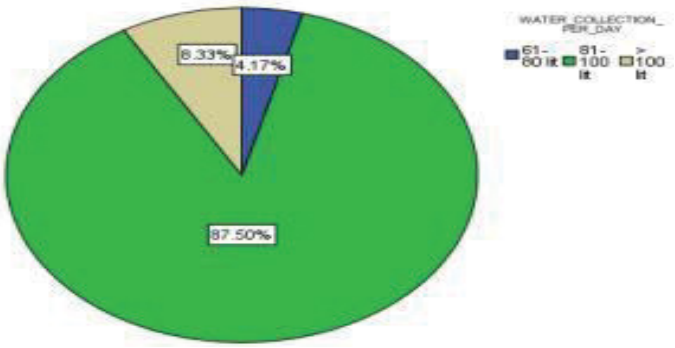


Figure 10. Average rang water collection per day.

Table 4. Is the water from the water source enough?

Valid	Frequency	Percent	Valid Percent	Cummulative %
Cooking\drinking washing cloth	24	100	100	100

Table 5. Safety of the water from the local source.

Valid	Frequency	Percent	Valid Percent	Cummulative %
Safe	24	100	100	100

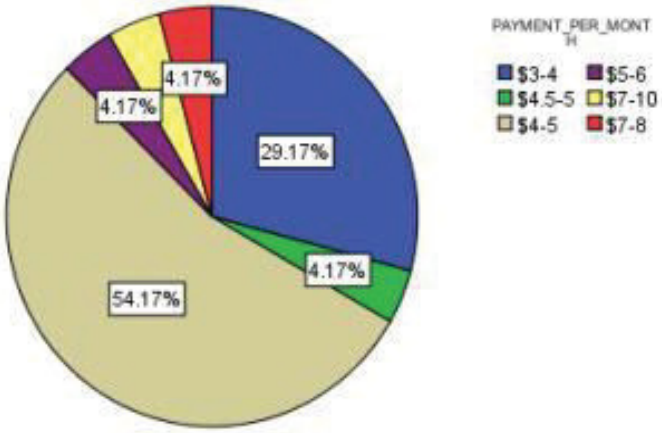


Figure 11. Payment of the water per month.

As indicated Figure 12 above, 37.5% of the respondents evaluated that the existing water fees cheap of the sample population. Where 62.5% of the respondents evaluated the existing water fees is fair.

As indicated Table 6 above, 100% of the respondents stated that they did not pay additional fee for maintenance and technical support.

Community participation in planning and management of water supply projects

As the Figure 13 indicated above, 20% of the respondent stated that they don't participate in the decision-making in all aspects that relates with the water supply development, and 79.17% of the total respondents stated that they participate in the decision-making in all aspects that relates with the water supply development.

As the Figure 14 indicated above, 79.17% of the respondents evaluated the community participation is good, and 16.67% of the respondents evaluated the community participation is very good, where 4.17% of the total respondents evaluated that the community participation is low.

Sustainability of the water supply system

As we see the Table 7 above, all of the respondents stated that the water source was operated and managed by water committee representing the community.

As the Figure 15 indicated above, 95.83% of the respondents stated that the women don't participate in the water managing committee, where 4.17% of the total respondents stated that the women participate in the water managing committee.

Common question about the water in the study area

As the Table 8 indicated above, all the respondents mentioned that the water they get from the water sources in study area is adequate.

As the Table 9 indicated above, all of the total respondents stated that the water of the water sources in the study area are available whole year.

As the Figure 16 above indicated, 66.67% of the respondents stated that the community of the study area faces water scarcity at dry seasons (March and April) of the study area, where 33.33% of the total respondents stated that community of study area does not face water scarcity at all.

As we can see at the Table 10 above, all of the respondents stated that the water of the water sources at the study area does not have smell.

As we can see at the Table 11 above, all of the respondents stated that the water of the water sources at the study area does not have test.

As we can see at the Table 12 above, all of the respondents stated that the water of the water sources at the study area look clear and clean.

As the Table 13 above indicated, 29.2% of the respondents stated that they did not made complaints that relates to the water services in the study area, where 70.83% of the total respondents made complaints that relates to the water services of the study area.

As shown in the Figure 17 above, 20.19% of respondents did not complain to owners of the water supply services, where 70.83% of respondents complained from the water to the owners of the water.

As the Figure 18 above shows us, 29.17% of the respondents did not give their complaints at all, where 70.83% of the total respondent's complaints were answered as prompt action taken toward the water services.

