CHALLENGES FOR THE GROWTH OF ASMARA CITY FROM WATER PERSPECTIVE

By: Hagos Gidey
Municipal Engineer

1. Introduction

The challenge to supply sufficient and equitable water to the inhabitants of Asmara city and its environs is enormous. The aim of this presentation is neither to give up to-date information on the present water supply situation nor the permanent solution for the future, if Asmara has to grow economically and size-wise like many capital cities in the world. This, rather, is the main task of the Asmara Water and Sewerage Authority and to some extent the Water Resources Department as far as raw water availability is concerned.

The main objective of this paper is to create awareness in the audience in general and the concerned authorities in particular about the importance of water in the future growth of Asmara city and the extent to which it has to grow. For this, water seems to be the determining factor. How Asmara has grown from a village to what is now a city, is given in a nutshell.

The continuous growth in population and the search for adequate water supply to cope with the need had been progressing side by side for the last seventy years or so. Now, with the frightening global climate changes and the depleting water resources in and around the peripheries of Asmara, what could be the alternative solution.
The Asmara Infrastructure Development Study to be under taken in the very near future with the financial aid from the African Development Fund (ADF) will be faced with the challenge of finding an appropriate solution, and the water authorities have the responsibility of supplying reliable information and of active participation in the study throughout.

2. The Evolution of Asmara as a city

The Asmara of today used to be a conglomerate of scattered villages, each village having its own rules and regulations to administer itself.
The original villages at that time were Arbaate Asmara, Godaif, Ghedgeret and Beit Mekhae. With the coming of the Italians, the space between these villages started to draw the attention of the colonizers and they soon started to give it a shape by building houses and institutions at selected areas. Obviously the Italian colonizers made division between the residential areas of themselves and that of the indigenous people. While in the colonizers zone, the buildings, streets and other infrastructural services were of the modern type at least for that time, the indigenous zone was simple, shanty houses and tukuls without adequate services.

By May 1935 Proclamation, Asmara was declared the Administrative Centre of the Italian East Africa Colony. In March 1937, the area and the boundary of Asmara was established and a master plan prepared. Asmara has grown from scattered villages into what is now a city of about 400,000 inhabitants.
The last Master Plan of Asmara was prepared by Architect Mezzedimi in 1972. This area consisted of approximately 50 km^2. In the last 40 years, the population of Asmara had been fluctuating between low and high numbers due to the political turmoil and the 30 years war of liberation. After independence it is expected there will be a baby boom and dramatic increase of population. Therefore Asmara needs to grow in size and one of the solution for increased area is to amalgamate the surrounding satellite villages into Asmara proper, and workout a new master plan.

3. Water Supply Situation at Earlier Periods

When Asmara was first established as a town centre, the main sources of water supply were the Sembel shallow wells which lie between the Expo compound and the Sembel Residential complex. The water from these wells (about 9 of them) was being pumped into the Godiaf Treatment plant nearl by which still remains intact except for lack of some repair works. However the quality of the water in the wells started to deteriorate and is therefore now abandoned. The other sources of water were the two open reservoirs of surface water at Akria area. The water from the two lakes was being treated in the treatment plant there, but for quality reasons these too have been abandoned. Before, this area used to be in the outskirts of the built-up area, but now the catchment area for these reservoirs is a built-up area itself and quality of the stored water has deteriorated due to human habitation around the lakes. The growth of algae has also caused problems to the filters.

As Asmara continued expanding in size and population, more water was also required. This initiated the search for other water sources. Gradually, micro and medium sized storage dams were constructed on the outskirts of Asmara among which are Mai Sirwa, Adi Sciakha, Quazien, Beleza, Adi Nefas, Valle Gnechi and Stretto Vaudetto. All the above mentioned reservoirs feed the treatment plant at Stretta Vaudetto, This plant produces about 3,500- 6000 m^3 of treated water per day depending on the amount of raw water fed. In the mid sixties, signs of water shortages were noticed and again a search for more water sources was launched.
Between 1968 and 1972 the biggest surface water reservoir of Mai Nefhi, 16km South West of Asmara was realized with a nominal storage capacity of 26,000,000 cu.m However, the maximum storage so far attained has been 18,000,000 cu.m The capacity of the rapid sand filter treatment is 20,000 cu.m. per day. After almost 30years of service and finally rehabilitation, it can now produce 16,500 cu.m. per day.

