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Scenario of Water Supply System in Mekele City, Ethiopia

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***Abstract* - Water supply System is very poor in developing countries and its right time to study due to rapid pace of urbanization especially in Africa continental. In this context, this paper is representing the Mekele city in Ethiopia with regard to water supply delivery system. The study is focus on the water supply system in regards to the water sources, water delivery (water supply interruption), distribution network, and revenue collection. In order to study, the following objectives; (1) to study the sources of water supply and production in the city, (2) to study the status of water revenue collection and distribution networks, (3) to study the various indicators such as water quantity and quality based on household survey (4) to draw an inference based on studies to encourage the practice for better service. The methodology was adopted the very limited literature review. The data analyses were mainly from the secondary data from various offices of Urban Local Bodies (ULBs), field investigation and households data (conducted in sub city of the Mekele city, and focus group discussion). The sampling size of the households was 300 dwelling units. The SPPS and Excel were used as tool to analyze the primary data.**
Keywords: **Urbanization, Water Supply, Community Participation**

I.INTRODUCTION

Water is the basic need for human being. It is an essential for life and plays an important role for economic development (United Nation, 2005). Ethiopia is frequently said to be the 'water tower of North-East Africa' (MBI, 2013). Equal distribution of safe drinking water across section of society in urban areas is hardly discovering across world except Singapore city (Ben Taylor, 2008). Urban water supply system is quite poor in Ethiopia nation in terms coverage and quality (EEA, 2013). As per WSSA report (1994) reveal that water supply coverage in urban area was 65.3 percent excluding Addis Ababa city whereas in rural areas was 15%. In the last few decades urbanization is occurring very rapidly in the developing nations (Maria E, et al, 2014). Public investment and economic development are some of factors for urbanization in Ethiopia country (IFPRI, 2010). This rapid transformation of urban system has increased demand for water supply in Mekelle city. This growing town caused the inadequacy of water supply. To sustain for human being to meet the ever expanding residential water demand is challenges in the poor countries towns and cities. The Mekelle city has started the pipe line water connection since 1949 with a connection 34273 of houses in old city area and at present, 75 public stands post in service for those houses did not have connection (MMC, 2015). At present situation of water system in Mekelle city is poor in terms of water quality and quantity aspect and even service system by municipality of Mekelle.

Hypothesis

The water supply system is very poor in terms of delivering the water quality and quantity in the Mekelle city. It would be one of the study which would be encouraged for better in future with regard to water supply system.

Case Study – Mekelle City

The Mekelle city is located in the northern part of Ethiopian country at $13^0 30'$ N Latitude and $39^0 30'$E Longitude. The distance of this city from Addis Ababa (capital of Ethiopia) is approximately 778 km. The total area of Mekelle city is 76 sq km. The temperature is around 22^0C at minimum and 24^0C at maximum temperature (MCAO, 2008). This city is also known as capital of Tigray region (Fig 1).

The projected total population of the Mekelle city is 323673 as per the city plan report (2015). This city has divided into six sub city namely; (1) Hawelti with a population of 61507, (2) Hadnet with a population of 56579, (3) Ayder with a population of 45773, (4) Adi Haki with a population of 444491, (5) Semen with a population of 44288, (6) Quihna with a population of 39000, and (7) Kedamay Weyane with a of 32035. In comparison among the sub city of Mekele city, Hadnet has the highest population and located in southern region of Mekelle city and lowest is Kedamay sub city in south eastern (Table I).

II. RESULTS AND DISCUSSION

The sources of water in the Mekelle city are ground water, rivers, springs, and well. It is very high approximately 92 percent of households being connected pipe line through municipality of Mekele city. Mekelle city is being supply through borehole mainly in the old city area and expansion sub city of Hadnet (Fig 4). Around 5.6 percent of households is being used from the well within the premises where 1.4 percent households are being used from the river. Least percent of households being used spring water

approximately 0.7 percent of Adi Haki sub city (Fig 2). The water quality and quantity is very poor due to the old pipe lines and lack of operation and maintenance. As per survey data (2015), the 19.7 percent of the households are having a water connection within the premise whereas 70.4 percent of the households are fetching water outside of the premise. The remaining 9.9 percent of the households are depending on the public stand post with the colony of the sub city (Fig 3 and Fig 5).

