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Water Demand Management in Gaza City

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ABSTRACT

Access to sufficient amount of water is still one of the main challenges facing the Palestinian people in the Gaza city in addition to water quality problems. Nowadays, it is becoming clear that developing new water sources will not be enough to meet these challenges; it must be coupled with wiser use of existing stocks of water through water demand management measures, water reuse and maintenance of water quality.

In reality water demand in Gaza city exceeds water supply, therefore the water deficit is continually increasing, based on these facts, water institutions needs to adopt water demand programs, for efficient use of water. This research focuses on creating, and establishing a framework of water demand management in Gaza city under the existing situation and pointed to the importance of water demand management instruments in conserving water through effective use of water.

Surveys were conducted through distribution of well designed questionnaires for all water related institutions, moreover, interviews with official people were held in different water institutions within Gaza city.

This research is dealing with the study of existing water situation related to water demand management in Gaza city, there are many deficiencies and obstacles related to implementation water demand measures.

The practical intended results for this research are as follow:

1. Identify the main tools that influenced the water demand management in Gaza city which can be implemented to control the demand.
2. Develop an approach for managing the demand in Gaza city that can be used as a guideline for any future program for water demand management.

Furthermore, the study provides several recommendations such as, establishing water demand management unit, developing effective water monitoring and establishing data bank center.

Dedication

I proudly dedicate this thesis to the soul of my father and my nephew Rami, to my mother, as I always feel her prayers in all aspects of my life, my beloved two brothers, Dr. Mohammed and Eng. Walid, my sisters , and finally my wife, Heba, and three lovely children Amr, Emad Al -Deen and Ali.

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CHAPTER I

INTRODUCTION

1.1 Background

Gaza city has very limited water resources, groundwater is a major resource, which plays an important role in the support of natural ecosystems and as a source of water supply for agricultural, industrial and domestic needs.

Over the last forty years, the recognition of the important challenges and threats which have been accrued as depletion of groundwater storage and deterioration of quality which has led to many changes to water resource.

As a part of facing these challenges, proper management of the demand is an important step to achieve the water balance and ensure that water use for a range of beneficial purposes is sustainable.

1.2 Problem Identification

The population of Gaza strip at present is 1.3 million inhabitants, and they create a demand for water of 140 MCM by the year 2005. This amount of water comprise nearly (60-70%) for agriculture use, (20-30 %) for municipal use and the remaining for industrial use .The per-capita water supplied varies from 100 to 120 L per Capita per day(2004-2005). By the year 2020 it is expected to be 165 L per Capita per day and the demand for water is expected to reach 265 MCM per year (Al-Dadah J 2004).

Clearly this means that, there is an immediate need to implement water demand management WDM programs for utilizing the available water resources. (CAMP 2001, PWA)

In Gaza strip the water demand exceeds supply and the water deficit is continually increasing as results of combination of factors that influenced the water demand due a rapid population growth, continued exploitation of water resources that causing their depletion. This means that there are urgent and clear needs for drastic action to close the gap between supply and demand by controlling the demand side through water demand management or ensuring additional quantity of water to cover the water deficit and fulfill the water balance. The main objective of WDM is to safeguard the right of access to water for future generations, limit water demand, ensure equitable distribution, protect the environment and increase the efficiency of water use.

1.3 Objectives

The main objectives of this research are:

1. Study the current water demand situation.
2. Evaluate the water demand management.
3. Identify the main instrument that influences the water demand management in.
4. Identify the role of key players in the water sector in managing water demand.
5. Develop an approach for managing water demand in Gaza city.

