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ACCESS AND EQUITY PROBLEMS OF URBAN WATER SUPPLY IN MEKELLE CITY

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ABSTRACT: *One of the millennium development goals by 2015 is to decrease the population who have no access to both quality and quality for safe drinking water and sanitation by half. The aim of this study is to investigate the existing water supply and sanitation service provision, its access and equity in distribution among different income groups in different geographic areas of Mekelle city in north Ethiopia. Specifically, the physical, social and economic factors are the main elements that are affecting the smooth run of accessing improved water supply and sanitation services. Both open and closed ended Questionnaires were distributed to 268 households. The outcome of the study revealed that the spatial location, inability to pay, and the illegality of their tenure and others are the main reasons for access and equity problems of the lowest level standard, particularly the disadvantaged and low income sector of society. It was also found that the majority of the people are not served according to the access parameters in terms of quantity, quality and proximity. Only 18% of the surveyed residents are used more than the recommended WHO standard which is 20 l/c/day. Other residents have been suffering either in quantity, quality or proximity of the service. The existing limited amount of water is not distributed with equity among different income groups and geographic areas.*

KEYWORDS: Access to water, equity, Water use, Water storage, Service Interruption

INTRODUCTION

Water is the vital resource and is a great necessity for food production, drinking purposes sanitation and many other uses. It is indispensable for the welfare of human beings and their natural environment. Different international agreements have recognized the access to clean water and sanitation as basic human right (Langford, 2005; UN, 2010). However, despite the fact that global understanding has been created, in developing countries the wide inequality in opportunity has worsened the access problem. The poor has less access to safe water and sanitation; consume less, pay more for the service and suffer more from water related diseases (UNDP, 2006).

The situation in Africa, particularly in sub Saharan Africa is worst. The access to sanitation is for one from three (UNDP, 2006). In urban areas water supply access through household connection is as low as 16% (WHO/UNICEF, 2006).

The water and sanitation coverage in Ethiopia is one of the lowest in Africa. In 2007 the population with access to safe water was estimated 52.5% that is 46.4% in rural and 82 % in urban (MoFED, 2008). Access to sanitation is also very low, it is provided only for one from seven (UNDP, 2006).

Mekelle city is one of the fast urbanizing centers in the country; the rate is higher than the national average. The rate for 1967-1994 was 5.31% (Golini, 2001), and for the time between 1994/2004 estimated 4.6%. with continuous expansion and fast population growth for the last 15 years have created a stress to the urban social services, particularly the water supply service office is unable to meet the upward shooting demand. The sanitation situation of the city is also in poor condition. In the city there is no sewerage system. The liquid and semi solid wastes are disposed off at uncontrolled open dumping areas such as, rivers, open fields and agricultural farms in environmental and health hazardous way, because there is no treatment plant or liquid waste disposal site.

The concept of access refers to the quantity quality and availability of water in the close proximity, but this access may be affected by some geographical factors. The current water service is geographically distributed mainly in the inner city and the new expanded parts of the city.

The word "access" indicates opportunity or right to use some thing. This opportunity or right to water is necessary for human survival. Without access to water there is no survival, but the question in developing countries is the type of access because the access can be improved or unimproved water supply. According to the current international consensus improved access is reasonable access to water supply or improved provision to water supply and sanitation. This concept is used for international comparison and reporting based on water security, quality, proximity, quantity and type of technology used (UNDP, 2006).

When the access to improved service is not realized in equitable way unimproved sources is used. Unimproved source use endangers health and welfare of society which consequently lead to low productivity, increase national health cost, poverty and death. The access to improved water and sanitation is affected by a number of factors; such as natural, physical, technical, financial, institutional, social, environmental, and economic factors which give rise to several access problems or problems which limit the access to improved water and sanitation service.

Water and sanitation are considered social goods, so that the service should be designed to ensure equity and fairness in the distribution. The benefits should be distributed with equity between different income groups, between different areas or regions, between different sectors, and between different consumer types. For future sustainable urban water management equity opportunities with in the city and surrounding area needs highest priority (Niemczynowiz, 1999). But, in practice attaining equity is a challenging and complex task. Public services such as water supply, solid waste disposal and transportation are not pure public goods because some people may be excluded from using them due to fees and charges, but they are entitled to the minimum service so the equity norm indicates equality of access rather than equal use (Lucy *et al*, 1977).