TABLE I MEKELE CITY POPULATION

Sl. No.	Sub City	Male	Female	Total Population	Shared Population in %
1	Hawelti	30138	31369	61507	19.00
2	Hadnet	27724	28855	56579	17.48
3	Ayder	22429	23344	45773	14.14
4	Adi Haki	22025	22466	44491	13.75
5	Semen	21701	22587	44288	13.68
6	Quihna	19110	19890	39000	12.05
7	Kedamay Weyane	15697	16338	32035	9.90
	Total	158824	164849	323673	100

Source: Based on Mekelle City Plan, 2015

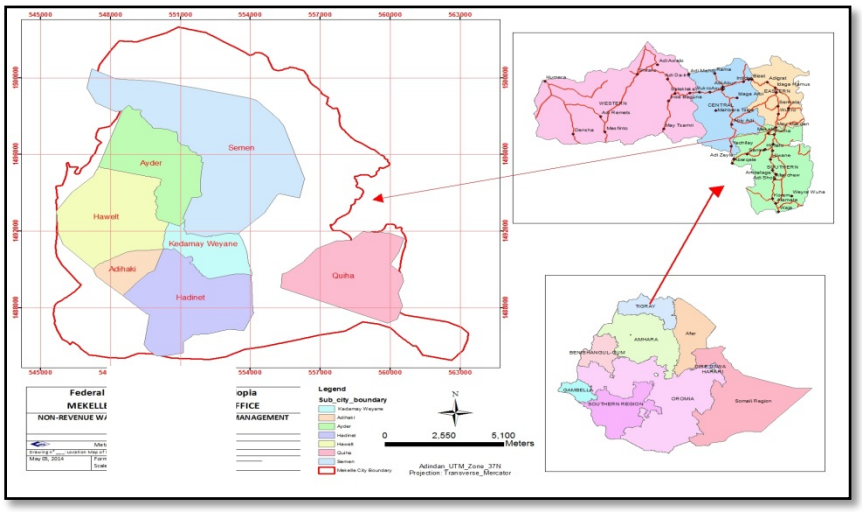


Fig.1 Location Map of Mekelle City, Source: MCUDO, 2015

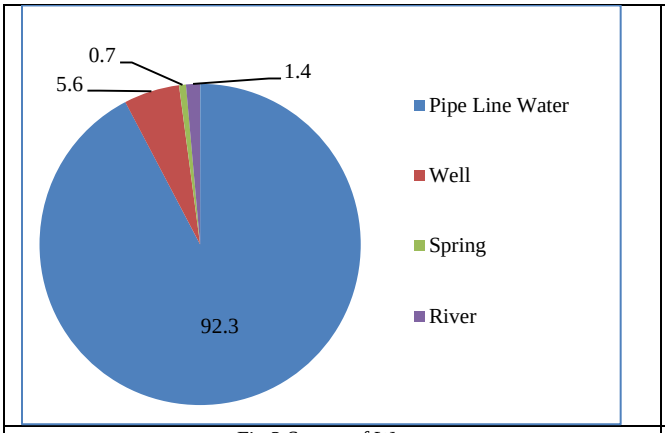


Fig.2 Source of Water

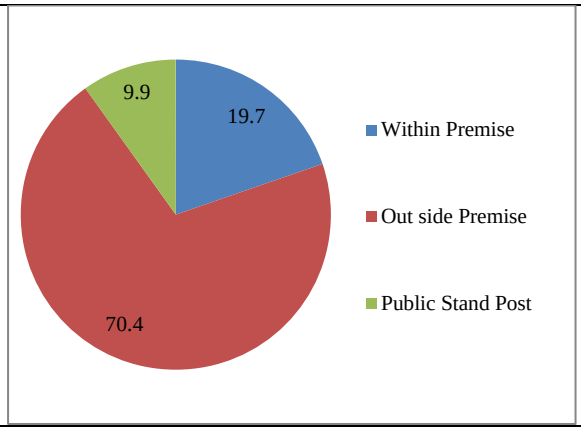


Fig.3: Water Collection System

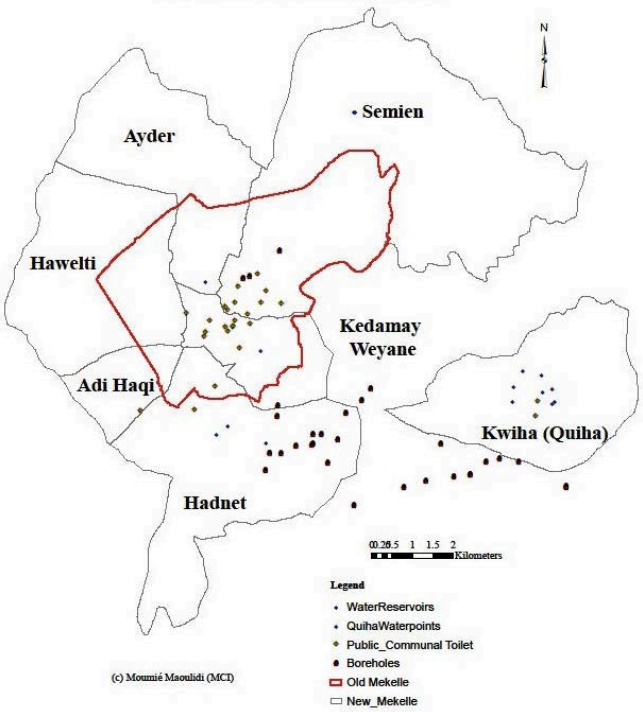


Fig.4 Mekelle City Map Showing - Water Reservoirs, Water Point and Boreholes. Source: Mekelle City Water Supply Service Office, 2015

Fig 5 Public Stand Post at Hawelti, Picture Credit by Author, 2015

Water Supply Plan in Mekele City: The water supply service system has been planned out by the Mekele City Water Supply Service Office (MCWSSO) in order to deliver effective and efficiently across the city. The major water reservoirs, bore hole (bh), major pipe line within the city has represented in the Fig. 6. The detail of water supply networks in the city has been shown in Fig. No. 7. The network for water supply has been covered maximum area of the city and only few areas in the south eastern zones have been covered till now.

The sources of water are mainly from river and ground water. The total production in the city is 8816940 M^3 and coverage in area wise was 73 percent. The unaccounted flow of water is 20 percent. In comparison over the last 2010 to 2015, there were increasing the production of water by implementing the new projects for water supply. In regards to the coverage of water supply in area wise within the city was increased from 2010 to 2013 and declined due to the expansion of the city during this time. At present, it has increased up to 73 percent of the city area (Table II).

The total number of water connection in the city is 40262. Each consumer has water meter facility. The maximum number of connection is residential (88.5%), commercial (10.12%) and government (1.35%) respectively (Table III).

TABLE II WATER PRODUCTION AND COVERAGE IN THE CITY

Year	Production in M^3	Daily Production in M^3	Used in M^3	Daily Use in M^3	Coverage in City Area	Loss (in %)
2010	4630597	385883	3043005	253584	50	23
2011	4755351	396279	3774241	314520	69	21
2012	6110000	509167	4397537	366461	76	28
2013	7961140	663428	5652410	471034	78	29
2014	6752023	562669	5391881	449323	65	20
2015	8816940	724680	7838532	653211	73	20

