MANAGEMENT OF DESALINATION PLANTS AND DISTRIBUTION OPTIONS OF DESALINATED WATER

BY:

Rebhy El – Sheikh
M.Sc. Mechanical Engineering
Palestinian Water Authority
Director of technical Department/Projects Manger

Moahmoud Shaban
Bsc, Civil Engineering
Palestinian Water Authority
Head of consumer Affairs

Ibrahim Jaber
Palestinian Water Authority
Head of License, fees and tariff

1.Abstract:

The strategic plan of the Palestinian Water Authority (PWA) is to construct three sea water desalination plants a long the coast of Gaza Strip, with a total capacity of 15,000 m^3 / day (5000 m^3 / day each) to cover the current needs of potable water. PWA has started the erection of a first phase in one of the three plants with daily capacity of 1250 m^3.

A survey has been carried in Gaza covering different categories of consumers, investors and operators in the private sector to find out to what extent an economic market for desalinated sea water can exist, how it can be distributed, what tariff can be applied on different schemes of distribution, and how the overall industry can be managed and monitored.

The survey has taken into consideration socio-economic data, feasibility of RO Sea water desalination and options for water distribution.

The output of the study has given an average willingness to pay according to method of distribution demand growth on desalinated water by time and to what extent and in which way the private sector cab be involved in this industry under regulations of the Palestinian Water Authority.

2.Keywords:-

Demand, Over pumping, Salinity, Reverse Osmosis, bottled water, distribution, customer's affordability, regulations, management.

3.Introduction:-

Gaza Strip is located in an area suffering from scarcity of water resources. Demand on potable water and water for irrigation is rapidly increasing due to sharp increase in population especially as a result of the peace process. With the ground water as the only water resource currently available, the extraction of ground water is exceeding the recharge of ground water aquifers.

This is resulting in decreasing the ground water level, hence invation of the sea water to the aquifer which results in increasing chloride concentration of the extracted water. This is continuously leading to an unsatisfactory level of water supply, particularly in the refugee camps which represent about 60% of the total population of Gaza Strip. In those areas, water is available in bad quality in terms of salinity, limited quantities and restricted times of supply during the day.

Another side of the problem is the uncontrolled discharge of untreated or partially treated wastewater to the ground and the excessive use of fertilizers for agriculture is continuously resulting into high levels of nitrates.

This situation has lead to start thinking in R.O. sea water desalination in small and medium scales to provide water for drinking purposes, provided that big scale desalination plants are avoided at this stage in order that they will not replace Palestinian rights in water through the peace negotiations.

4. Present situation of high quality water in Gaza

Four small capacity brackish water desalination plants are available mainly under municipal management.

1.One plant at Deir Al – Balah area (population 60,000) of production capacity of $20m^3$/ hr
2.Two plants at Khanyounis area, (population 120,000) of total production capacity of $50m^3$/ hr.
In both cases, desalinated water is partially pumped into the distribution networks directly and partially consumed through public taps located just outside the sites of plants. The systems are being managed by the two municipalities for a daily operation of about 14 hours. As the case in other water facilities operated by Municipalities, the system suffers from low maintenance level, no tariff structure, and inefficient distribution,

especially the part pumped through networks directly does not give sensitive improvement on quality, more over it covers only the vicinity where the plants are located.

3.A newly constructed brackish water desalination plant at the Gaza industrial estate, 400 m^3/day capacity, where the target is limited to provide good quality water for industrial foundations. Unfortunately, the Gaza industrial estate is not functioning as planned right now because of the high risk considered by investors due to political uncertainty.

For this reason, the plant is being commissioned by the USAID (who built it), and a pilot distribution system for homes in the vicinity through a dual distribution system is under testing. On the other hand, the private sector has been involved in distributing about 20m^3 /day by trucks and water shops. The consumer price for a Jerrycans 16 liter capacity is $1.6 (excluding cost of empty Jerrycan). This water is purchased mainly for tea, cooking and drinking.

On the other hand Gaza and the West Bank became a good market for import of bottled water. Bottled water is being imported from different markets e.g. Egypt, Turkey and Israel.

In addition, a Palestinian bottling company located in Jericho is producing bottled spring water and distributes for both Gaza and the West Bank.

The package size of bottles available is 0.5, 1, 1.5 and 20 liters capacity where the later is still uncommon.
The consumer price of one liter of bottled water varies between $0.76 to $ 0.9.
This relatively high cost makes it still uncommon to be purchased by all the people of Gaza Strip.
A comparative calculation based on market information of an average number of 10,000 bottles imported per day (mainly 1.5 liter volume) makes it quite clear that an annual cost of imports is estimated at 1.35 MUSD.

The trend to use bottled water in Gaza gives an indication that size of imports is increasing with time due to the following reasons:

1.People are becoming familiar of the fact that quality of municipal water is deteriorating with time. They taste continuously the increasing salinity content.

2.The increasing number of returnees due to the peace process, where most of them are back home with an understanding of the bad water quality in Gaza.

5. Potential of drinking water market in Gaza:-

Currently, population of the Gaza Strip amounts to 1 million. A high growth rate of 3.8% per year is encountered in Gaza. This gives rise to population to about 2.6 million in the year 2020.

Random groups of consumers of bottled water show that there are mainly three categories of consumers with tendency to increase at different rates till the year 2020.

a) Small consumers, who depend to cover their needs partially and occasionally, mainly for economical reasons. Those consume in average 0.25 liter/ capita/ day. They use this water only for tea occasionally. They could represent 8% of the population of Gaza by the year 2020.

b) Medium size consumers, using this water occasionally for drinking and tea. They consume in average 1 L/ capita/ day. The growth rate of this category is less rapid. They could represent 5% of the population of Gaza by the year 2020.

c) Regular consumers, who depend mainly on this high quality water for drinking, tea, cooking and in some cases interior flowers irrigation. They consume 1.5 L/ capita/ day. The growth rate is more slow in this category. Mainly some consumers in categories (a) & (b) above tend to fall under this category.

This category could represent 2% of Gaza population by the year 2020.

Thus comparing the current situation of having 10,000 bottles (1.5 L volume) per day, with an average consumption of 0.5 L/ capita/ day, corresponding to 30,000counsumers in Gaza with the forecast number of consumers (15% of Gaza population) in the year 2020, gives a growth rate of consumers of bottled water to 12% over the coming twenty years.

On the other hand, the potential market for Jerrycans 16-20 liter of water, with an average consumption of 3 L/ capita / day indicated that about

14% of Gaza population are currently accepting the idea of distribution in this way.

Other categories of consumers are, hotels and restaurants, who although consume about 20 L/room (in hotels), still hove a low gross consumption. Tourism plans indicate a sharp increase in the number and facilities of such place. The number of hotel rooms is going to increase from 316 in 1999 to 1000 in the year 2005.

Recently, the residential R.O. units (20 liter capacity/day) are becoming increasingly used. The feed water is in principle is tap municipal water, originally supplied by municipalities and being extracted from the aquifer. Similar to the municipal brackish water desalination plants mentioned earlier, where about 40% is rejected as brine is resulting in more and more loading on the aquifer which is against the Palestinian Water Authority regulations and strategies.

In summary, the total estimated quantity of high quality drinking water in Gaza will rise to 2220 m^3/ day by mid 2000 and could increase to 11,900 m^3/ day by year 2020. On the other hand, the following hypothesis has been assumed in analyzing the forecast demand on desalinated water.