Particularly water supply service is not distributed with equity either spatially or among different social groups. Urban centers of developing countries serve richer neighborhood on a priority basis, while poorer areas are under served (OECD, 2003). A study in Dar-es-salam, Tanzania showed that higher income residents get 166 liters of water per day, but the poor house holds with out connection use an average 19 litres per day (UNDP, 2006). Similar report shows that residents of high income areas in Ghana and Kenya receive 24 hrs services a day, while residents of slums such as kibera spent two hours at the stand pipes that function 4-5 hours a day. There is also a sharp service difference between built-up urban centers and

the peri-urban areas or informal settlements. During difficulties related to water stress the political and economical disadvantaged groups are also the first to be ignored (UN-Habitat, 2003).

One of the important tools for ensuring equity is pricing, many literatures has focused on the pricing aspect. pricing has become the vital topic of analysis in water supply literature, but less attention was given to the non price aspects of equity. Pricing is important to promote equity, efficiency, and sustainability, and it influences behavior of users, different rates such as block type rates are used to reflect the difference in seasons or consumers type. Particularly the increasing block rate is commonly used in developing countries, because it claimed to achieve the equity objective by subsidizing poor customers by charging richer customers (Diaktel *et al*, 2008).Thus, the equality of access has a positive effect in distributing income. With a shift to privatization of the water service, in many European countries the policy is moving toward economic equity that users should pay the costs for the service they get (Bakker, 2001). But in most of the developing countries the principle of social equity has become a corner stone of their policy which based on the principle of ability to pay for the service rather than the cost they imposed on the system. In May 1995 the government of Ethiopia council of Ministers also endorsed principles for water pricing to achieve efficient allocation of economic resources to ensure social objectives of fairness and equity.

On the other hand, some empirical studies show that the equity effects of block pricing are ambiguous. Study in Jerusalem showed poor house holds pay higher average prices as block sizes are not corrected for household size. Dahan and Nisan (2007 cited in A.Rujis *et al*, 2008), Whittngton (2000 cited in A.Rujis *et al*, 2008) also observes that, often the poor who share connections and as a result have to pay the price for higher consumption block. Many studies showed the poor are made to pay more by the existing pricing system. They are trying to meet their basic water need which is reinforcing their poverty (UNDP, 2006). Efficiency and social equity experience in European countries studies also assert that increasing block rates cannot effectively promote the objective of social equity (Bithas *et al*, 2008).

Urban service is one which serves the public interest by accomplishing one or more of the following purposes; preserving life, liberty and property, promoting public enlightenment, happiness, domestic tranquility and general welfare (Baer, 1985). The service providing sector may be classified as public sector (public utility), voluntary sector and private sector and their service provision is regulated by government body.

Public service or utility may be provided by Municipal and non Municipal agencies such as gas and telephone service providers. Public utility is defined as an organization that is majority owned and controlled by government and could consist of number of different forms (Baietti *et al*, 2006).

Water and sanitation is an essential public service. This service has strong natural monopoly characteristics, it is mostly provided by sole provider, this makes important to control the service either it is public or private. Government regulates the service with different objectives such as, improving the service, extending the service to the poor customers and managing environmental impacts to ensure that the service is provided according public interest. Particularly the economic regulation objectives are designed to ensure service provision at reasonable price (David *et al*, 2007).

STUDY AREA AND METHODS

The study was conducted in Mekelle city; the regional administrative and economic capital of Tigray region, northern Ethiopia located at $13^0$30' North and $39^0$28' East, with an elevation of 2000 m.a.s.l (Fig,1). The city covers an area of 100 km^2 and population estimation for 2011 based on CSA was 261,177. There are only 17 bore holes used as pure water source in the city.

The study used both primary and secondary data through structured questionnaires, and personal interviews with key informants. Primary data related to demographic and socio economic condition such as water use, distance, type and quality of water in use, frequency of interruption, the amount of water stored in the households, the amount of expense on water and the sanitation condition were collected from 268 households. In the study the city seven administration areas were divided spatially into three clusters; the Formal settlement, planned settlement with better housing and infrastructure. Informal settlement, the unplanned settlement dominated by slums, and the peri-urban settlement or the interface areas between urban and rural areas. The households were selected randomly to represent their respective settlement and service level proportionally. These samples were selected from seven ketenes (sub cities) of the city using recent updated lists of each sub city and the data collected analyzed using SPSS version 12.