Source: MWSSO, 2015

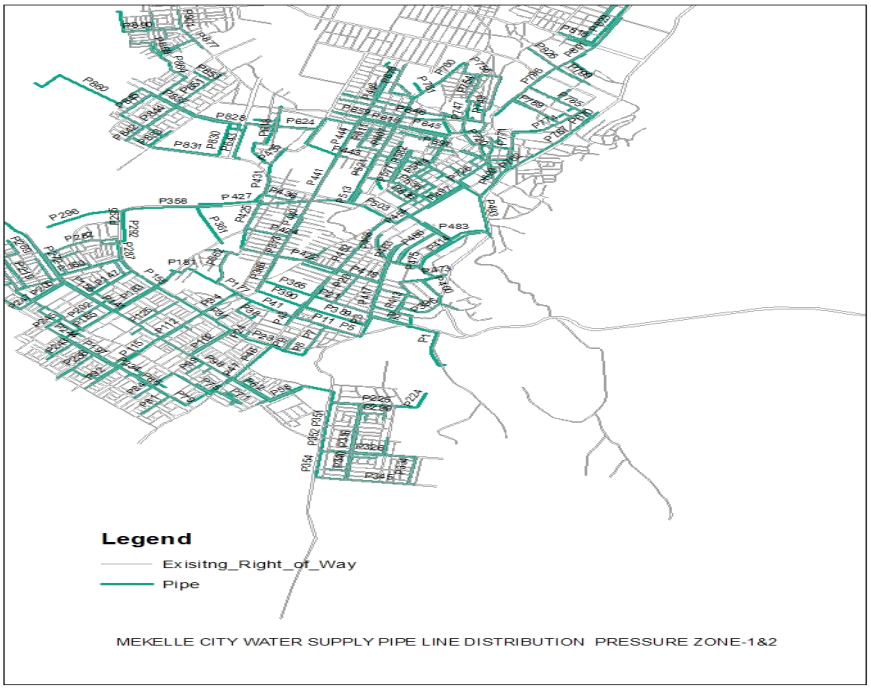
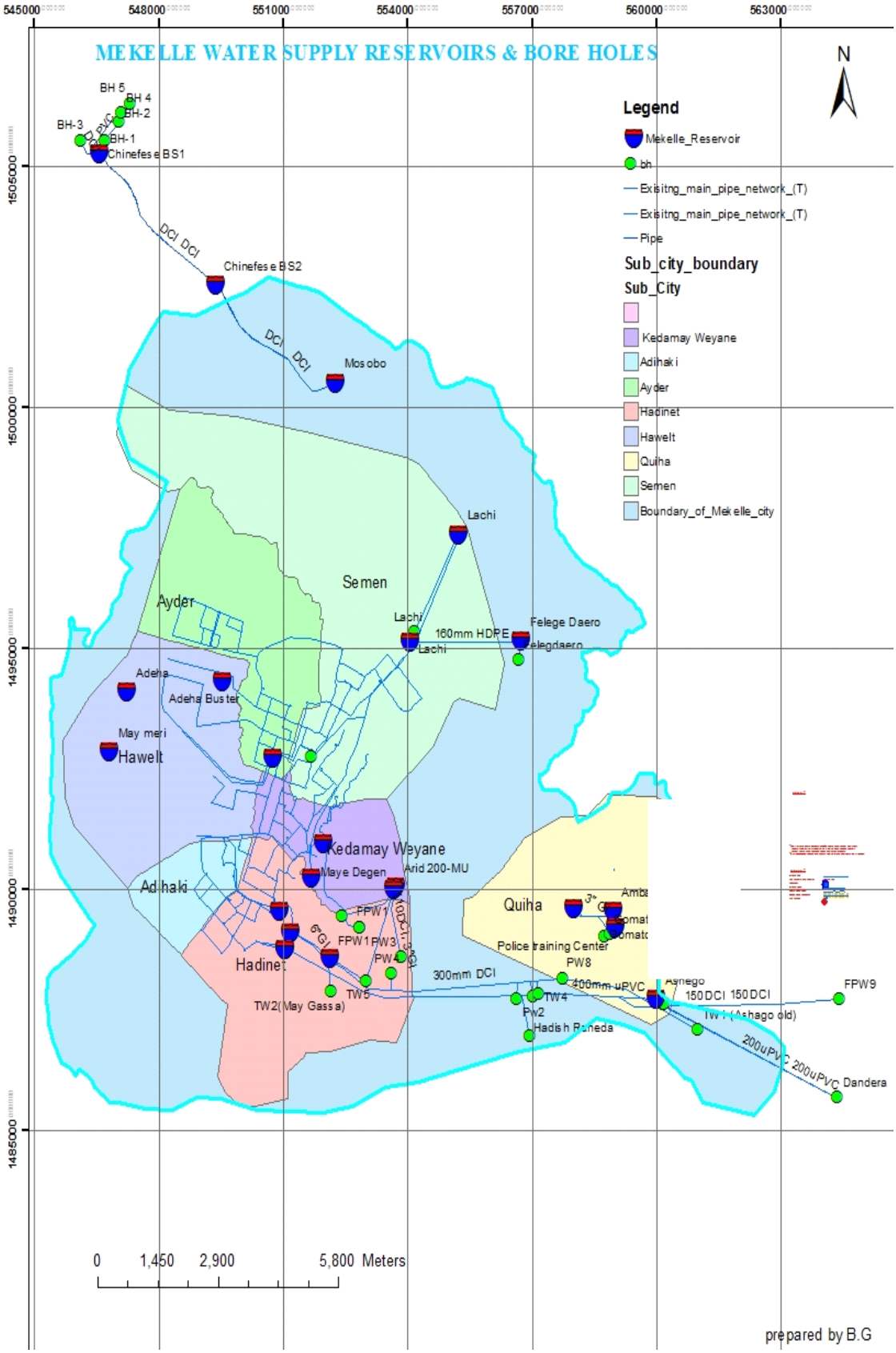