1.4 Methodology

The research methodology following in this study:

- Data collection for water demand information and raw data (water consumption, production, rainfall and other related data and information).
- Four questionnaire surveys was developed and implemented
 - 1- Water consumer
 - 2- Gaza municipality and Palestinian water authority
 - 3- Water devices market
 - 4- Education (schools, University)
- Conducting interviews with officials through site visits including filling of questionnaire survey. Also a survey for collecting the required variables related demand.
- Data analysis and evaluation using statistical tools (SPSS).
- Data analysis and processing for WDM.
- Check the water balance in groundwater system to identify the Problem
- Identification of WDM tools in Gaza city.
- Develop an approach for water demand management in Gaza city.
- Conclusion and recommendation.

1.5 Thesis organizations

This thesis is divided into seven chapters, **chapter one** is an introduction, which give an overview about purpose of this research objectives, research methodology and results. While, **chapter two** is dealing with the work done previously in research of water

demand management in Gaza city, **chapter three** is covering urban water demand management; **chapter four** is presenting the statistical analysis of different types of questionnaire surveys and short awareness. Also it has to be mentioned that all these questionnaire surveys were developed and written in Arabic language so consumers can understand and be able to response to it effectively, therefore the forms which are listed are the equivalent English translated versions. **chapter five** shows the interviews with some officials, **chapter six** is covering the results the sit visit to the representation of fixture and finally, **chapter seven** is giving final research conclusions, recommendation, suggestions, and future work.

CHAPTER TWO

(WATER DEMAND MANAGEMENT IN GAZA CITY)

This research is intended to investigate water demand management in Gaza city, therefore this chapter is focusing in reviewing related literature in general and particular, such as geography literature, climate, groundwater, water demand and population growth, water quality, needs for WDM in Gaza city, current status, public awareness and involvement, present pricing system for potable water and metering system in Gaza city.

2.1 Geography

Gaza strip is located at 34.5° - 35.5° longitude, 25 minutes east and 31° latitude, 30 minutes north, its area is about 360Km² . The length is about 45 Km on the western Mediterranean coast and the width varies from 7 to 12Km. The Sinai Desert is located in south, the Naqab Desert in the east and Mediterranean Sea in the west as shown in Figure (2.1). With dense population in the Gaza strip is considered the highest in the world with a population of 1.3 million people and a growth rate (3.5 %) annually. Figure (2.2) and latest surveys (MOPIC). Gaza city occupied 74 km² from the whole area of Gaza Strip and its population is around 0.43 million people. (Palestinian Central Bureau of Staticis - PCBS 2003)