Results of the water samples

To insure that the safety of the water for human domestic uses the researcher took Samples from the water sources of the study area and were analyzed from bacterial contamination (total coli form), physiochemical parameters (PH, turbidity, electrical conductivity, total dissolved solids, smell, and color) in the Mumtaz engineering & general services company laboratory in Mogadishu (Figure 19-23).

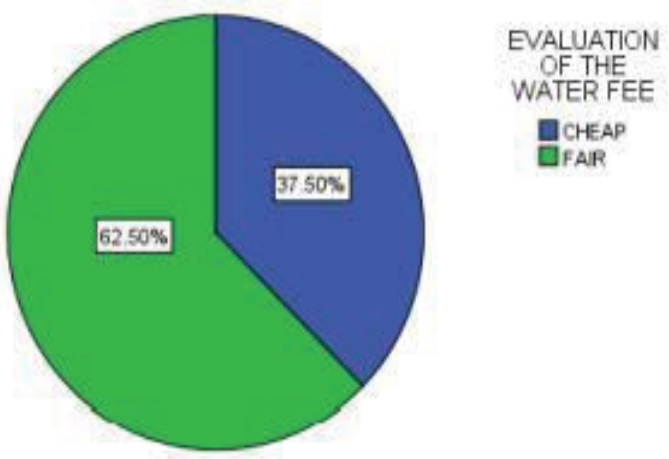


Figure 12. Evaluation of the water fee.

Table 6. Paying additional payment for maintenance.

Valid	Frequency	Percent	Valid Percent	Cummulative %
No	24	100	100	100

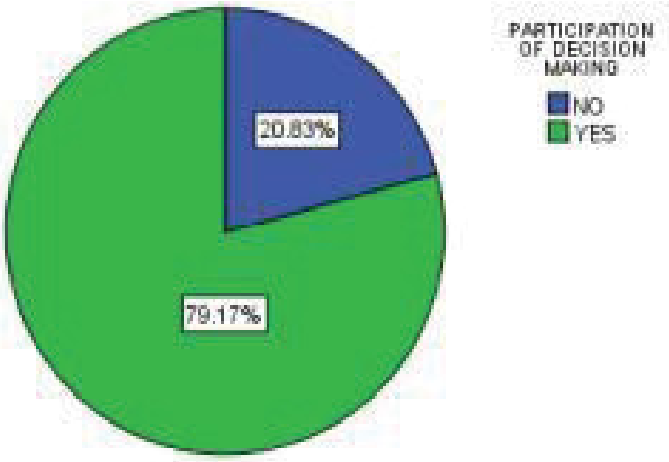


Figure 13. Participation of decision making in all aspects.

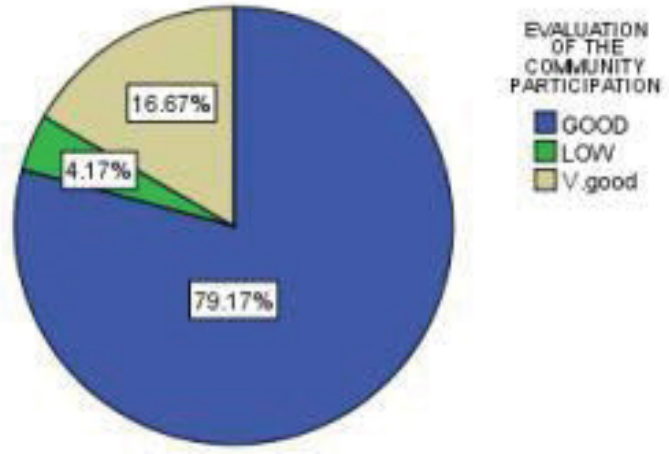


Figure 14. Evaluation of the community participation.

Table 7. Managing the water source in the community.

Valid	Frequency	Percent	Valid Percent	Cummulative %
Water committee representing the C	24	100	100	100

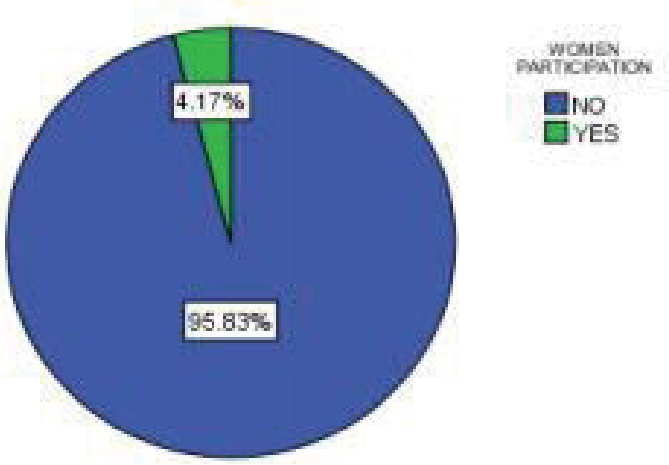


Figure 15. Women participation in water source managing committee.