Fig 6 Map of Mekele City Showing – Reservoir, Boreholes and Major Pipe Line

TABLE III WATER SUPPLY CONNECTION IN THE CITY

Sub city	Private (Individual Household)	Commercial	Government	Total
Quiha	3120	183	55	3358
k.weyane	1977	1324	124	3425
Hawelti	7838	521	32	8391
Hadnet	6854	627	42	7523
Ayder	4717	347	42	5106
Adi-haki	5394	550	62	6006
Semen	5739	525	189	6453
total	35639	4077	546	40262

Source: MWSSO, 2015



Source: MWSSO, 2015

Fig.7 Water Supply Networks in the Mekele City

The Financial for Water Supply in Mekele City: Water revenue and expenditure from 2010 to 2015 in the city has been analyzed and its reveals that in the year of 2012 and 2013 has spend more money on the water supply operation and maintenance as well as others services sectors. These times had overdraft for the financial whereas in the years of 2010, 2014 and 2015 were improving the financial status (Table IV)

TABLE IV REVENUE AND EXPENDITURE FOR WATER SUPPLY (IN BIRR)

Year	Revenue	Expenditure on O&M and Others	Different	% of Expenditure
2010	111476743	102771832	8704911	92.19
2011	77025352	79287950	-2262598	102.94
2012	68951010	59077676	9873334	85.68
2013	71578251	81465125	-9886874	113.81
2014	79161550	50254194	28907356	63.48
2015	141186337	139973950	1212387	99.14

Source: Based on the Mekele City Water Supply Office, 2015

The maximum number of households had responded for water quality in the category of good (60.6%), very good (13.4%), poor (12%), and very poor (14.1). The main reason of the poor water quality in some of the sub city of Kebele is due to leakage of pipe line (Fig. 8). As per the field survey data (2015) has reveals that water taste for very good which has been responded by households are 13.4 percent, for good category (65.5 percent), for poor category (9.9 percent) and remaining category (very poor) was around 11.3 percent respective (Fig 9).