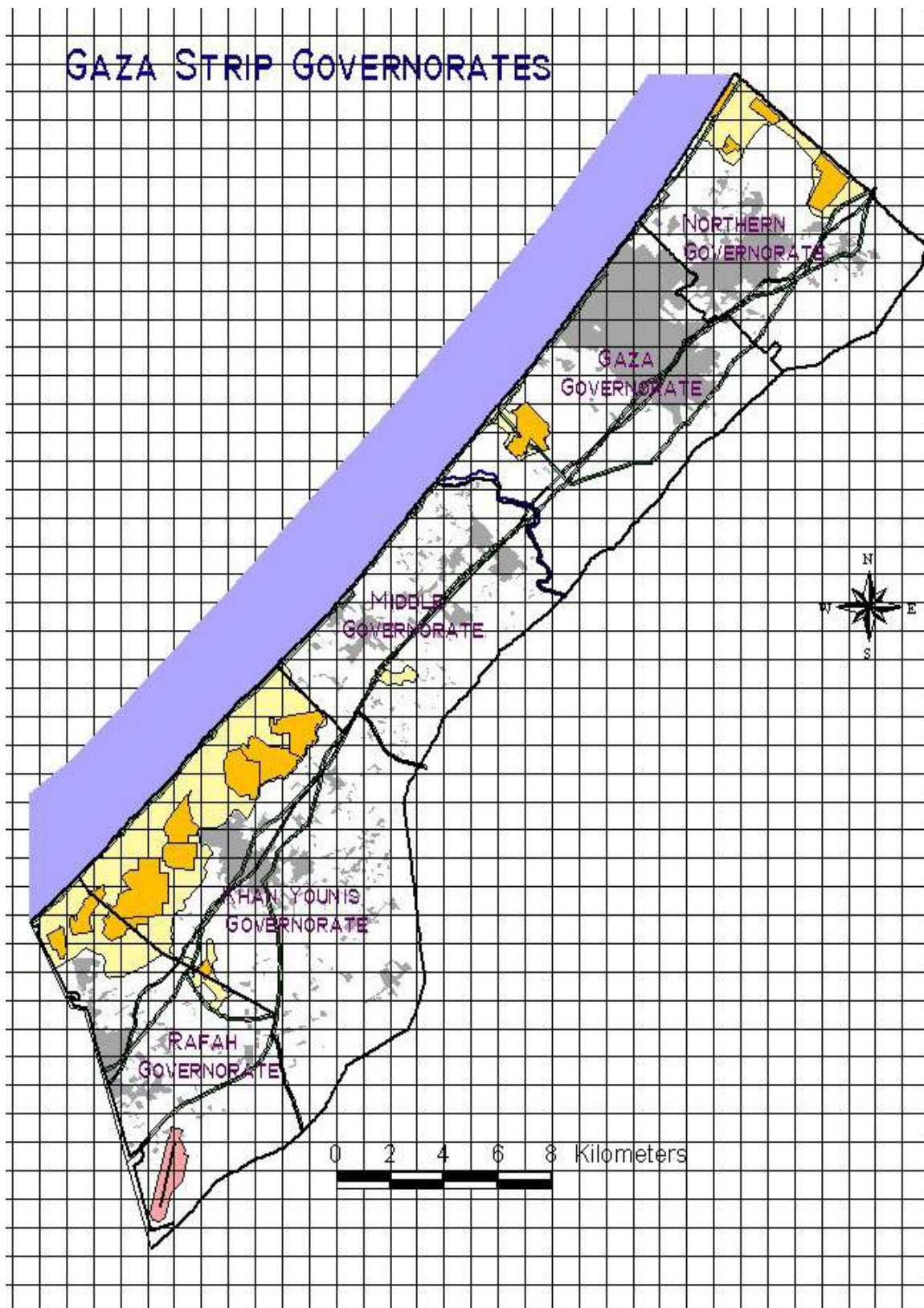


Fig (2.1): Gaza Strip Map in year 2002

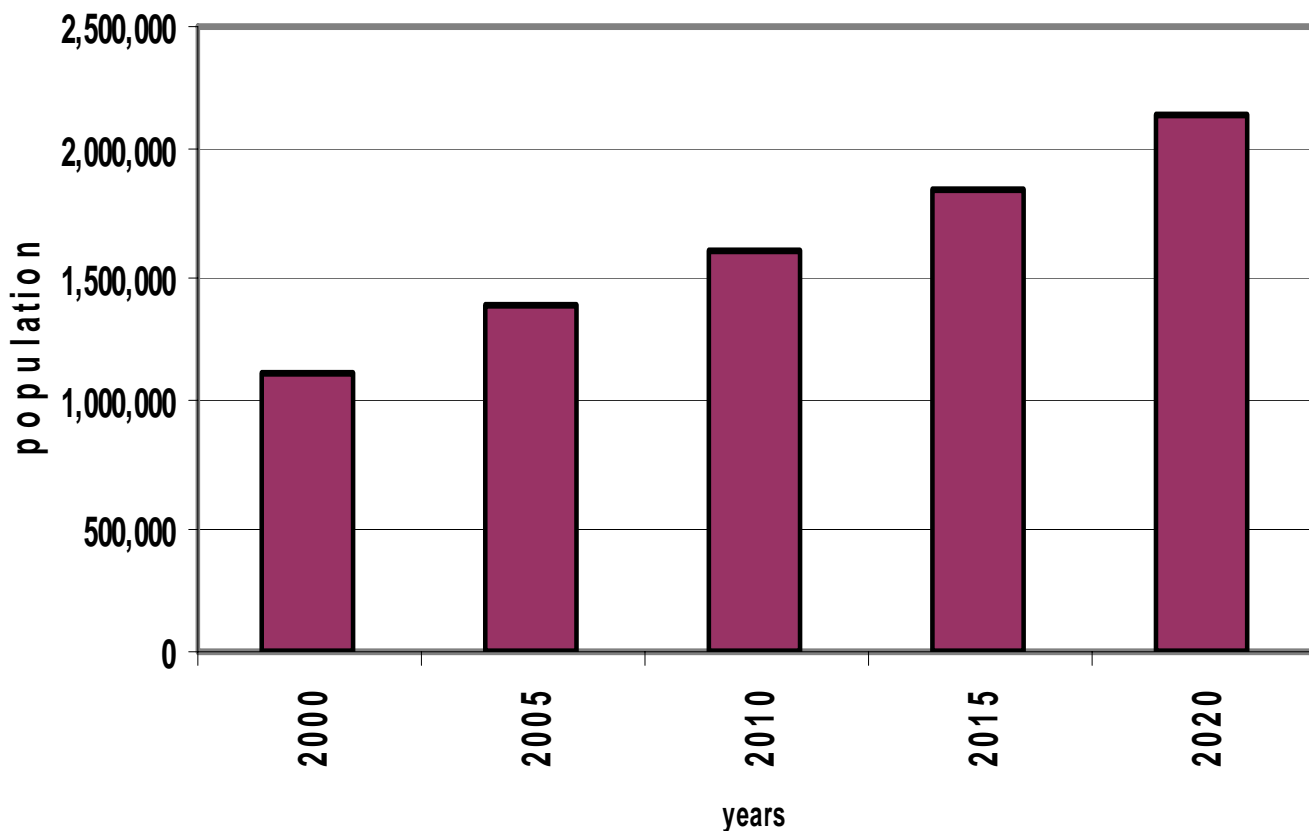


Fig (2.2) Population in Gaza City

2.2 Climate

The annual temperature average of the city is 20.3° C, the highest temperature is in summer that reaches 32° C and the lowest temperature is in winter that reaches 6°C. The annual average wind speed is 19 knots with highest wind speed is in winter that reaches 60 knots. The prevailing wind is from the southwest (MOPIC-1997).

2.3 Groundwater

The Gaza strip is a narrow strip of land encompassing an area of 360km². The geography of the region is not favorable to the water situation. There are no permanent surface freshwater sources, the region is not infiltrated by any lakes, springs, or rivers. The primary source of water is groundwater, namely the Gaza section of the Coastal aquifer. The Coastal Aquifer lies underneath the Mediterranean seashore in Israel and Gaza between Rafah and Mount Carmel as in Figure (2.3). The approximate area of the

entire aquifer is 2200 km², with 360 km² beneath Gaza strip (Elmusa 1997). The section that underlies Gaza is considered for all practical purposes independent of the remaining Israeli portion, and henceforth will be referred to as the Gaza aquifer. Although some water theoretically flows from the Israeli section to Gaza, the aforementioned construction projects during occupation have diverted most of this flow back to Israel. The total thickness of the Gaza aquifer ranges from (80 – 100) m in the east to (120-160)m by the shore. The aquifer is very shallow and unconfined by rock. (Roy 1995) In the uppermost sections, water is pumped at depths ranging from 5 to 80 m. These upper layers also provide the best quality water, a very important factor in light of the deteriorating quality of Gaza's supply. Confining and semi confining layers divide the aquifer into three major overlapping sub aquifers. Water within the aquifer principally flows from east to west (Kelly, K & Homer-Dixon, 1995). The Mediterranean Sea serves as the primary outlet for the aquifer, though water has increasingly flowed into coastal depressions because of severe over pumping. Evidently, the reverberations of unregulated Egyptian use are being felt now it has had a weighty impact on natural flows within the region. The main source of replenishment for the aquifer is direct rainfall on the coast. Annual rainfall ranges from 350 mm in the south of Gaza Strip to 400mm in the north. The average number of rain days is (30 – 40). (Elmusa 1997) Gazans are forced to dig deep into the aquifer if rainfall is low. Because of an arid climate, the rates of evaporation and transpiration are high. (PWA. 1997).