Table 8. Is the water of the water SP adequate?

Valid	Frequency	Percent	Valid Percent	Cummulative %
Yes	24	100	100	100

Table 9. Is water of the study available yearly?

Valid	Frequency	Percent	Valid Percent	Cummulative %
Yes	24	100	100	100

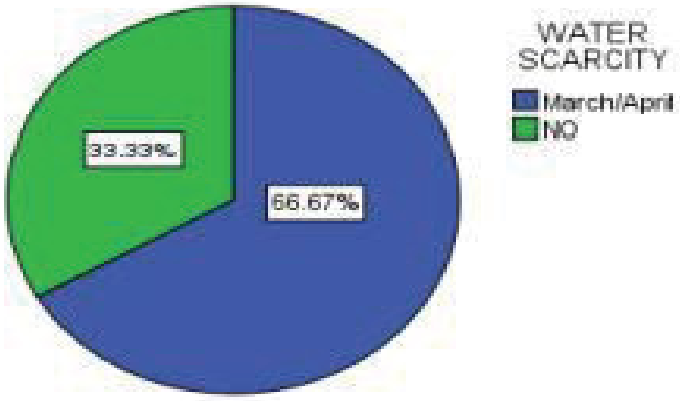


Figure 16. Scarcity of the water.

Table 10. Does the water of the water source have smell?

Valid	Frequency	Percent	Valid Percent	Cummulative %
No smell	24	100	100	100

Table 11. Does the water have a test?

Valid	Frequency	Percent	Valid Percent	Cummulative %
No Test	24	100	100	100

Table 12. How does the water look?

Valid	Frequency	Percent	Valid Percent	Cummulative %
Clear	24	100	100	100

Table 13. Complaints related to the water services.

Valid	Frequency	Percent	Valid Percent	Cummulative %
No	7	29.2	29.2	29.2
Yes	17	70.8	70.8	29.2
Total	24	100	100	

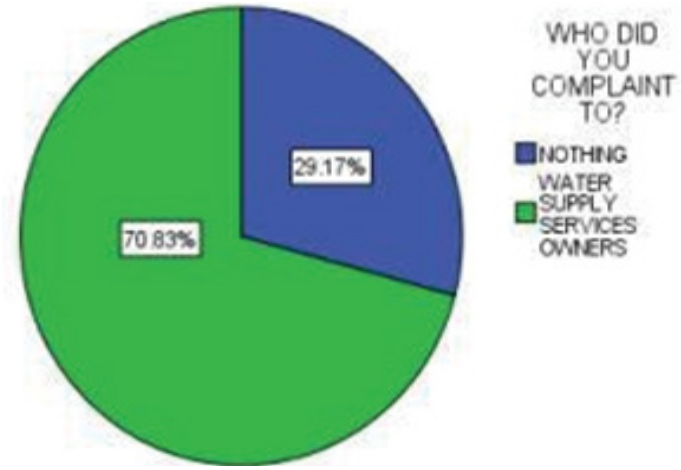


Figure 17. Who did you complain to?

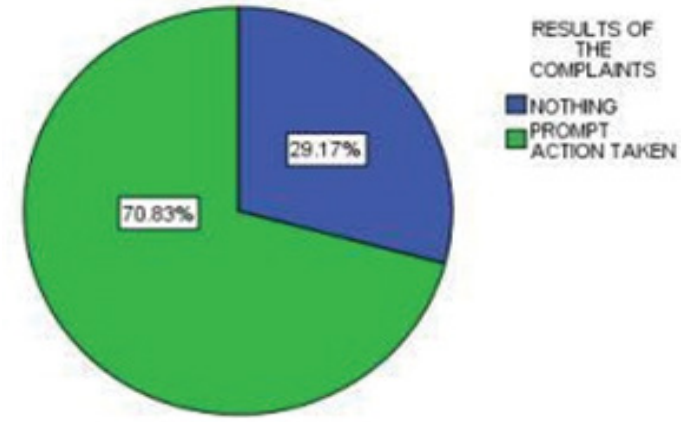


Figure 18. Results of the complaints.