The quality in term of smell at consumer level had shown the different category of response in the old city area within Mekele city. The satisfactory levels from the households were very good, good, poor, and very poor. For very good category (14 %), good (86.3%), poor (10.6%), and very poor (7%) (Fig 10).

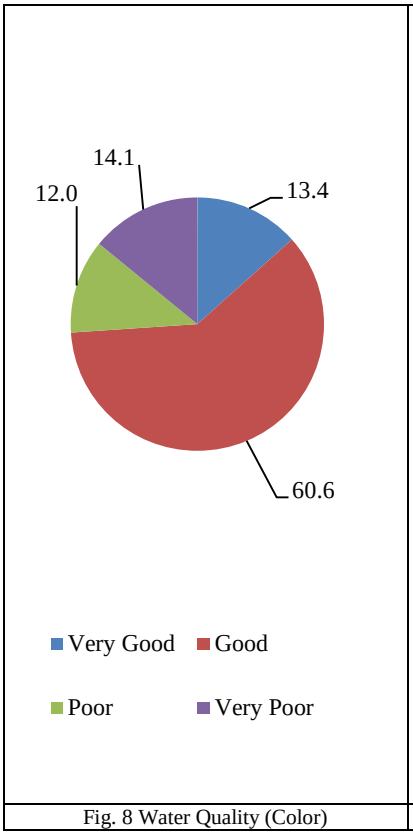


Fig. 8 Water Quality (Color)

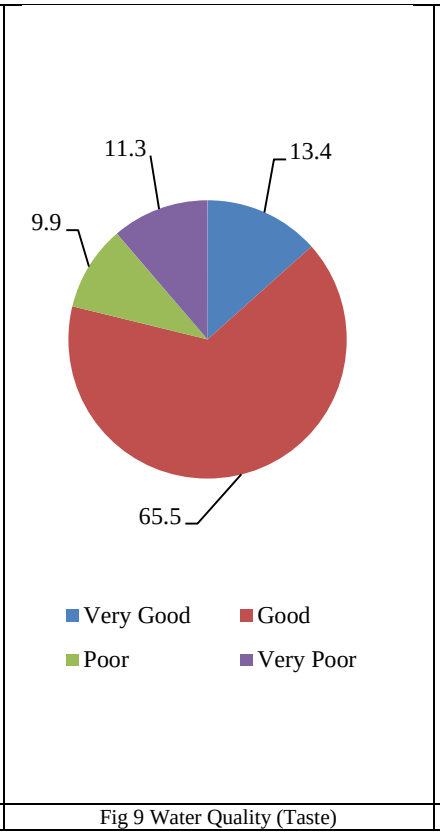


Fig 9 Water Quality (Taste)

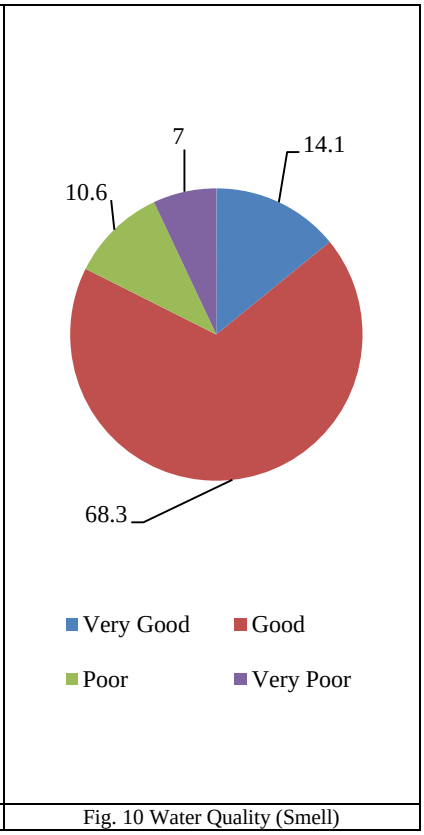


Fig. 10 Water Quality (Smell)