Figure-1 The study area location

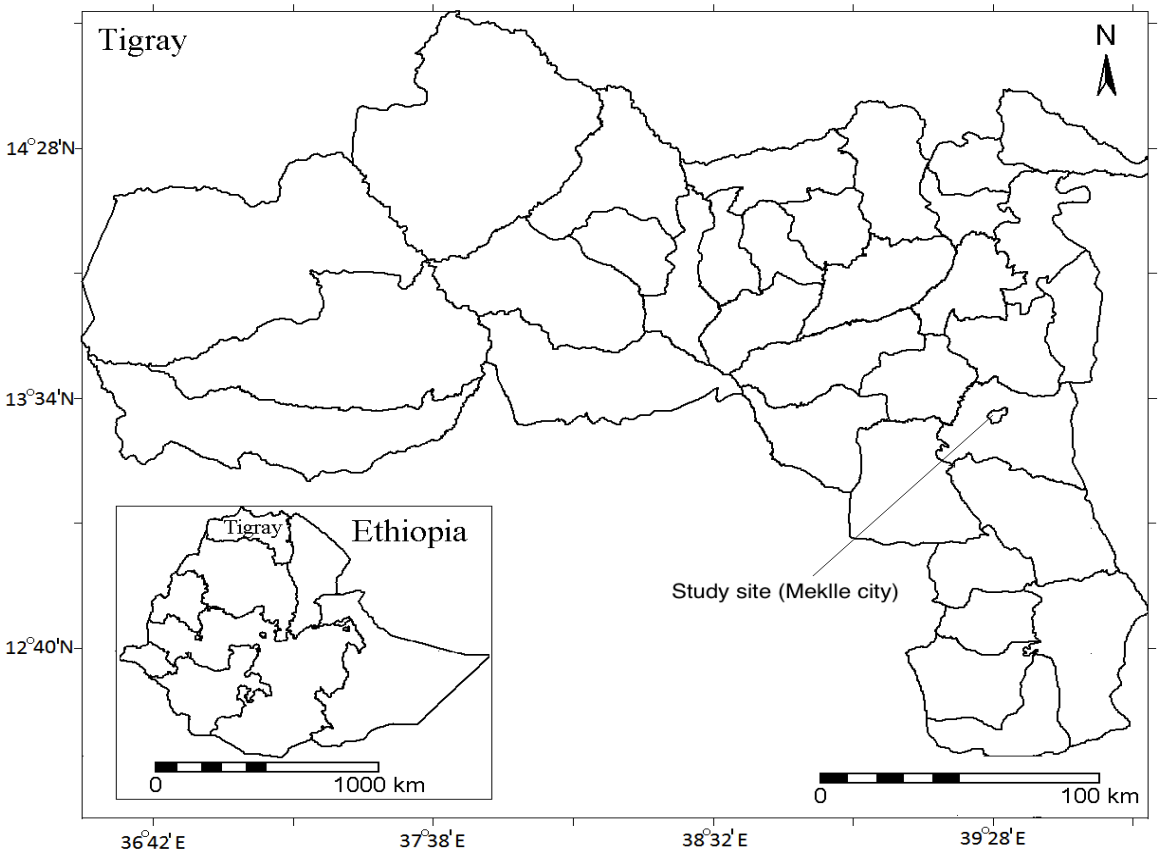
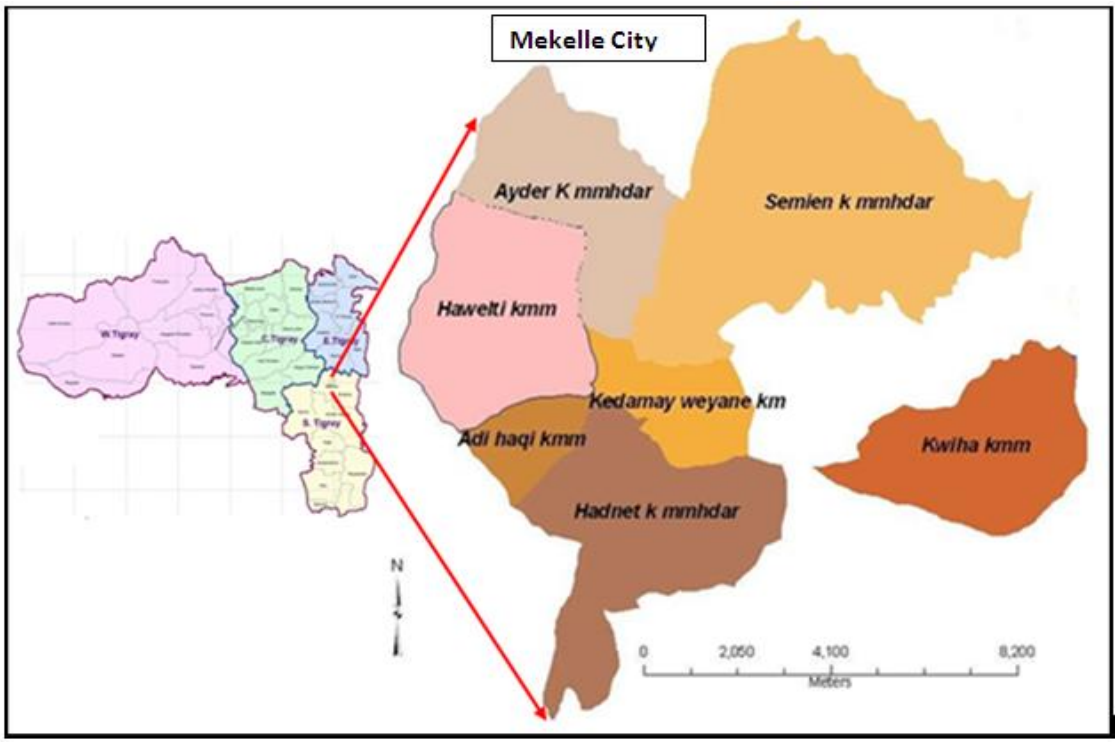