Contact : Well name : Hawa Tako Report Date : 13/04/2019
Tell : Sample ID : Water Use: Drinking (W.H.O.)

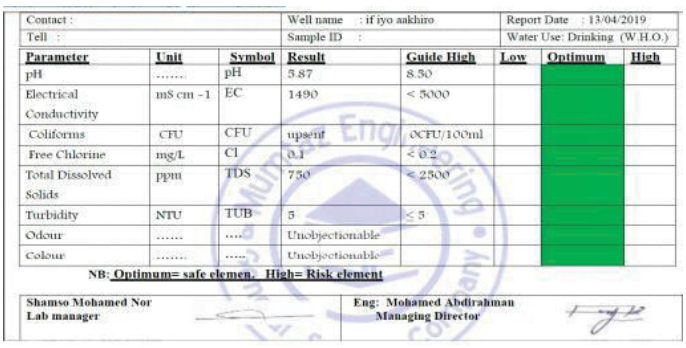
Parameter	Unit	Symbol	Result	Guide High	Low	Optimum	High
pH	.....	pH	6.04	8.50			
Electrical Conductivity	mS cm -1	EC	1580	< 5000			
Coliforms	CFU	CFU	upsent	0CFU/100ml			
Free Chlorine	mg/L	Cl	0.1	< 0.2			
Total Dissolved Solids	ppm	TDS	790	< 2500			
Turbidity	NTU	TUB	5	≤ 5			
Odour	.....	.....	Unobjectionable				
Colour	.....	.....	Unobjectionable				

NB: Optimum= safe elemen. High= Risk element

Shamso Mohamed Nor
Lab manager

Eng: Mohamed Abdirahman
Managing Director

Figure 19. Tadamun/ Hawa tako well.



Contact : Well name : if iyo aakhiro Report Date : 13/04/2019
Tell : Sample ID : Water Use: Drinking (W.H.O.)

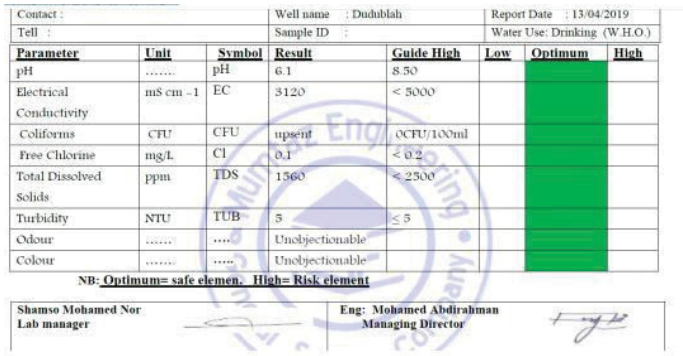
Parameter	Unit	Symbol	Result	Guide High	Low	Optimum	High
pH	.....	pH	5.87	8.50			
Electrical Conductivity	mS cm -1	EC	1490	< 5000			
Coliforms	CFU	CFU	upsent	0CFU/100ml			
Free Chlorine	mg/L	Cl	0.1	< 0.2			
Total Dissolved Solids	ppm	TDS	730	< 2500			
Turbidity	NTU	TUB	5	≤ 5			
Odour	.....	.....	Unobjectionable				
Colour	.....	.....	Unobjectionable				

NB: Optimum= safe elemen. High= Risk element

Shamso Mohamed Nor
Lab manager

Eng: Mohamed Abdirahman
Managing Director

Figure 20. Tadamun/ If & akhiro well.



Contact : Well name : Dudublah Report Date : 13/04/2019
Tell : Sample ID : Water Use: Drinking (W.H.O.)

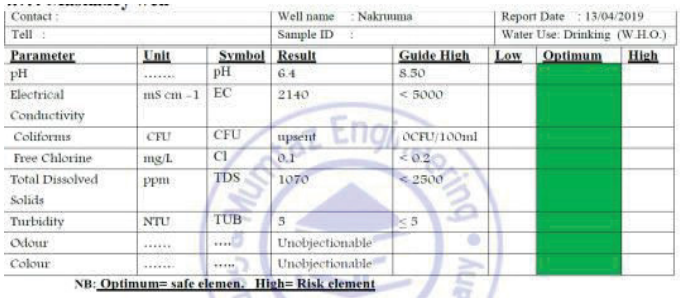
Parameter	Unit	Symbol	Result	Guide High	Low	Optimum	High
pH	.....	pH	6.1	8.50			
Electrical Conductivity	mS cm -1	EC	3120	< 5000			
Coliforms	CFU	CFU	upsent	0CFU/100ml			
Free Chlorine	mg/L	Cl	0.1	< 0.2			
Total Dissolved Solids	ppm	TDS	1560	< 2500			
Turbidity	NTU	TUB	5	≤ 5			
Odour	.....	....	Unobjectionable				
Colour	.....	.....	Unobjectionable				

NB: Optimum= safe elemen. High= Risk element

Shamso Mohamed Nor
Lab manager

Eng: Mohamed Abdirahman
Managing Director

Figure 21. Dudublaha well.