1. Population: precisely, as far as population increases, demand on desalinated water will increase, keeping in mind that the rate of growth differs from one area to another within the Gaza Strip. For example, dense population is clear in refugee camps where the area is limited, thus resulting in almost no chance to increase population in the same area.
2. Type of service: Demand and consumption will vary according to the way consumers get their water. The highest consumption rates will be where direct connections from a main supply line (Refer to distribution options) are made. This can apply on homes, restaurants and hotels just located close to the main supply line. Demand and consumption rates fall down when water is supplied by tankers so that people fill their own Jerrycans. It falls more if consumers have to carry their Jerrycans to water shops or filling stations. The lowest consumption and demand rates will remain for the case of bottled water.
3. Living standards: consumers living in villas will consume more than those living in high standard housing projects and those will consume more than those living in refugee camps.

6.Distribution Options:

In the light of data collected about available similar water (bottles), demand, geographical location, socioeconomic conditions, affordability to pay and traffic intensity, the following distribution options for certain quantities of the product are found to be appropriate:

1. A main water carrier from the plant site to the closest area of high density population with an average total length of 8 km (two branches, 4 km long each in two different directions). Customers for this component will be hotels and restaurants a long the beach of Gaza, housing projects planned a long the beach and scattered existing houses. Supply is proposed to be in the form of direct metered house connections so that those customers will have dual supply system. The total population estimated to be served under this scheme is 25,000 inhabitants in the year 2005.

2. Distribution networks inside densely populated areas so that selling points or water shops be erected at selected locations. By this scheme consumers will be close to selling points and will be easy for them to carry their empty Jerrycans against a pre – determined fee. The total population estimated to be served under this scheme is 280,000 inhabitants in the year 2005.

   In both of the above two schemes, the system must be monitored for leakage and illegal connections by a telemetry system reporting meter readings to the monitoring room at the plant.

3. Tanker filling station:

   Tanker filling stations are estimated to be erected close to the ends of the main carriers so that they transport water to places not covered by the distribution system. They can supply water to water shops, direct selling in the street or filling house tanks.

   The number of tankers is estimated to be limited to 31 units to avoid traffic troubles, out of them are 3 units of 20m ^{3} capacity for big consumers (e.g. big water shops in certain areas), 15 units of 6 m^3 capacity for delivery to homes and selling in streets to provide service to other places.

   The quantity distributed under this scheme will be limited to 600m^3/ day till year 2005. A reservoir needs to be erected at the site of the filling station.

4. Filling station for Jerrycans:

   Some consumers who have their own cars and used to drive a long the coast for entertainment prefer to carry their own empty Jerrycans and

fill it from such a station. This scheme can provide water to 11,000 inhabitant per day. The system can be similar to fuel stations, with underground reservoir.

5.Water bottling plant:

It is not anticipated that this scheme will replace imported bottles directly. A trade mark must be given to the bottling plant so that customers be confident of the product 19,000 bottles per day can be produced giving about 38,000 m^3 per day of bottled water.

7.Institutional framework, management and operation of different components:

The Palestinian Water Authority has obtained letters of interest from the local private sector who wish to be involved in the management and operation. Interviews were carried with some investors and data were collected in connection to their opinions. By the time it is well clear that the product is of high cost, the private sector is willing to incorporate on the basis of profit making. A compromise between the private sector interest affordability of consumers to pay and the regulations of Palestinian Water Authority has been analyzed.

On the other hand, the Palestinian Water Authority is in the process of forming a coastal water utility. (CWU) which will be a non profit entity owning all water infrastructure in Gaza .

More over, CWU can hire the private sector to carry out operation and maintenance for some parts of the water & waste water sector.

In the light of above points, the following management operation schemes are recommended:

Desalination Plant:

PWA will build the R.O. plant out of allocated funds and give ownerships to the CWU. The CWU is recommended to enter into a leasing contract with the private sector. The operator (private sector) will be the bulk water seller to tankers, water carrier and the bottling plant. PWA will play the role of regulator on level of service provided, quality of water distributed and tariff.

Water Carriers and networks:

Due to limited funds, PWA may not be able to carry out the construction of such distribution facilities. A BOT contract between the CWU and the private sector is a recommended option for a duration of 30 years. The operator of this component will purchase from the bulk water seller (R.O. plant) and distributes for distribution network, Jerrycans filling station and tanker filling stations.

Bottling Plant:

This option will encounter high investment and must be encouraged by the public sector. A self-financing option by the private sector is recommended without the need to transfer this infrastructure to the public sector. PWA will monitor the product quality and price.

Tankers, Tanker and Jerrycans filling station, water shops:
Self-financing option is encouraged to be carried by the private sector. These components need to be licensed by PWA and regular inspection need to be carried by PWA to check level of service.

8.Financial Analysis:

For the different distribution options, a financial analysis covering capital investment items and the running costs of operation and maintenance has been performed. The selling price for end consumer has been found competitive with other similar available options. Hypothesis followed in this analysis can be summarized by following:

1. The cost of production of a cubic meter of desalinated sea water includes the marginal capital investment in addition to maintenance and operational costs.
2. Rate of interest is taken as 8%
3. The study assumed that the depreciation time for civil works is 40 years while for Electromechanical works is 20 years.
4. The maintenance cost from practice and literature is between 2.5% to 5%.

The unit price for the end user is given in the analysis shown in annex 1 for the different distribution options.

9.Conclusions and recommendations:

1. The local market absorption capacity of the product will not meet the strategic plan of the Palestinian water Authority. In steed of having three plants 15,000 m^3/ day capacity as urgently needed, it is advised to erect into phases gradually, starting by 1250 m^3/ day and increasing the capacity by 1250 m^3/ day at intervals of 3 years.
2. The least cost per m^3 distribution option is pumping water in networks. The operator, in order to be able to make profit shall have a very tight monitoring system.
3. The private sector shall be encouraged to engage in the operation of the different components. This will give more chance of success as a new industry
4. Investment required for a bottling plant is too high. In the same time capacity of production is too low. Accordingly, in case of efficient and reliable distribution by tankers and water shops may have the effect on bottle users to switch to Jerrycans. It is not advisable to construct a bottling plant at this stage.
5. The Palestinian Water Authority should start putting clear guidelines, regulations and contractual conditions required to engage the private sector into the operation and maintenance program.
6. Awareness companies should be started to let consumers accept smoothly the replacement of tap water with such high quality water for drinking purposes.

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Table (1)

Desalination Plant							
Cost And Revenues For Potential Capacity 1250 M3 Per Day							
Interest Rate	8%						
Item	Component	Const.Date	Total C.	Life	Factor	Annual Cost	%
Investment Cost							
	Civil Works	2000	500,000	40	11.92	41,930	
	Equipments	2000	2,666,667	20	9.82	271,606	
Total Investment			3,166,667				
Sub-Total						**313,536**	0.35
Operation Cost							
Manpower						43,200	0.05
Electricity						297,086	0.33
Chemicals						45,322	0.05
Membranes						18,129	0.02
Maintenance	3.50%					110,833	0.12
Advertising Campaign						10,258	0.01
Total Ope.Cos.						**524,828**	
Total Cost						**838,364**	
Water Production	m3					**453,250**	
Cost	$/m3					**1.850**	
	NIS/m3					**7.584**	
Tariff Per M3 To Buyers						**2.000**	
Revenues						**906,500**	
Net Reset Per Year						**68,136**	
Electricity Consumption	**Manpower**			**Volume of Desalination**			
Number of KWH Rer m3 5.7	Number of Employees 5			Volume Per Hour m3 52			
Unit Cost of KWH .115	Salary Per Month US 599			Number of Hours Per Day 23			
Unit Cost of Per m3 .656				Production Per Day m3 1249			