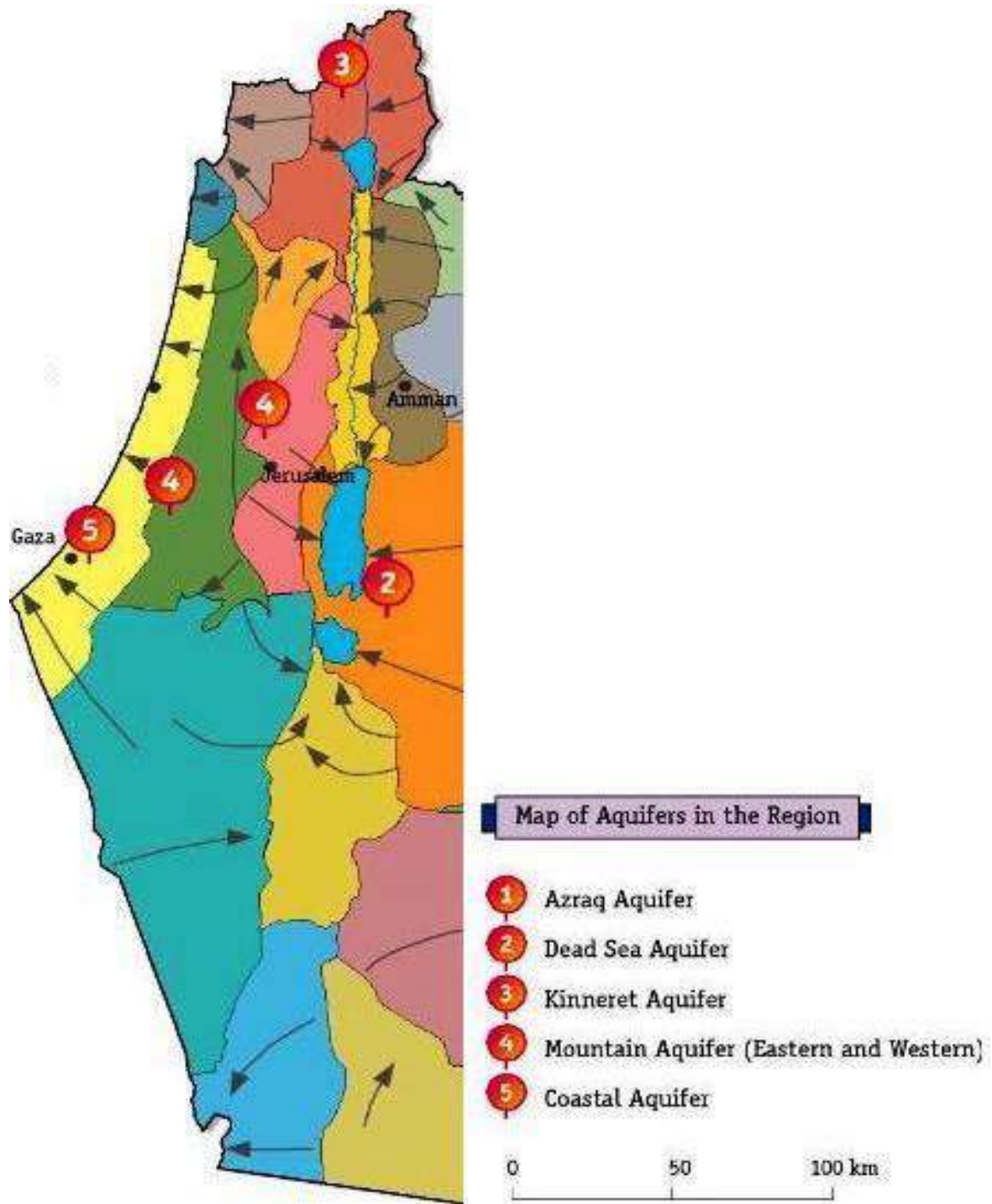


Fig (2.3): Map of Aquifer in the Region

2.4 Water Demand and Population Growth

Population growth will continue to be one of the most severe demand problems facing Gaza water resources. The Gaza strip already has one of the highest population densities in the world. Current population is over 1.3 million by the year 2005, and has been steadily increasing the present growth rate is 3.5 percent. According to results from the 1997 Palestinian Population and Housing Census conducted by the PA, 0.7 million people will live in the Gaza city and it is expected to reach 2.3 M people Gaza strip by the year 2020. So water domestic consumption will more than double by that time, and demand is likely to be more with expected increases in the standard of living (Table2.1). The overall water demand is expected to increase to 265 MCM by 2020 according to PWA records (CAMP project PWA1999), as shown in figure (2.4).