Table-1 Sampling plan

No	Local Administration Area	Population	Sub cites	Selected Sub cites	Samples
1	Kiwha k .mmhedar	19235	7		
2	Hadenet k.mmhedar	22761	10		
3	Adihaki k.mmhedar	36974	7		
4	Kedamaywoyane k.mmehedar	48301	14	4	205
5	Hawelti k.mmhedar	33661	11	1	29
6	Ayder k.mmhedar	25967	6		
7	Semen k.mmhedar	39860	16	2	34

Figure-2 Mekelle city and its Administration sub-areas



RESULT AND DISCUSSION

Access to Water use - Spatial aspect

The concept of access refers to the quantity, quality and availability of water in the close proximity, but this access may be affected by some geographical factors. The current water service is geographically distributed mainly in the inner city and the new expanded parts of the city. The informal parts and pre-urban areas of the city are less served parts. And most of the peri-urban areas are not covered by the service. The analysis of variance shows that there is a significant difference in water use between the settlements ($F=11.244$, $p< 0.01$). Eighty

eight percent of the surveyed peri-urban residents use secondary source of water such as rivers, ponds or springs for their daily use, because the amount of water they collect from public taps is not sufficient for their daily consumption.

In some peri-urban areas of the city such as Adikefero and Adi wellel 54% of the respondents reported access to the public taps, but these are open for only few days and hours in week. In some peri-urban areas such as, Endamariam Adishumduhun the only sources are water vendors' wells with unreliable quality.

The average daily per capita water consumption for all surveyed households in the formal and informal settlements is 13.56 litres. This is far lower than the recommended minimum 20 litres per capita per day norm (WHO/UNICEF), and only 18 % of the surveyed house holds use more than 20 litres per capita per day. Further analysis across different settlements also shows the variation in water use per day. In the formal settlement per day per capita consumption is 11.2 litres and the consumption in the Informal settlement is 16.32 litres and large part of it is obtained from vendors. Here the amount of water used by the informal residents is slightly higher not because the household members consume more water, but because of the informal business activities such as brewing traditional alcoholic drinks, selling tea and food.

Most of the residents believe that the amount of water they are using is not sufficient for food and hygienic purpose, 60% of the respondents take a bath once a week but half of them did not believe it is sufficient for their personal hygiene, and if there had been sufficient water they would like to have more frequent bath.

The average water use per day in the peri-urban area is greater than the other settlements, because they have easy access to the springs and rivers, and they also use more water for their animals, but the amount of clean water they use from public tap is computed 2.79 litres per capita per day. It is known that the 20 litres per capita per day norm is only for basic life line consumption, consuming less amount would be health threatening, but most households are not having this amount or they are using additional water from the unsafe sources.