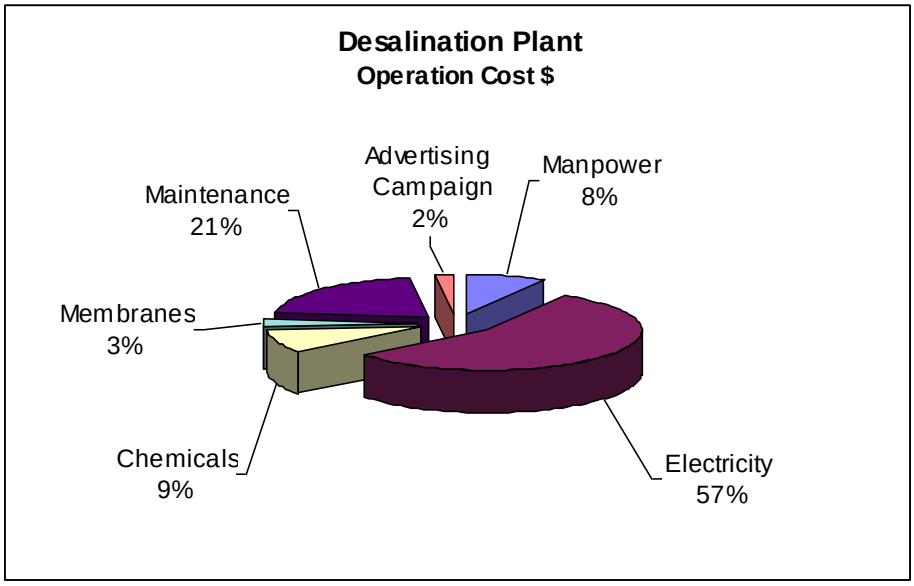


Table (2)

Water Bottling Plant							
Cost And Revenues For 15000 Bottles Per Day							
Interest Rate	8%						
Item	Component	Const.Date	Total C.	Life	Factor	Annual Cost	%
Investment Cost							
	Civil Works	2000	1,000,000	40	11.92	83,860	
	Equipment's	2000	1,500,000	20	9.82	152,778	
Total Investment			2,500,000				
Sub-Total						**236,638**	0.20
Operation Cost							0.00
Manpower						96,000	0.08
Electricity						2,067	0.00
Cleaning Products for Cleaning						1,797	0.00
Inputs						748,800	0.62
Maintenance	3.50%					87,500	0.07
Cost of Water						31,200	0.03
Total Ope.Cos.						**967,364**	
Total Cost						**1,204,002**	
Number of Bottles Per Year	1.5 Liters					**5,990,400**	
Cost	$/m3					**0.201**	
	NIS/m3					**0.824**	
Selling Price Per Bottle Wholesaler						**0.220**	
Revenues						**1,317,888**	
Net Reset Per Year						**113,886**	0.09
Electricity Consumption		**Manpower**			**Volume of Desalination**		
Number of KWH Rer m3	2	Number of Employees		20	Volume Per Hour m3 4		
Unit Cost of KWH	0.115	Salary Per Month US		400	Number of Hours Per Day 8		
Unit Cost of Per m3	0.23				Production Per Day m3 29		
					Number of Working Days Per Week 6		
Number of Bottles 1.5 Liter					Total Volume Bottled Per Year m3/y 8986		
Number of Bottles Per Hour		2,400			Water Required for the Process m3/y 6614		
Number of Hours Per Day		8			Total Volume USAD Per Year m3/y 15600		
Number of Bottles Per Day		19,200					
Number of Working Day Per Week							
Number of Bottles Per Year		5,990,400					

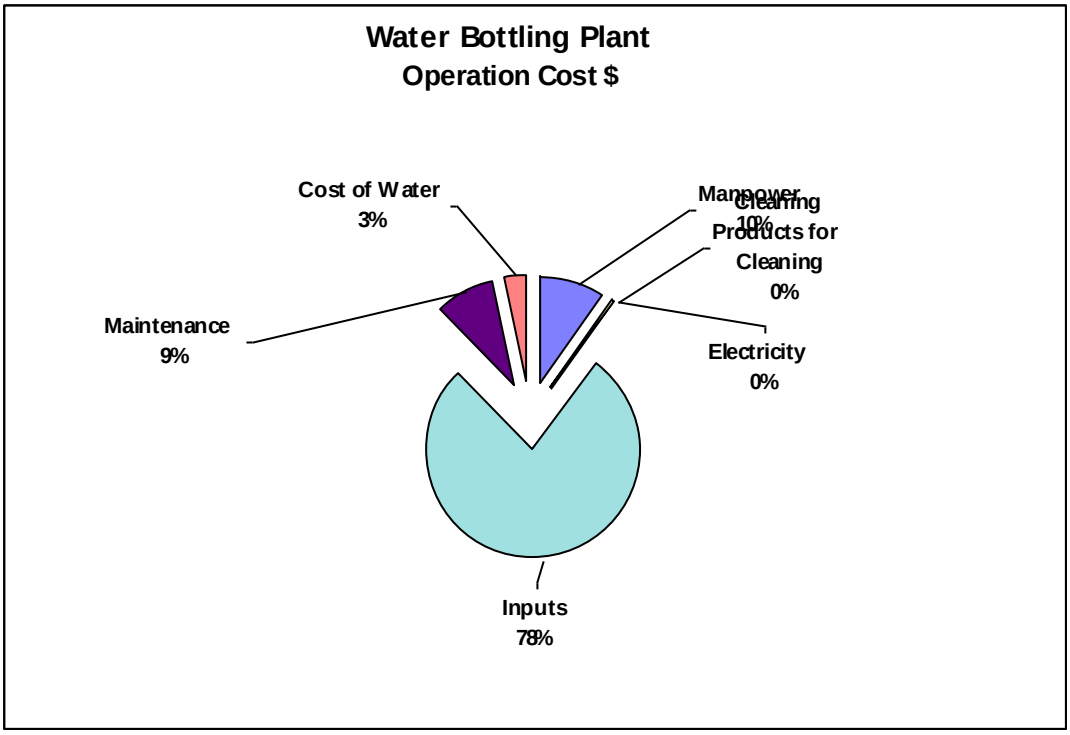


Table : 3							
Pure Water Network From The Plant to High Density Population							
Cost And Revenues for 1250 M3 Per Day							
System Eff.	90%						
Interest Rate	8%						
Item	Compone	Const.Date	Total C.	Life	Factor	Annual Cost	%
Investment Cost							
	Civil Works	2000	135,000	40	11.92	11,321	
	Equipment's	2000	135,000	20	9.82	13,750	
Total Investment			270,000				
Sub-Total						**25,071**	
Operation Cost							
Manpower						14,400	0.02
Maintenance	2.50%					6,750	0.01
Cost of Water Paid to The Desal. Plant						875,240	0.95
Total Ope.Cos.						**896,390**	
Total Cost						**921,461**	
Total Volume Water Billed	m3					**437,620**	
Cost	$/m3					**2.340**	
	NIS/m3					**9.592**	
Tariff Per M3 To Buyers						**2.500**	
Revenues						**984,645**	
Net Reset Per Year						**63,184**	
Manpower		**Volume of Network Desalination Water**					

Number of Employees	2	Volume For Consumers			117,972	
Salary Per Month US	600	Volume For Individual Connection			76,558	
		Volume For Water Filling Station			243,090	
		Total Volume Billed Per Year	m3/year		437,620	
		10% Unaccounted-For-water	m3/year		43,762	