Based on the above figures, some of the households in Mekelle city are still suffering the diseases due to inadequate of water supply system. Almost approximately 23-25 of the school children are drop out as a result of causing diseases such as cholera, amoeba and so on. The common issues in Mekele city are interruption of water supply and poor quality and quality. As per focus group discussion (2015) in various sub cities had reveals that Hawelti sub city is supplying 2 times in a week and frequency of supply is 3 hours. In the case of Hadnet sub city is supplying 2 times in week and frequency of water supply is 2 hours.

For Ayder sub city, the water is being supply once a week and duration of supply is 3 hours. For Adi Haki sub city, water is being supply once in a week and frequency of supply is 4 hours. For Semen sub city, water supply (2 day in a week) and frequency of supply (2 hours), for Quihna sub city, water supply (2 days in a week) and frequency of supply (3 hours). The last sub city in Kedamay Weyane sub city is being supply one time in a week and frequency of water supply is 3 hours (Table V).

TABLE V FREQUENCY AND DURATION OF WATER SUPPLY

Sl No.	Sub City	Duration in a Week	Frequency in a day (Hours)	Performance Indicator
1	Hawelti	2	3	Poor
2	Hadnet	2	2	Poor
3	Ayder	1	3	Poor
4	Adi Haki	1	4	Poor
5	Semen	2	2	Poor
6	Quihna	2	3	Poor
7	Kedamay Weyane	1	3	Poor

Source: Based on FGD, 2015

III.CONCLUSION AND SUGGESTION

The water supply coverage in the city is 73% in area wise with total production is 24156000 litres per day. The water quality and quantity are still poor. The duration of supply and frequency are also quite low. In most of expanding areas of the city do not have proper water supply system and lack of planning for water supply. The poor performing of water delivery in the city is due to the lack of capacity Urban Local Bodies (ULBs) such as municipality and other agencies. Establishment and structure of Municipality has to function effective and efficiently in the expanding areas in order to improve the water quality and quantity. The roles and function of the various departments should be strong enough to carry out the planning and implementation of development works to solve the water issue (Fig. 11). Each section within the city municipality should encourage the technical skill.

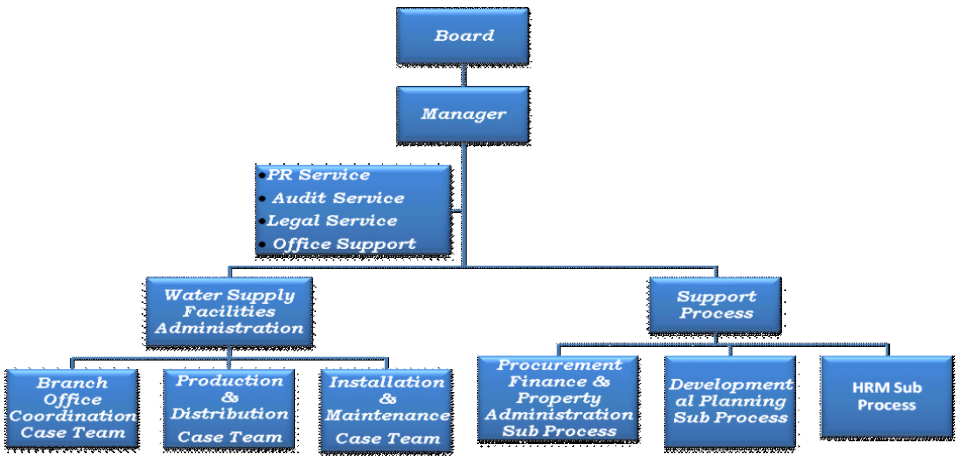


Fig.11 Mekele City Administrative Structure Based on Discussion with Mekelle City Administration, 2015

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