It is clear that based on the minimum service principle large parts of the settlements are served below the minimum service level, but the low income sections of society are suffering more than others. The equity principle requires equitable share of benefits and costs, but in some areas are having less than the other settlements and are paying higher costs to water vendors, thus the inequitable service is enforcing the level of poverty.

The main reason for low network coverage and lack of expansion to these areas is low investment and priority. The expansion to these areas may require high investment, but since water is basic need and right, the amount of investment required for this purpose should be given priority. The principle of equity allows unequal application of resources to bring equality of use (Lucy *et al,* 1977), but the current service focus is to the new expanded settlements which are settled by middle and high income groups.

Distance

The distance to main water source shows significant variation from one settlement to the other ($^{X\,2}$=121; P< 0.01; phi (Φ) 0.700: P<0.01; and contingent coefficient (c) 0.574: P<0.01). Further ANOVA test made between the ketenas (the smallest administrative unit) shows significant difference (F=38.491;P< 0.01), and the T-test conducted between formal and

peri-urban (F=688:P<0.01) shows significant difference in distance. The maximum distance in the formal settlement is 150 meter, but in the surveyed peri-urban areas many households (31%) live at a distance more than 500mt. In the informal settlement 2.5% of the residents collect water at a distance longer than 500mt from their residence.

In the surveyed peri-urban areas most of the households depend on the springs and rivers at close proximity. Sixteen percent of them spent more than 30 minutes to collect water from rivers and springs. The distance from residence and lack of information when public stand pipe opened after long interruption are the main reasons for not using clean water. The study found that these residents are not only using less water but also their main source is located at a distance longer than recommended distance (0.5km) for urban areas.

Table-2 Distance from main water source

Type of settlement	Distance from main water source in different settlements			Total
	<100mt	100-500	>500mt	
Formal	83 (0%)	1 (1%)	0 (0%)	84
Peri- urban	16 (38%)	13 (31%)	13 (31%)	42
Informal	112 (92%)	6 (4%)	3(2.5%)	121
Total	211	20	16	247

Own survey, 2011

Break down and Interruption

The frequency of interruption is found higher in some settlements than others. Chi-square test result for interruption between different settlements shows significant association between the settlements, and the frequency of interruption (X^2=122.4; P< 0.01), and the strength shown by contingent coefficient (c) and phi (Φ) shows strong association at P<0.01 (0.57, 0.70 respectively). 85.7% of the surveyed households of the formal settlement have less interruption. The service interruption is for one or two days in a week. But in the informal parts of the city for 31 % of the households the rate of service interruption is more than three days in a week. Due to the pressure problems of the system in many hill side unplanned localities water is available only during night time. In the peri-urban 49 % of the respondents reported interruption for more than four days in a week. The existing public taps of the most

peri-urban areas and the few yard connections are functional for only one or two days in a week.

The interruption problem due to the design and technical problems of the system is most common pressing problem in the city. The quantity of water on the pipes depend on the pressure of the system so that settlements on high pressure areas and low pressure areas are not served with fairness and equity, particularly the residents on informal and peri-urban settlements complain about the fairness of the system because they are located in the hilly part or far away from the center.

Table-3 Service interruption per week

Type of settlement	Service interruption per week in different settlements				Total
	<1	1-2	3-4	>4	
Formal	0 (0%)	72 (85.7%)	4 (4%)	8 (9%)	84
Peri- urban	6 (14%)	5 (12%)	10 (24%)	20 (49%)	41
Informal	7 (6%)	75 (62%)	30 (25%)	8 (6%)	120
Total	13	152	44	36	245

Own survey, 2011

Water Storage

In many cities service interruption is a very common phenomena, and the common coping mechanism of interruption is storing sufficient water. If the interruption stays for longer time larger storage capacity is required. Most of the time storing capacity of the households is determined by the income and type of the house they live in. In different settlements of the city the frequency of interruption and storing capacity of the residents is different. In the informal and peri-urban settlements higher interruption frequency and low storage capacities observed than the formal settlement.

Visual inspection of the data shows that the average volume of water stored in formal settlement is 4.98 jerrycan (124.5 litres), but the storing capacity in the peri-urban settlement is found to be 1.75 jerrycan (43.7 litres). Independent T-test indicated a significant difference between the formal and peri-urban settlements ($F=1.845;P<0.05$). The mean storage difference between the informal and formal settlement shows no significant difference ($F=11.834;P>0.05$). Peri-urban residents water storing capacity is found to be lower than the formal and Informal residents this is because of high concentration of low income households in the areas, and it is found that, the correlation between income and water storage is

significant but not strong (Pearson 0.277; P< 0.01), so that low income residents of the peri-urban areas are more relied on river and pond where water is available at the time of their need.