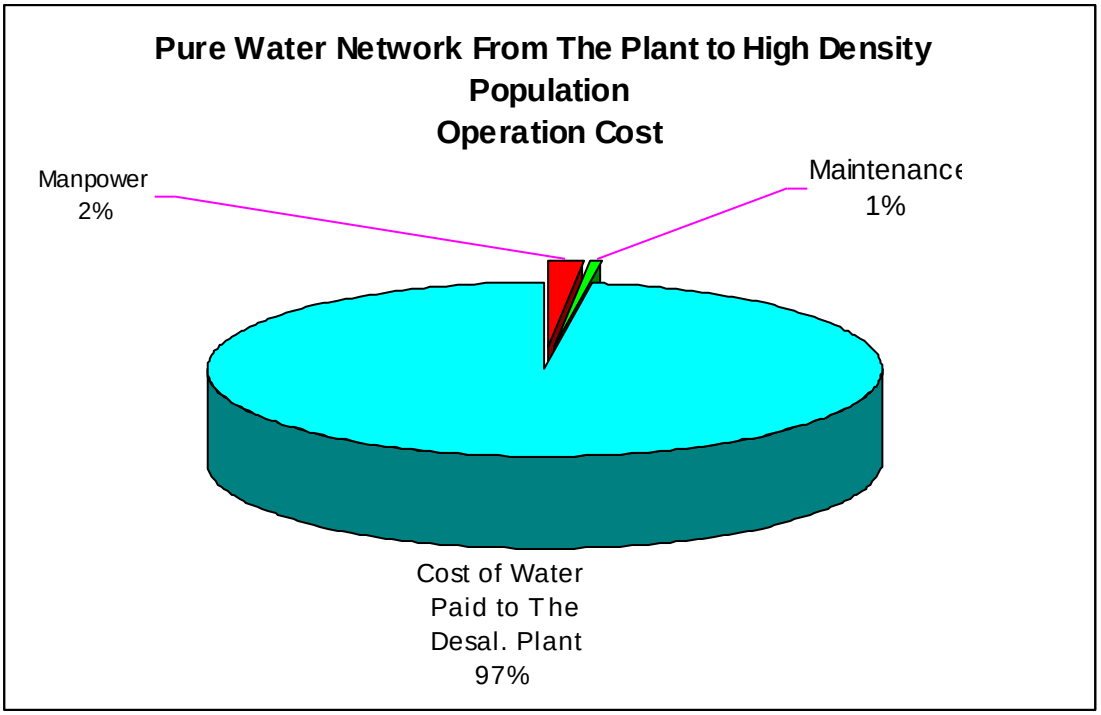


Table :4							
Pure Water Network Inside the High Density Area							
Cost And Revenues for 1250 M3 Per Day							
System Eff.	90%						
Interest Rate	8%						
Item	Component	Const.Date	Total C.	Life	Factor	Annual Cost	%
Investment Cost							
	Civil Works	2000	50,000	40	11.92	4,193	
	Equipment's	2000	170,000	20	9.82	17,315	
Total Investment			220,000				
Sub-Total						**21,508**	
Operation Cost							
Manpower						33,600	0.09
Maintenance	2.50%					5,500	0.02

Cost of Water Paid to The Desal. Plant						294,930	0.83
Total Ope.Cos.						**334,030**	
Total Cost						**355,538**	
Total Volume Water Billed	m3					**117,972**	
Cost	$/m3					**3.349**	
	NIS/m3					**13.729**	
Tariff Per M3 To Buyers						**3.700**	
Revenues						**392,847**	
Net Resut Per Year						**37,309**	0.09
Manpower		**Volume of Network Desalination Water**					
Number of Employees	7	Volume For Consumers				117,972	
Salary Per Month US	400	10% Unaccounted-For-water			m3/year	43,762	

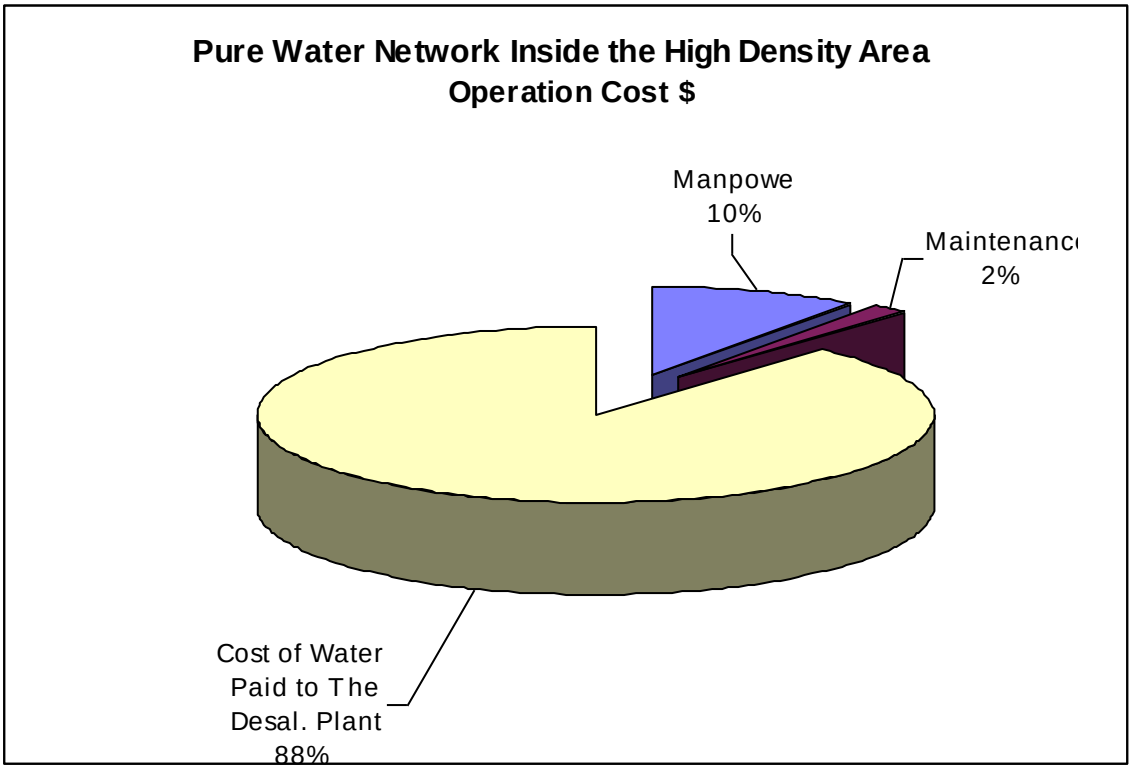


Table:5							
Water Filling Station for Tankers & Cars							
Coast And Revenues for 1250 M3 Per Day							
System Eff.	90%						
Interest Rate	8%						
Item	Component	Const.Date	Total C.	Life	Factor	Annual Cost	%
Investment Cost							
	Civil Works	2000	100,000	40	11.92	8,386	
	Equipment's	2000	130,000	20	9.82	13,241	
	Land	2000	380,000	40	11.92	31,867	
Total Investment			610,000				
Sub-Total						**53,494**	0.08
Operation Cost							
Manpower						14,400	0.02
Electricity						559	0.00
Maintenance of Civil Works	2.50%					2,500	0.00
Maintenance of Equipment's	5.00%					6,500	0.01
Cost of Water Paid to The Desal. Plant						607,725	0.89
Total Ope.Cos.						**631,684**	
Total Cost						**685,178**	
Total Volume Water Billed	m3					243,090	
Cost	$/m3					**3.132**	
	NIS/m3					**12.840**	
Tariff Per M3 To Buyers						**3.330**	
Revenues						728,541	
Net Resut Per Year						**43,363**	0.06
Manpower		**Volume of Desalination Water**					
Number of Employees	3	Volume Delivered Per Day				779	
Salary Per Month US	400	Num.Of Working Days Per Week				6	