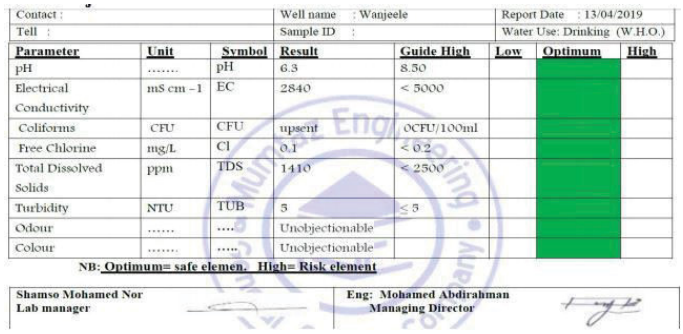


Contact : Well name : Nakruuma Report Date : 13/04/2019
Tell : Sample ID : Water Use: Drinking (W.H.O.)

Parameter	Unit	Symbol	Result	Guide High	Low	Optimum	High
pH	.....	pH	6.4	8.50			
Electrical Conductivity	mS cm -1	EC	2140	< 5000			
Coliforms	CFU	CFU	upsent	0CFU/100ml			
Free Chlorine	mg/L	Cl	0.1	< 0.2			
Total Dissolved Solids	ppm	TDS	1070	< 2500			
Turbidity	NTU	TUB	5	≤ 5			
Odour	.....	....	Unobjectionable				
Colour	.....	.....	Unobjectionable				

NB: Optimum= safe elemen. High= Risk element

Figure 22. Maskaxey well.



Contact : Well name : Wanjeele Report Date : 13/04/2019
Tell : Sample ID : Water Use: Drinking (W.H.O.)

Parameter	Unit	Symbol	Result	Guide High	Low	Optimum	High
pH	.....	pH	6.3	8.50			
Electrical Conductivity	mS cm -1	EC	2840	< 5000			
Coliforms	CFU	CFU	upsent	0CFU/100ml			
Free Chlorine	mg/L	Cl	0.1	< 0.2			
Total Dissolved Solids	ppm	TDS	1410	< 2500			
Turbidity	NTU	TUB	5	≤ 5			
Odour	.....	....	Unobjectionable				
Colour	.....	.....	Unobjectionable				

NB: Optimum= safe elemen. High= Risk element

Shamso Mohamed Nor
Lab manager

Eng: Mohamed Abdirahman
Managing Director

Figure 23. Wanjel well.

Comments of the sample test results

The National Drinking Water Quality Standard and the WHO guideline for Electrical conductivity, Turbidity, Total hardness as $CaCO_3$, Fluoride, Ammonia, Nitrate, Iron (Fe), and Manganese (Mn) are 0.2 respectively. All of 40 the parameters tested for five sites were never above the National Drinking Water Quality Standard and WHO guidelines. Thus the final water quality parameter at consumer point meets the National Drinking Water Quality standard and WHO guidelines. The treatment systems have substantially improved the water quality. There seems to be no deterioration of water quality in the distribution system and it is well maintained; according to the analysis that the researcher made, the five drinking water supply system are able to provide high quality water to the community of the study area.