4. Population and Water Demand

4.1 Population Growth and Future Projection

Even from earlier studies, there were doubts if Asmara could accommodate all sorts of developments without limitations. There were suggestions that industries consuming abundant water should not be established in Asmara, but somewhere else where raw material and water are abundantly available. There were even ideas to cap Asmara to a level of about 500,000 inhabitants in order to maintain it as a viable urban center. This all is because of fear of eternal shortage of water.

In the seventies and eighties, the population growth rate was fluctuating due to the political unrest, thus creating the migration of Asmara inhabitants to the liberated areas and to other foreign countries. After liberation the growth rate is expected to gradually stabilize few years after liberation which might have had a steep growth rate due to returnees from abroad and from liberated areas, and the influx of fighters themselves to the capital. The baby boom is also not to be under estimated. Until now no formal population census has been made for Asmara in the post-liberation years. However, in 1995 the population of Asmara proper i.e. the Asmara between the eastern escarpments and Villagio, Maitemai and the Airport but excluding the so called satellite villages was estimated to be 310,370. By the year 2015, the population of Asmara proper is estimated to reach 544, 274 at a growth rate of 3% per a. Similarly the population size of the surrounding villages and communities (Satellite Villages) is calculated to reach 38,285. The total population of Asmara proper and the satellite villages will be approximately 600,000 by the year 2015.

4.2 Water Demand Projections

Documents indicate that the daily average consumption of Asmara in 1931 was 350 cu.m. and in 1974, the daily average consumption was recorded as 12,900 cu.m. All this has its own history. In the early thirties Asmara was just under establishment as a settlement area for the Italians arriving from Italy whose numbers was not more than 3700 in the whole of Eritrea. Where as in 1974, Asmara was a well planned city with inhabitants not less than 200,000.
The continuous drought of the years between 1968 and 1974 forced the construction of the Mai Nefhi Storage Dam. The drought was again repeated between 1984 and 1996. This initiated the study of the Toker Dam which is now completed and is almost ready to start supplying water for Asmara city and the villages along the line.

Talking about the water demand in Asmara, people usually think of the domestic demand normally used for drinking, sanitation

purposes and small cottage industries and the like. But demand in its widest term includes government, institutional and commercial and public organizations, schools, colleges hospitals, churches and mosques, and large business establishments. In a larger scale, it also includes industrial such as major manufacturing and processing plants, military camps and nearby villages. Last but not least, it should also include the unaccounted for water which is lost due to leakage and unrecorded usages.

The magnitude of water demand depends on the number of house connections (this includes all connections like domestic, institutional, industrial) and unaccounted for water: the more connections the more consumption/capita. High life style, like flushing toilets. gadgets such as washing machines, gardening etc. also increase the consumption dramatically. Engineers designing the water supply system of any town should take all above points in to consideration.

5. Present Water Sources and the Rehabilitation Programme

The table below gives the existing raw water sources and the treated water being supplied to the city of Asmara.

Storage Reservoir	Nominal capacity	Actual storage m^3	Treatment plant location	Amount of water treated m^3/day
Mai Nefhi	26,000,000	13,000,000	Mai Nefhi	19,000
Adi Shekha	5,000,000	4,000,000	Stretta Vaudetto	
Mai Sirwa	2,150,000	2,000,000	" "	
Stretta Vaudetto	320,000	300,000	" "	3,500-6,000
Valle Gnechi	600,000	500,000	" "	
Adi Nefas	600,000	500,000	" "	
	34,670,000	**20,300,000**		**22,500-25,000**

At present the bulk treated water comes from Mai Nefhi and Valle Genchi. The total supply from both treatment plants is between 22,500 and 25,500 m^3/day. The soon to be completed project is the Toker Project. Some 14,500 m^3/day of treated water is expected from this project, bringing the total available treated water to about 40,000 m^3/day. This quantity is only available if the upgrading of the old treatment plant takes place and the rehabilitation of the hydraulics and network systems is completed.
The Rehabilitation Programme which is financed by the French Government includes the repairs and upgrading of pumping stations, reservoirs, treatment plants and the network system.