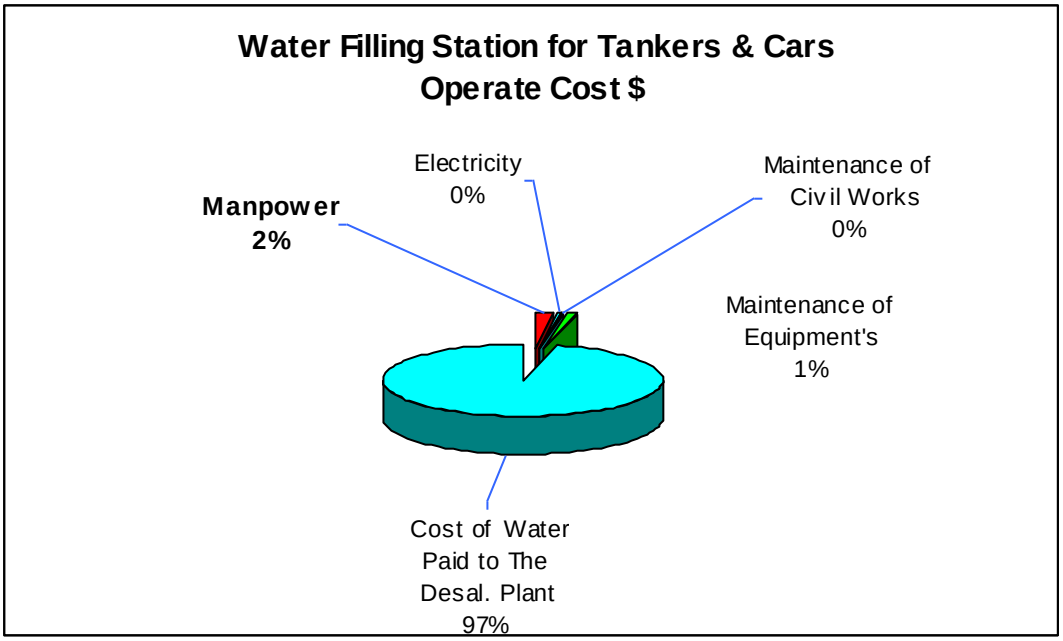


Table: 6							
Water Distributed By Tankers In Water Shops 20m3							
Coast And Revenues For One Tanker of 20 M3							
Interest Rate	8%						
Item	Component	Const.Date	Total C.	Life	Factor	Annual Cost	%
Investment Cost							
	One Tanker 20 m3	2000	150,000	15	8.56	17,524	
Total Investment			150,000				
Sub-Total						**17,524**	0.18
Operation Cost							
Manpower						7,200	0.07
Fuel						4,680	0.05
Lubricants	10%					468	0.00
Maintenance	5%					7,500	0.08
Cost of Water Paid to The Desal. Plant						62,338	0.63
Total Ope.Cos.						**82,186**	
Total Cost						**99,710**	
Total Volume Water Billed	m3					18,720	
Cost	$/m3					**5.326**	
	NIS/m3					**21.838**	
Tariff Per M3 To Buyers						**5.600**	
Revenues						104,832	
Net Result Per Year						**5,122**	0.05
Manpower		**Volume of Water Transported m3/year**					
Number of Employees	1	Volume PerTrip Liters				20,000	
Salary Per Month US	600	Number Of Working Days Per Week				6	
Fuel Cost		Number Of Trips Per Days				3	

Number Of Trips Per Day	3						
Number Of km Per Trip	25						
Number Of km Per Day	75						
Number Of Working Days Per Year	6						
Number Of Working Days Per Week	312						
Number Of km Per Year	23400						
Liters For 100 KM	40						
Annual Consumption	9360						
Cost of Fuel Per Liter	0.5						
Total Consumption	4680						

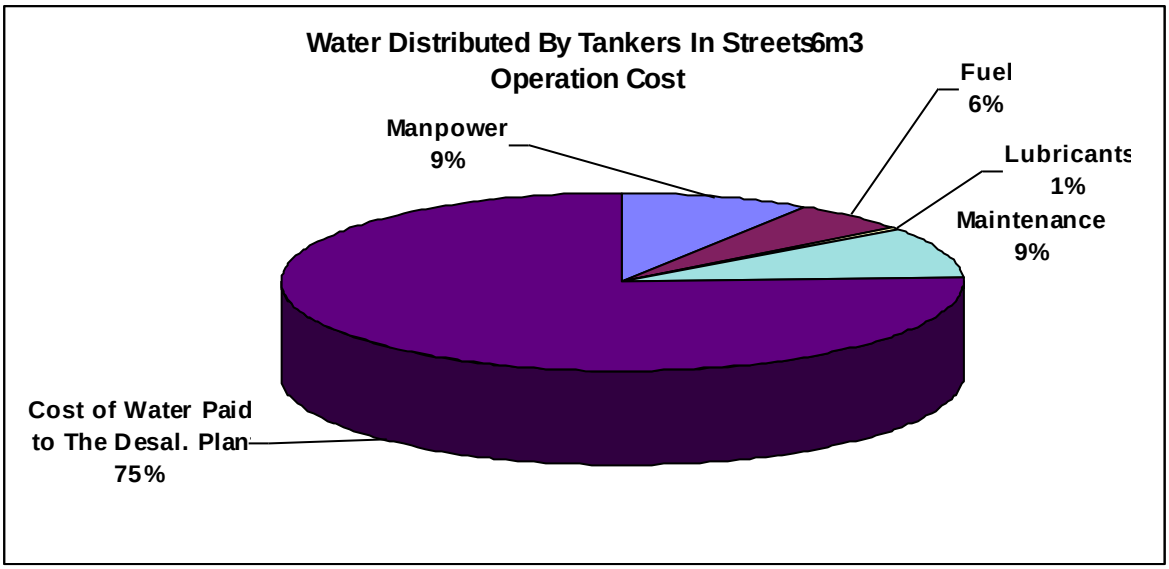


Table: 7							
Water Distributed By Tankers In Water Shops 6m3							
Cost And Revenues For one Tanker of 6 M3							
Interest Rate	8%						
Item	Component	Const.Date	Total C.	Life	Factor	Annual Cost	%
Investment Cost							
	One Tanker 6 m3	2000	50,000	15	8.56	5,841	
Total Investment			50,000				
Sub-Total						**5,841**	0.13
Operation Cost							
Manpower						7,200	0.16
Fuel						3,900	0.09
Lubricants	10%					390	0.01
Maintenance	5%					2,500	0.06
Cost of Water Paid to The Desal. Plant						24,935	0.56
Total Ope.Cos.						**38,925**	
Total Cost						**44,767**	
Total Volume Water Billed	m3					7,488	
Cost	$/m3					**5.978**	
	NIS/m3					**24.512**	
Tariff Per M3 To Buyers						**6.300**	
Revenues						47,174	
Net Result Per Year						**2,408**	0.05
Manpower		**Volume of Water Transported m3/year**					
Number of Employees	1	Volume PerTrip m3				7,488	
Salary Per Month US	600	Number Of Working Days Per Week				6	
Fuel Cost		Number Of Trips Per Days				4	
Number Of Trips Per Day	4						
Number Of km Per Trip	25						
Number Of km Per Day	100						
Number Of Working Days Per Year	6						
Number Of Working Days Per Week	312						
Number Of km Per Year	31200						
Litters For 100 KM	25						
Annual Consumption	7800						
Cost of Fuel Per Liter	0.5						
Total Consumption	3900						