Sanitation

The most common type of toilet in the city is on site sanitation or toilet with septic tank. This is common for many developing countries, and in sub Saharan Africa almost 100% of secondary towns are served by this method (Strauss *et al*, 2002 in kone, 2010).

The survey shows 55.6 % of respondents have shared pit latrines with their neighborhoods and the private pit latrines accounted 28.4 % and small proportion (3.4 %) have flush toilets, but the distribution of these toilets is not uniform across the settlements. Particularly the percentage for open field use is higher for the peri-urban and informal settlements, total of 12.6 % is found to use open field. In the surveyed households; 28.6 % in the peri-urban and 11.6 %of the informal settlement residents use open field even this is assumed to be lower than the actual figure because some of the respondents do not want to answer openly such issues.

In the peri-urban and informal settlements most of the pit latrines are made without appropriate design, so that, most of these latrines are not convenient for use and waste disposal. These latrines are made up of temporary local materials such as wood and stone. The reason for constructing temporary latrines is the unsettled land holding issue in most peri-urban and informal settlements of the city.

One of the reasons for the low sanitation in the toilets is lack of sufficient water. Thirty seven percent of the surveyed households in the informal settlement and 20% of the informal settlements use less than 13 litres of water per day for cleaning their toilets and some of them (20%) use dirty water or water from wells and rivers for cleaning. In managing and use the household's sanitary facilities properly the level of awareness is low. Particularly in the peri-urban areas 13.8% of the respondents did not know what to do with their toilet when filled, they just abandon it and construct new ones. Only 52% use vacuum trucks for emptying the toilet because of the high cost of the service or lack of access to their residence.

Water Quality

In the city low coverage of sewerage system and lack of modern solid and liquid waste management system is threatening factor of the water quality. The fast urban expansion towards well fields is also additional problem. The well field's boundary is not delineated, so that, the urban settlements are expanding toward well fields. Household refuses and liquid wastes are accumulating nearby to the sources.

Particularly the peri-urban areas such as Adi kenfero, Adi welel, are facing serious surface and groundwater pollution. Industries and vehicles are this main source of chemical pollution of the rivers. According to the interview with residents the concentration of the chemicals varies in seasons as well as in days and hours. To decrease the risk the residents, most of the times collect water in the morning when the chemical concentration decrease, or when the turbidity from the irrigation pumps, clothes washing and cattle becomes low. Generally it can

be said that the rivers in use are grossly polluted bacteriologically and chemically, as a result, human and animal casualties are being observed.

Table-4 Residents Perception on water quality

Type of settlement	Water quality perception					Total
	Bad taste	Bad smell	Muddy	Pathogens	Good	
Formal	27 (32%)	4 (4%)	21 (25%)	0 (0%)	32 (38%)	84
Peri- urban	1 (1%)	0 (0%)	6 (9%)	9 (14%)	47 (74%)	63
Informal	65 (53%)	14 (11%)	11(9%)	1 (1%)	30 (24%)	121
Total	93	18	38	10	109	268

Own survey, 2011

Since the concept of access to improved water includes the quality of water served to the users, some efforts are made to evaluate the quality based on the user's perception and sample tests from some selected prei-urban areas. The survey on perception (Table 4) shows that 15% of the surveyed respondents respond that the water they are using has caused health problem particularly large number of these respondents are from peri-urban who responded that the quality problem is very serious (14%) because their major source is the river or wells of water vendors.

In the formal settlement the problem with quality is low (table 4). The main problem reported is bad taste due to the hardness (32%) and some times an increase of turbidity (25%). In the informal settlement the quality problems raised are, bacteriological (1.3%) and turbidity (9%). According to some studies in different countries this may be related to the old and leaking lines or the intermittent flow in low pressure areas which create favorable condition for infiltration of bacteria and other contaminants during long interruption time (Bakker, *et al*, 2008; Vairavamoorthy, 2008). In total, 38% of the surveyed formal settlement residents and 24 % of the Informal residents agree on the safety of existing water quality. Large percent of the informal (53%) and formal (32%) settlement complain about the bad test of water in city. Though perception is very important in service provision mainly the quality issue is the concern of public health.