With the completion of Toker Project and with some re-arrangement. Asmara will be Supplied from three sources and will be divided in to three supply zones.

1. Tsetserat, Paradiso, Maitemenai, Tiravolo from Toker Dam.

2. Hazhaz, Mihram Chira, Acria, Arbaete Asmara, Gheza Khenisha, Edaga Arbi, Maikelai Sefer and Northern City Center from existing micro dams in the North.

3. The southern and eastern parts of Asmara which include Sembel, Expo, Godaif, Gehdjeret, kahawta, Addis Alem, Settanta Otto and the Southern City Center will be supplied from Mai Nefhi.

The expansion of the water supply system complies with the near future expansion of the city of Asmara which is thought to be towards the west and northwest direction, but how far Asmara can expand in the far future is a question related to the availability of sufficient water.
By the year 2015, the population of Greater Asmara i.e. including the satellite villages around will reach about 600,000 assuming a constant growth rate of 3% per annum.

The potential production capacity of the existing water sources including the soon to be completed Toker Project will be 40,000 m^3 /day. At present the unaccounted for water (UFW) is estimated to be 40% However, with ultimate reduction of the UFW to 20% by renovating the old system, the useful water reaching the consumer will be 40,000 x 80% = 32,000 m^3 /day = 53.3 l/c/d in 2015. In this figure is also included non-domestic consumption which may be estimated roughly as 1/3 of 53.3 = 17.8 e/c/d. Therefore the domestic consumption will be 35.5 l/c/d.

By the year 2015 a high percentage of the household is expected to have house connection facilities with more taps and gadgets in the house: more household will start using washing machines, flush toilets and even using

more water for gardening. Sewer system will need more water in order to function properly and this will undoubtedly raise the per capita consumption rate to higher level.

6. The Future Water Supply of Asmara vis-à-vis its growth

The general terrain of Asmara and its surroundings indicate that the prospects for ground water is doubtful, and if there is, then it may be some confined aquifers the quality and quantity of which is uncertain. A more detailed study would be required. So far, Asmara for its water supply has been dependent on surface water stored at various sites around the city. Now with the growth of the city size and its population, the site locations of the newer storage reservoirs are getting farther and farther of the city. This will not only increase the production and the distrbution cost but the chance of accumulating sufficient water becomes less and less as the catchment area is sub-divided among more reservoirs.

Next to Toker, the future sites for another storage dam will probably be the Little Mereb site about 30 km from Asmara, midway between the road Tera Emni-Dekemhare. This and other possible sites had been preliminarily studied by Associated Engineering International Ltd. Of Canada in 1987.

If we take it for granted that for the next phase the Little Mereb project will be implemented to compensate the future water shortage of Asmara City, what will then be the next step when Asmara grows further. The answer may seem to look for other suitable areas with sufficient quantity of water, but how far will this site be from Asmara. Are there suitable dam sites and catchment areas. Storage reservoirs are totally dependent on the availability of sufficient rainfall.

Although it is not easy to make a concrete conclusion on the hydro meteorological phenomena taking place globally, the rainfall data of Asmara Airport (1932-2001) might give us some ideas to ponder. See table 2 for rainfall data.

Average annual rainfall

$$\frac{\text{The total for all the 69 years}}{\text{The number of data years (69)}} = \frac{35,807}{69} = 519\text{mm}$$

$$\text{Index of wetness} = \frac{\text{Total rainfall of particular year}}{\text{Average annual rainfall}}$$

e.g 1) Index of wetness for 1932 = $\frac{687}{519}$ X 100 = 133%

This means the year 1932 had 33% more rain than the average annual rainfall which is 519mm.

e.g 2) Index of wetness for 1989 = $\frac{179}{519}$ X 100 = 34%

This means the year 1989 had 66% rain deficiency indicating a very bad year.

Deficiency of 30-45% is termed large deficiency
" " 45-60% is termed serious deficiency.
" " 60 % and more is termed disastrous deficiency.

The years 1939,1941,1973,1974,1999 show large deficiency.
The years 1966,1990,1996 show serious deficiency.
The years 1969,1989,1991 show disastrous deficiency.