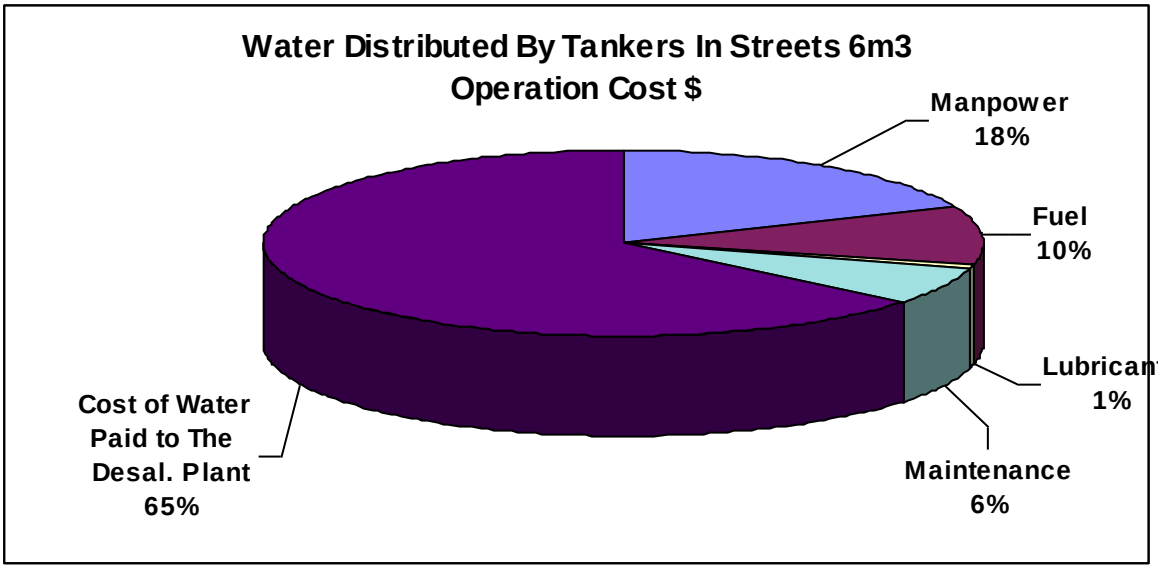

Water Distributed By Tankers In Streets 6m3
Operation Cost $
Manpower
18%
Fuel
10%
Lubricant
1%
Maintenance
6%
Cost of Water
Paid to The
Desal. Plant
65%

Table: 8							
Water Distributed By Tankers In Streets 6m3							
Cost And Revenues For One Tanker Of 6 M3							
Interest Rate	8%						
Item	Component	Const.Date	Total C.	Life	Factor	Annual Cost	%
Investment Cost							
	One Tanker 6 m3	2000	50,000	15	8.56	5,841	
Total Investment			50,000				
Sub-Total						**5,841**	0.16
Operation Cost							
Manpower						12,000	0.32
Fuel						3,900	0.11
Lubricants	10%					390	0.01
Maintenance	5%					2,500	0.07
Cost of Water Paid to The Desal. Plant						12,468	0.34
Total Ope.Cos.						**31,258**	
Total Cost						**37,099**	
Total Volume Water Billed	m3					**3,744**	
Cost	$/m3					**9.909**	
	NIS/m3					**40.627**	
Tariff Per M3 To Buyers						**10.400**	
Revenues						38,938	
Net Result Per Year						**1,839**	0.05
Manpower		**Volume of Water Transported m3/year**					
Number of Employees	2	Volume Per Trip m3				3,744	
Salary Per Month US	500	Number Of Working Days Per Week				6	
Fuel Cost		Number Of Trips Per Days				2	
Number Of Trips Per Day	2						
Number Of km Per Trip	50						
Number Of km Per Day	100						
Number Of Working Days Per Year	6						
Number Of Working Days Per Week	312						
Number Of km Per Year	31200						
Liters For 100 KM	25						
Annual Consumption	7800						
Cost of Fuel Per Liter	0.5						
Total Consumption	3900						

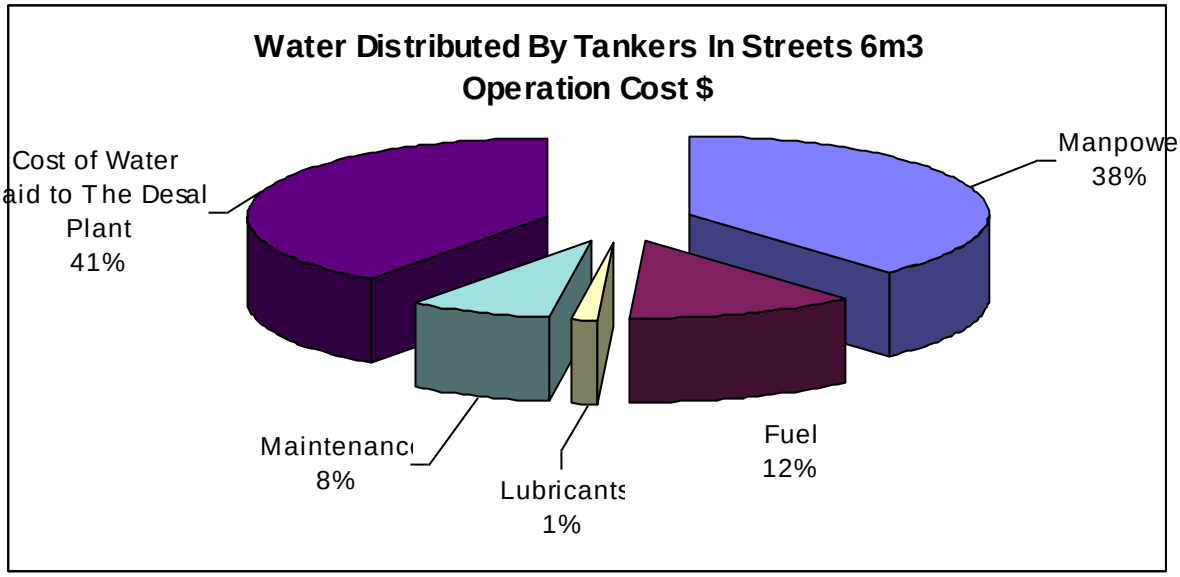

Water Distributed By Tankers In Streets 6m3
Operation Cost $
Cost of Water
aid to The Desal
Plant
41%
Manpowe
38%
Maintenanc
8%
Lubricants
1%
Fuel
12%

Table: 9							
Water Distributed By Tankers In Water Shopes20m3							
Cost And Revenues For One WaterShop With Reservoir 20 M3							
Interest Rate	8%						
Item	Component	Const.Date	Total C.	Life	Factor	Annual Cost	%
Investment Cost							
	One Tank 20 m3	2000	7,000	15	8.56	818	
	Building	2000	30,000	20	9.82	3,056	
	Equipment's of The Shp.	2000	8,000	10	6.71	1,192	
Total Investment			45,000				
Sub-Total						**5,066**	0.08
Operation Cost							
Manpower						19,200	0.30
Maintenance fo One Tank 20 m3	5%					2,250	0.03
Maintenance for Building	3%					1,125	0.02
Maintenance for Equipment's of The Shp.	5%					2,250	0.03
Cost of Water Paid to The Desal. Plant						34,944	0.54
Total Ope.Cos.						**59,769**	
Total Cost						**64,835**	
Total Volume Water Billed	m3					**6,240**	
Cost	$/m3					**10.390**	
	NIS/m3					**42.600**	
Tariff Per M3 To Buyers						**10.900**	
Revenues						68,016	
Net Result Per Year						**3,181**	0.05
Manpower		**Volume of Water Transported m3/year**					
Number of Employees	4	Volume PerTrip Liters				6,240	
Salary Per Month US	400	Number Of Working Days Per Week				6	
		Volume Per Working Day Liters				20,000	