Water supply and sanitation health impacts are not fully attained solely by access to clean water, because it is linked to the behavioral practices in the communities and household's appropriate sanitation and hygienic practice, but the level of awareness in handling and using the available water properly is found at the lowest level. In the peri-urban areas where quality problem is obvious most of the households did not use proper handling methods and water purification methods that can be easily available. The general perception for the river and well of the vendors water they use is good (74%) which is contrary to the laboratory result. From the surveyed peri-urban residents only 11.1% purify water by using different methods mainly due to the lack of awareness.

Table-5 Physical and biological Water Quality of peri-urban area of Mekelle city

Parameter	Sample 1	Sample 2	WHO Standard
Temperature (^{o}C)	21.7	21.8	-
pH	7.35	7.0	6-9
EC (μs/cm)	1393	1330	1500
TDS (mg/l)	780.08	744.8	1000
Faecal coliform (no./100mL)	23	43	0

In some areas there are several water vendors which sell low quality water to the peri-urban residents. To verify the quality of water two samples were collected from two vendors hand dug wells, and the laboratory analysis conducted at the regional health research center microbiological laboratory indicated high faecal coliforms growth in sample 1 and sample 2 which are 23/100ml and 43/100ml respectively. But According to the WHO standard for health reason there must no coliforms in drinking water.

Table-6 Chemical Parameters and cataions

Cataions	Sample 1 ($mg\ l^{-1}$)	Sample 2 ($mg\ l^{-1}$)	WHO Standard ($mg\ l^{-1}$)
Iron (Fe total)	0.25	0	0.3
Nitrate (No_3)	12.0 mg/l	21.0 mg/l	50 mg/l
Nitrite (No_2)	0.055 mg/l	0.010 mg/l	0.5 mg/l
Fluoride (F^-)	0 mg/l	0 mg/l	1.5 mg/l
Sulfate (so_4^{-2})	156.0 mg/l	146.0 mg/l	400 mg/l
Phosphate (Po_4^{-3})	0.40 mg/l	0.56 mg/l	2 mg/l
Total Alkalinity as $CaCo_3$	60.0 mg/l	60.0 mg/l	-

The chemical analysis results for the water samples of the peri-urban areas (table 6) are within the recommended limits and they satisfy the WHO standards. The high level of faecal coliforms (table 5) is attributed to the indiscriminate waste disposal, on site sanitation and animal waste in the area. In the formal settlement, the secondary water sources used in the

time of shortage are safer than others. The residents are using bottled water (9.5%) protected wells (16.7%) in addition to the water they collect from vendors.

Water Market

The city of Mekelle with a population more than 265,000 the households with formal piping connection are near to 30,000 the rest collect water from shared yard tap and vendors in the neighborhood. In the city there are only few trucks for supplying water and these are mostly used for the construction or emergency areas, and there are no vendors who can deliver water house to house.

The only option for those who did not get sufficient water from stand pipe, yard or house connection is to buy water from the water seller in the area. Particularly the poor population who do not have direct access to the public service the only choice is the vendor.

Households with larger family members buy water from vendors regularly. The correlation coefficient shows significant correlation between households with large family size and the amount of water bought from vendors (Pearson =0.323; $P<0.01$). The study found that larger households consume less per capita when compared with smaller households and pay more for vendors. According to the survey 65% of the formal,57% of the peri-urban, and 82 % of the informal settlement residents buy water from vendor at least one jerrycan during interruption.