Conclusion

Among five water supply system, Tadamun/If & akhiro, Tadamun/Hawa tako, Dudublaha, Maskaxey, Wanjel water supply systems are old and advanced systems constantly operating since the last 30 years. A water supply system is sustainable, if it can provide safe water and can recover the cost of operation and maintenance locally for instance through water tariff. All the five schemes studied are able to maintain operation and maintenance cost at their own resources and also provides a good quality of water to the community of the select study area. When local communities participate directly in the planning their own water supply system, these systems are more likely to be sustainable, in all schemes, local people participate in different phase of the project, these systems are likely to be sustainable because they have adequate financial and administrative capacity for system operation and maintenance. If water supply projects are to be managed efficiently and are to be sustainable, Communities need to be given due consideration and wider platform that give them greater opportunity to manage and decide on issues affecting their livelihood. As for the finding of this study, it was confirmed that the community members does not take the lead in initiating the project idea of the water supply scheme. This being the case, the place given for community members in decision making on matters related to choice of technology to be installed for 47 the water supply system is very limited. In most cases this issue has been decided by NGOs involved in the project. According to the water supply systems financially, all five water users committees are self-sustained and there are no problem in the water tariff Collection and Financial Management in the entrenched site and it can be said that willingness to pay for quality drinking water is high among the people; which is that the water quality that these five water supplies systems is good as the respondents of this study stated in the previous chapter. As per study finding, the user community has acknowledged the water committee manages the water supply scheme in terms of operation & maintenance, collecting water fee, up keep financial records. But there are also indications from the community that the water committees need to scale up their capacity in providing better services, improving financial management, handling operation & maintenance, and responsibilities as per the water committee and then by win the lasting trust from their relevant communities that uses the water supplies. In general terms, the issue of institutional sustainability has been established in the study communities as they have been acknowledged that the water committee, responsible for the overall management of the water supply scheme in their respective communities. Finally, what has been assessed by the researcher regarding the issue of water supply management and sustainability has brought to light prevailing trends and concerns surrounding safe drinking water access in Afgoi district context. These involve the issue of community participation; community management and governance of water supply scheme, and functional status of water supply scheme. These are areas identified as practical field research issues where further studies in the area need to investigate in depth as per water supply system sustainability. Hence all of the water supply system seems to be smoothly operating without financial, technical or institution problems with in water supply system and the community. Thus, it can be concluded that five water supply systems are providing quality drinking water to the people.

Recommendations

According to the study these are the major recommendations suggested based on the conclusion of this study:

- Community participation has to be scaled up; and it need to involve in participation of management and governance of the water supply systems.
- Water quality of Tdamun/Hawa tako, tadamun/If & akhiro, Dudublaha, Maskaxey, and Wanjel water supply systems are should be monitored to sustain the water quality, safety, and adequacy of these water supply systems.
- The Stakeholders have to continue the monitoring the water supply systems after construction to better operation, and maintain the water supply scheme as well as improving their financial management.

Acknowledgements

First and foremost, we would like to thank our ALLAH who has always been at our side providing us his support and gave us the strength all along in finalizing this research project; We would like to express our deepest gratitude to our families, fathers, mothers, brothers, sisters and relatives who encouraged us and helped us to become at this stage of Education. Our special thanks to our supervisor, Eng. Abdishakur Abdullah Dhi'isow for his support and assistance through our research thesis writing process. Also we

express our gratitude to our beloved University “ABRAR UNIVERSITY” and the Dean of the faculty of Civil Engineering and technology, Eng. Ahmed Abdi Ali ‘Mataan’. This work would have not been completed without the contribution of various people, such as Dr. Ahmed A. Hassan Kadle who gave us a great help of writing this thesis book, and Eng Mohamed Abdirahman; the manager of Mumtaz Engineering and general Service Company that helped us with our water analysis tests for free. Also we would like to thank Tadamun charity association, Tadamun School, and Tadamun water supply systems crew who welcomed us and helped us to get the information and the data from the study area.

References

1. Raut, Kalyani. "Sustainability of community water supply system managed by water user committee: A case study of rural water supply system in Nepal." Master's thesis, Norwegian University of Life Sciences, Ås, (2015).
2. Tadesse, Abebe, Techane Bosona, and Girma Gebresenbet. "Rural water supply management and sustainability: The case of Adama Area, Ethiopia." (2013).
3. Rathnayaka, Kumudu, Hector Malano, and Meenakshi Arora. "Assessment of sustainability of urban water supply and demand management options: A comprehensive approach." *Water* 8(2016): 595.
4. Ghose, RLM. "Report to the Government of Somalia on rice experiments at Afgoi." Report to the Government of Somalia on rice experiments at Afgoi. (1966).
5. https://en.wikipedia.org/wiki/Somalia
6. https://en.wikipedia.org/wiki/Shebelle_River
7. UNISOM. ‘Planning and information unit’.(1994): 2
8. https://en.wikipedia.org/wiki/Jowhar

How to cite this article: Sheikh Ali, Abdullahi Mohamed, Abdirahman Mohamed Ahmed, Ali Warsame Hassan Arale and Abdulshakur Abdullahi Di’iso. “Water Supply Management and Sustainability in Afgoi District, Somalia.” J Civil Environ Eng 11(2021): 426.