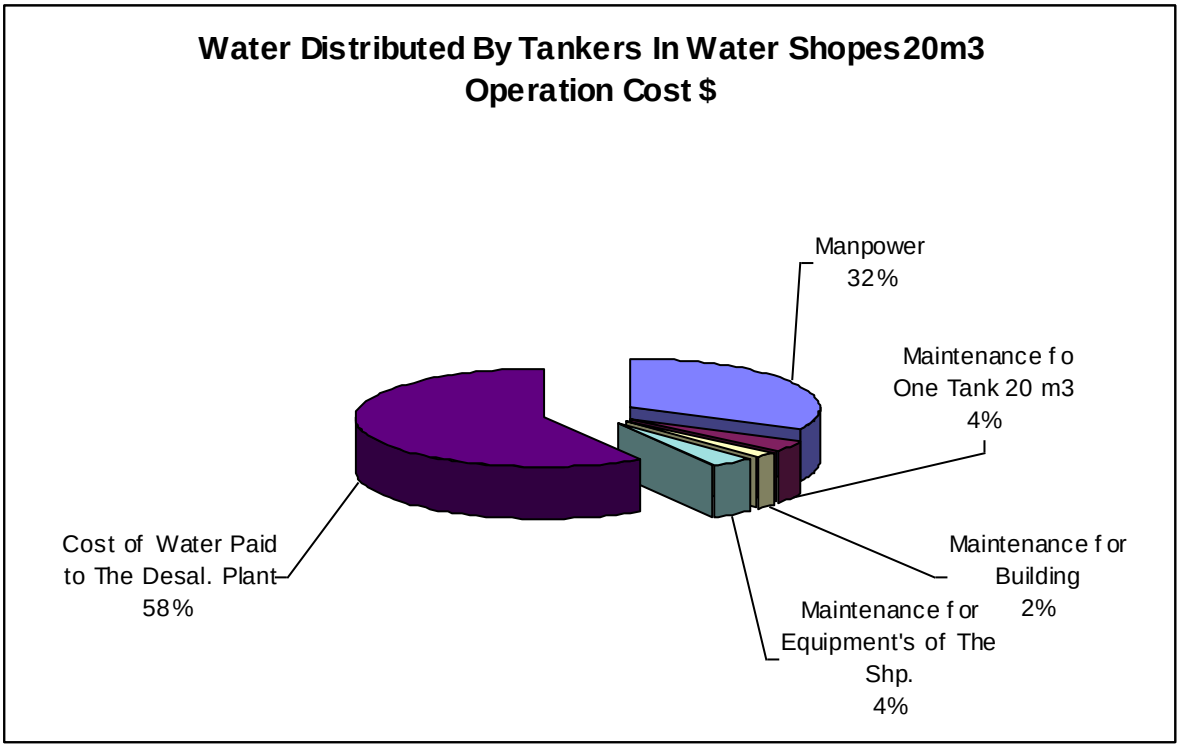
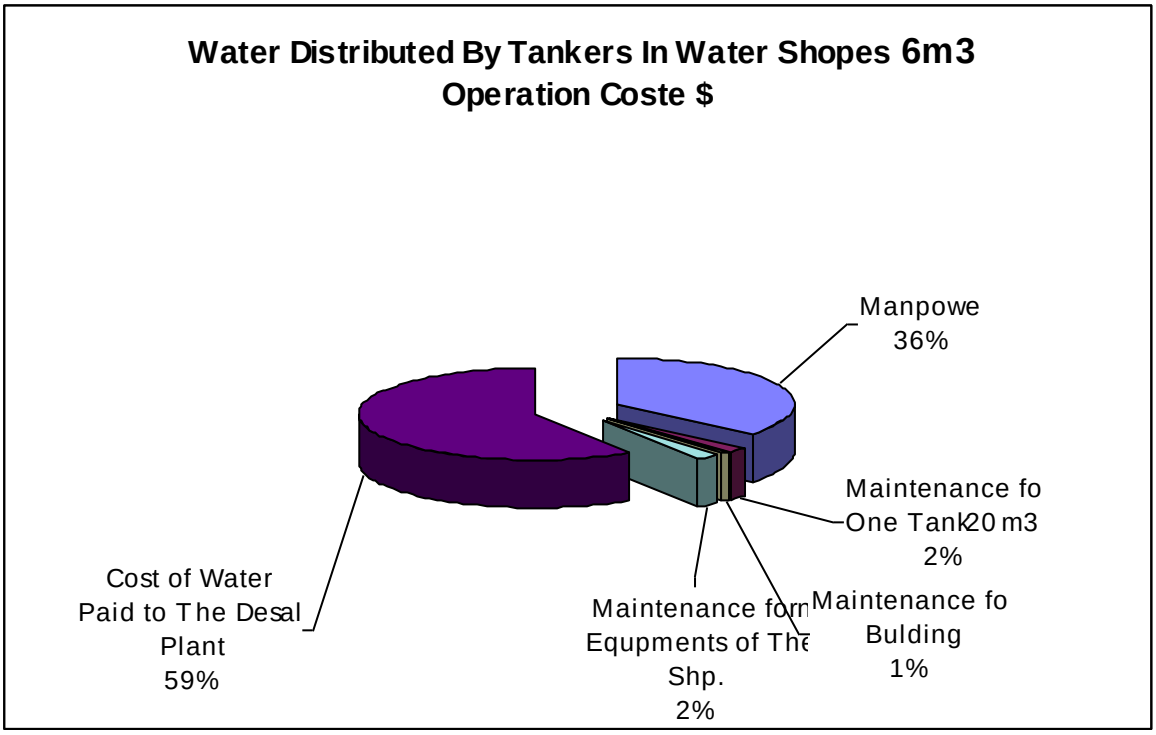
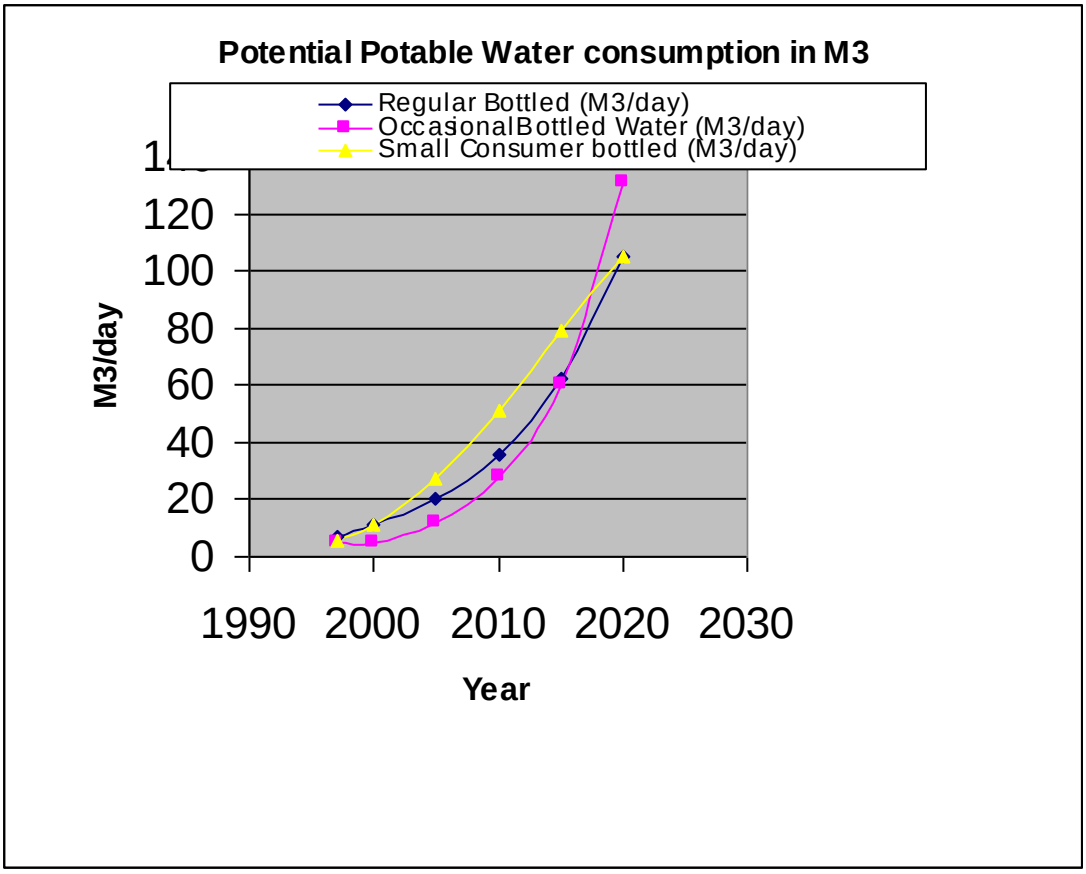