Generally speaking from 1947-1950 a continuous deficiency in the rage of 14%-28% occurred.
In 1965-1974 a continuous deficiency in the range of 15%-60% occurred. This was a long period (9 years) with the exception of 1967 (7%) excess.

Again in 1988-1996 a continuous deficiency in the range of 20%-66% occurred for 9 years with the exception of 1993 (9% deficiency).

In conclusion, the deficiency years, although ranges do differ, -occur ever 13-14 years.

This scarcity of water or rainfall leads us into a hypothetical thinking that the growth of Asmara City, size wise and population wise should be restricted at one stage, probably after the implementation of the Little Mereb Project. This gives also chance for the development of other cities and rural areas by reducing migration to Asmara and enhancing the reduction of problems that come with urbanization. The same trend should be followed in all other regional centers because water problem is everywhere in Eritrea.

7. Conservation and Saving of Water

We have witnessed in our lift times how ground water levels are depleting and the rivers that once were perennial have now become seasonal. This is a clear indication that our planet is undergoing changes in climate the causes of which are multiple; to mention few, deforestation and gas emission as the main causes. It is predicted by scientists and politicians that the future causes of conflict and war between nations will be WATER.

Situation can change to the better by strict commitments to afforestation and environmental control but the visible changes that these actions will bring takes decades and centuries. It is a long term action that should pass from generation to generation.

The only option we are left with is to make plans on how to use the available water and the dwindling rains. The remedy is to conserve every drop of water and to make people aware to save water and avoid unnecessary wastages.
The following are some of the precautions that help us make the optimum use of god given rains: -

1. Harvesting of rain water from roofs, and ground surface for domestic use as additional to the municipal supplied water.

2. Harvesting of rain water from ground surface by collecting it at appropriate dam sites and at excavated ponds.

3. Diverting flood waters for irrigation and infiltration for replenishment of ground water.

4. Recycling of sewage water for re-use.

5. Reduce leakage loses by constantly repairing the network system

6. Teaching the public to be economical with the use of water.

7. Tariff [illegible]

8. [illegible] HAF

9. Organization

TOTAL ANNUAL RAINFALL
(1932-2001)

YEAR	TOTAL RAINFALL MM.	INDEX OF WETNESS %	YEAR	TOTAL RAINFALL MM.	INDEX OF WETNESS %	YEAR	TOTAL RAINFALL MM.	INDEX OF WETNESS %
1932	687	133	1956	515	100	1980	860	166
1933	722	140	1957	469	91(9)	1981	733	142
1934	528	102	1958	478	92(8)	1982	688	133
1935	693	134	1959	675	131	1983	448	87(13)
1936	928	179	1960	464	90(10)	1984	450	87(13)
1937	892	172	1961	711	138	1985	688	133
1938	631	122	1962	549	106	1986	489	95(5)
1939	304	59(41)	1963	573	111	1987	559	108
1940	503	97(3)	1964	528	102	1988	421	81(19)
1941	326	63(37)	1965	441	85(15)	1989	176	34(66)
1942	534	103	1966	275	53(47)	1990	215	42(58)
1943	620	120	1967	599	116	1991	178	34(66)
1944	626	121	1968	390	75(25)	1992	374	72(28)
1945	373	72(28)	1969	208	40(60)	1993	468	9(9)
1946	553	107	1970	378	73(27)	1994	413	80(20)
1947	375	73(27)	1971	398	77(23)	1995	416	80(20)
1948	371	72(28)	1972	381	74(26)	1996	249	48(52)
1949	426	82(18)	1973	362	70(30)	1997	689	133
1950	447	86(14)	1974	362	70(30)	1998	563	108
1951	640	124	1975	684	132	1999	360	69(31)
1952	490	95(5)	1976	526	102	2000	543	105
1953	748	145	1977	803	155	2001	564	109
1954	612	118	1978	915	177			
1955	465	90(10)	1979	710	137			

- Average Annual Rainfall for 69 years = 519 mm.
- (41) Rain deficiency.
- 34 years with deficient rain, ranging from 3% to 66%.

272.2
340.8

2002
2003

opposite
pages

References

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