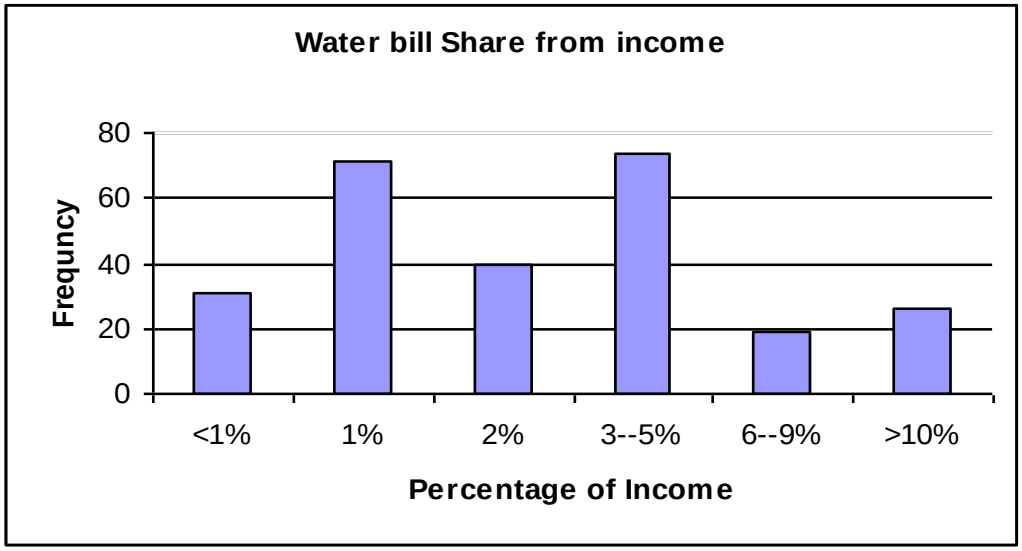
Most of the time residents of the city buy water from vendors during interruption, and the frequency of interruption differs between the settlements. In the formal settlement 75% households have water for most of the days in a week. If they use stored water for the rest of the days only some residents (25%) will buy from seller. In the informal settlement only 53% of households have water for five days and 20.8% of the households served for less than three days in a week, so that, the 53% of residents may use the water in their storage for one or two days but the remaining 47% should buy water from vendor for two up to four days in a week. To estimate the amount of money they spent on vendor, two scenarios for two days and four days were taken with the usual price 0.50 cent for a jerrycan. Households pay between 4-16 birr per month and 22% of them also pay additional cost between 4-16 birr for transporting the water.

In the second scenario by taking four days in a week 8-32 birr paid for vendors and 22% of them need extra money 8-32 birr for transporting it. Though this computation is made on the lowest usual price it doesn't represent the price prevailed at each corner, sometimes in some areas the price may go up to two birr for a jerrycan so that the water price of vendors will be between 25 birr for m^3 and 100 birr for m^3 which is more than 10 times more than utility price.

Several literatures argue that vending of water is sufficiently competitive to keep vendor profits below rent earning levels, but this is not the case in many developing countries cities with many users depend on some vendors. In the city many vendors exploit the weak regulatory system and they try to earn extra profit from reselling the water supplied from the utility to the low income consumers. Observation and studies in several countries indicate that the denial of service to the slum and peri-urban squatter settlement encourages parallel growth of an informal water market in these areas (Kahan & Siddique, 2000).

In the city of Mekelle the users are depending on some vendors in their area to save their time and transportation cost, so that, vendors in the area impose unregulated high price. In the peri-urban areas without public tap only few vendors are monopolizing the water market of the area. The residents do not have sufficient information to assess cost differences or use stand pipe after long interruption, so the residents are paying high price for water from wells with unreliable quality. The survey shows that 28% of the surveyed households spent 3-5% of their income to water utility and vendors, 7% spent 6-9% of their income and 9% of the respondents spent greater than 10% of their income. Particularly the low income group are spending large amount of their income on water market.

Figure-2 Water bill share from income



CONCLUSION

The existing source of water supply in the city is underground water source, treated and distributed through net work. However this source lacks reliability, accessibility and equity. Significant numbers of households are lacking the minimal amount required for food and sanitary purpose. The geographic distribution of the service is found inequitable between different settlements of the city particularly areas settled by lower income groups are not served properly, the water in use is either lower in quality or quantity. The investment made on urban service is focusing on the Formal, newly expanded settlement and investment areas. This shows the wider in equality in service distribution.

The rate of interruption is also found higher in some parts of the city rather than others. In the low income areas such as the peri-urban and informal settlements the rate of breakdown and interruption is found higher, and the residents of these areas are suffering because they are unable to store or buy sufficient water due to their poor economic situation. Replacing the old lines and expanding new ones in these areas may require higher investment, but to bring equitable service and to attain the MDG goals they should be entitled to the minimum service at any cost.

Generally, the study indicated the existing low level of access and equity in the city. The service interruption is very common problem of the system attributed to several technical and inherent design problems of the system. But the problem is more severe in the peri-urban and informal settlements. Large population of the city depends on water vendors during interruption, but the situation of the low income groups in the informal and peri-urban settlements is worst, they pay large proportion of their income to water vendors and they consume less in quantity and low in quality.

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