Water Distributed By Tankers In Water Shopes20m3
Operation Cost $
Manpower
32%
Maintenance f o
One Tank 20 m3
4%
Maintenance f or
Building
2%
Maintenance f or
Equipment's of The
Shp.
4%
Cost of Water Paid
to The Desal. Plant
58%

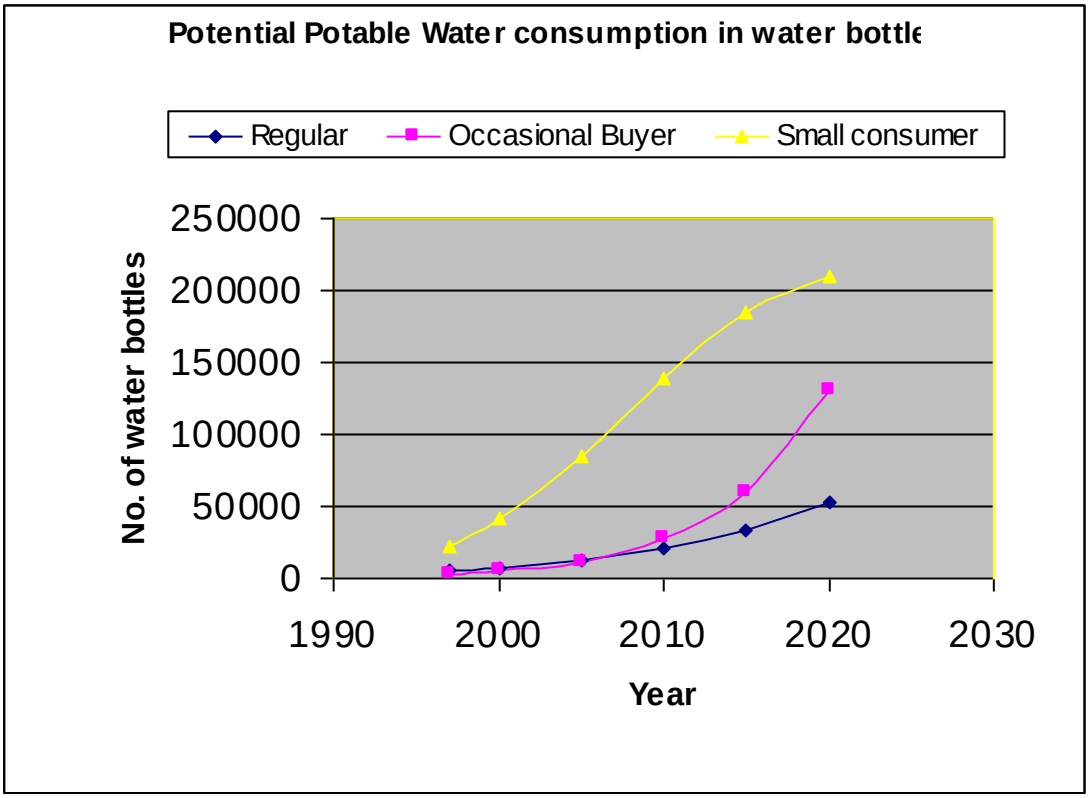
Table:10							
Water Distributed By Tankers In Water Shopes 6m3							
Cost And Revenues For One WaterShop With Reservoir 6 M3							
Interest Rate	8%						
Item	Component	Const.Date	Total C.	Life	Factor	Annual Cost	%
Invesment Cost							
	One Tank 6 m3	2000	2,100	15	8.56	245	
	Bulding	2000	5,000	20	9.82	509	
	Equpments of The Shp.	2000	1,000	10	6.71	149	
Total Investment			8,100				
Sub-Total						**904**	0.04
Operation Cost							
Manpower						7,200	0.34
Maintenance for One Tank 20 m3	5%					405	0.02
Maintenance for Bulding	3%					203	0.01
Maintenance forn Equpments of The Shp.	5%					405	0.02
Cost of Water Paid to The Desal. Plant						11,794	0.56
Total Ope.Cos.						**20,006**	
Total Cost						**20,910**	
Total Volume Water Billed	m3					**1,872**	
Cost	$/m3					**11.170**	
	NIS/m3					**45.796**	
Tariff Per M3 To Buyers						**11.800**	
Revenues						22,090	
Net Result Per Year						**1,180**	0.05
Manpower		**Volume of Water Transported m3/year**					
Numper of Employees	1						
Salary Per Month US	600	Numper Of Working Days Per Week				6	
		Volume Per WorkingDay Liters				1,872,000	


Water Distributed By Tankers In Water Shopes 6m3
Operation Coste $
Manpowe
36%
Maintenance fo
One Tank20 m3
2%
Maintenance fo
Bulding
1%
Maintenance form
Equpments of The
Shp.
2%
Cost of Water
Paid to The Desal
Plant
59%

	Total Population	Regular	Occasional Buyer	Small consumer
1997	995522	4978	2987	21901
2000	1138126	6819	4928	41251
2005	1472333	11923	11752	84612
2010	1871144	20482	27532	138664
2015	2213216	32747	60031	184414
2020	2617823	52355	130891	209426



	Regular Bottled (M3/day)	OccasionalBottled Water (M3/day)	Small Consumer bottled (M3/day)
1997	7	5	5.5
2000	11	5	11
2005	20	12	27
2010	36	28	51
2015	62	60	79
2020	105	131	105


Potential Potable Water consumption in water bottle
Regular
Occasional Buyer
Small consumer
No. of water bottles
250000
200000
150000
100000
50000
0
1990
2000
2010
2020
2030
Year