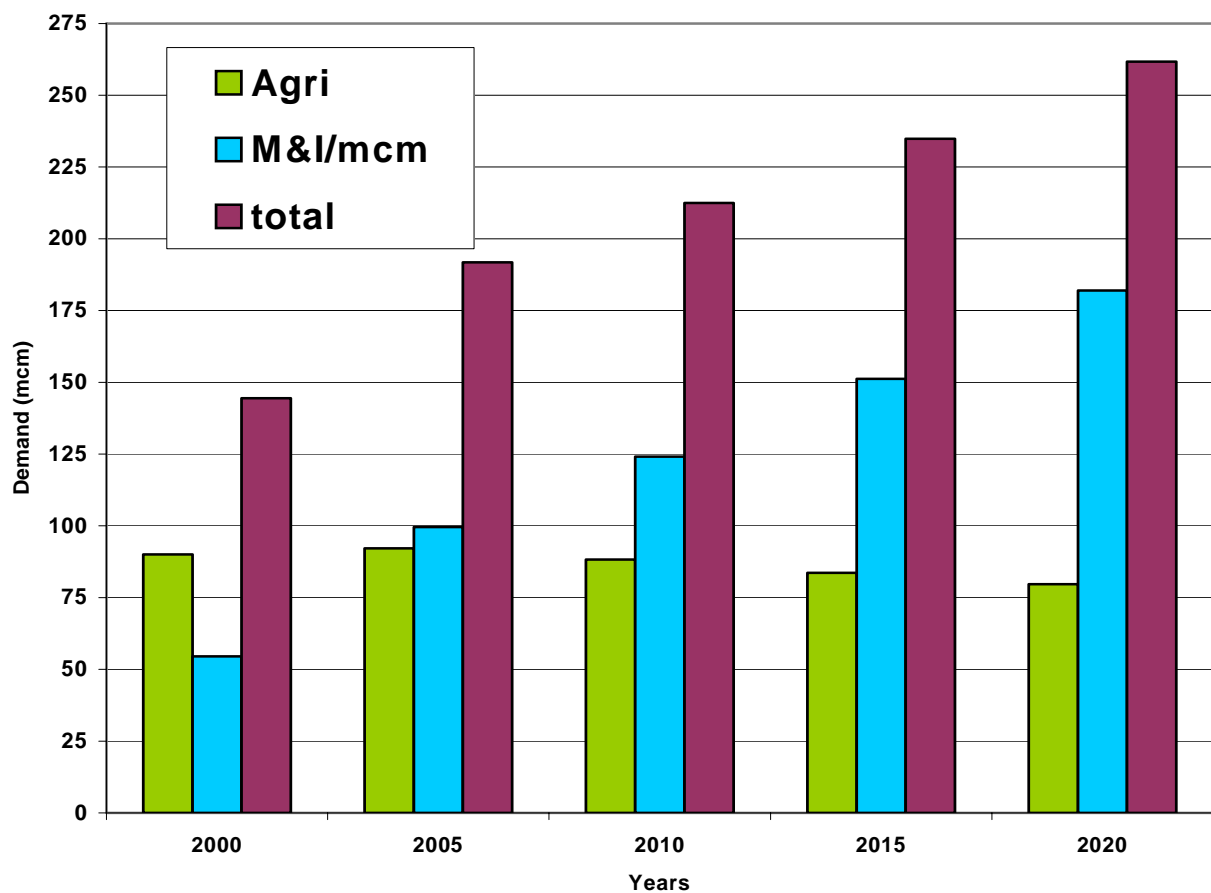


Fig (2.4). Water Demand Project in Gaza City.

2.4.1 Administration

The Gaza city consists of around (11) eleven Zones, which are : Shieek Ejleen, Southern Remal, Daraj, Sabra,Zaytoon,Nasser, Tal-Hawa, Beach camp, Sheik h Radwan,Tuffah and EL-Shujaeya as shown in Figure (2.5). The Gaza municipally is responsible for public services and Zones administration.



Fig (2.5): Gaza City Map

2.4.2 Water Balance

Major water resources in Gaza strip are coming from rainfall stored in aquifer, return flow from irrigation, sewage effluent, and water leakage from pipes. Table (2.1) includes the current inflows and outflow of coastal aquifer as estimated for CAMP project in 1999. The table shows that the current deficit of water resources in the Gaza strip is from 21 to 28 million cubic meters annually. This deficit will be increased if the saltwater intrusion of the inflows shown in table (2.1) is eliminated.

Table (2.1): Estimated Water Inflow and Outflow for Coastal Aquifer

Inflows(Mm3/year)			Outflows(Mm3/year)		
	Min.	Max		Min.	Max.
Rainfall recharge	40	45	Municipal abstraction	47	47
Lateral inflow from Israel	18	30	Agriculture abstraction	80	100
Lateral inflow from Egypt	2	5	Mekorot abstraction	5	8
Saltwater intrusion	10	15	Discharge to the sea	10	15
Water leakage	10	15			
Wastewater return flows	10.5	10.5			
Other recharge	3.5	3.5			
Irrigation return flows	20	25			
Totals	114	149		142	170
Net Balance	-28	-21			

Source: Palestinian Water Authority & Ministry of Agriculture 1999.

Moreover, future picture of water balance in the Gaza strip is not satisfactory. The demand for water in the future will be affected by population growth, socio-economic development and changing demands of agriculture. The population of the Gaza strip is expected to increase by over one million in the next 20 years. The current Water demand per capita in Gaza city is estimate 120 L/s according to the PWA records. In addition, many agricultural illegal wells spreading along the Gaza strip are pumping water from aquifer without abstraction information that helps in exact estimation of the future deficit of water. The number of these wells unfortunately exceeds 700 wells (NWP, 2000) including agricultural and municipal wells.

2.5 Water Quality

The major documented water quality problems in the Gaza strip are elevated salinity and nitrate concentrations in the aquifer. Almost all municipal wells within the Gaza strip are containing a high level of Chloride that exceeds a value of 250 mg/L and Nitrate value more than 50 mg/L. Figures (2.6 &2.7) show the current values of Chloride and Nitrates for municipal wells in the Gaza strip from the North to the South. As seen from the figure some wells may contain a low concentration of chloride but a high concentration of Nitrate. In general, the quality of water extracted from Gaza strip Coastal Aquifer varies by area and time and does not meet the World Health Organization WHO guidelines values for drinking water quality.

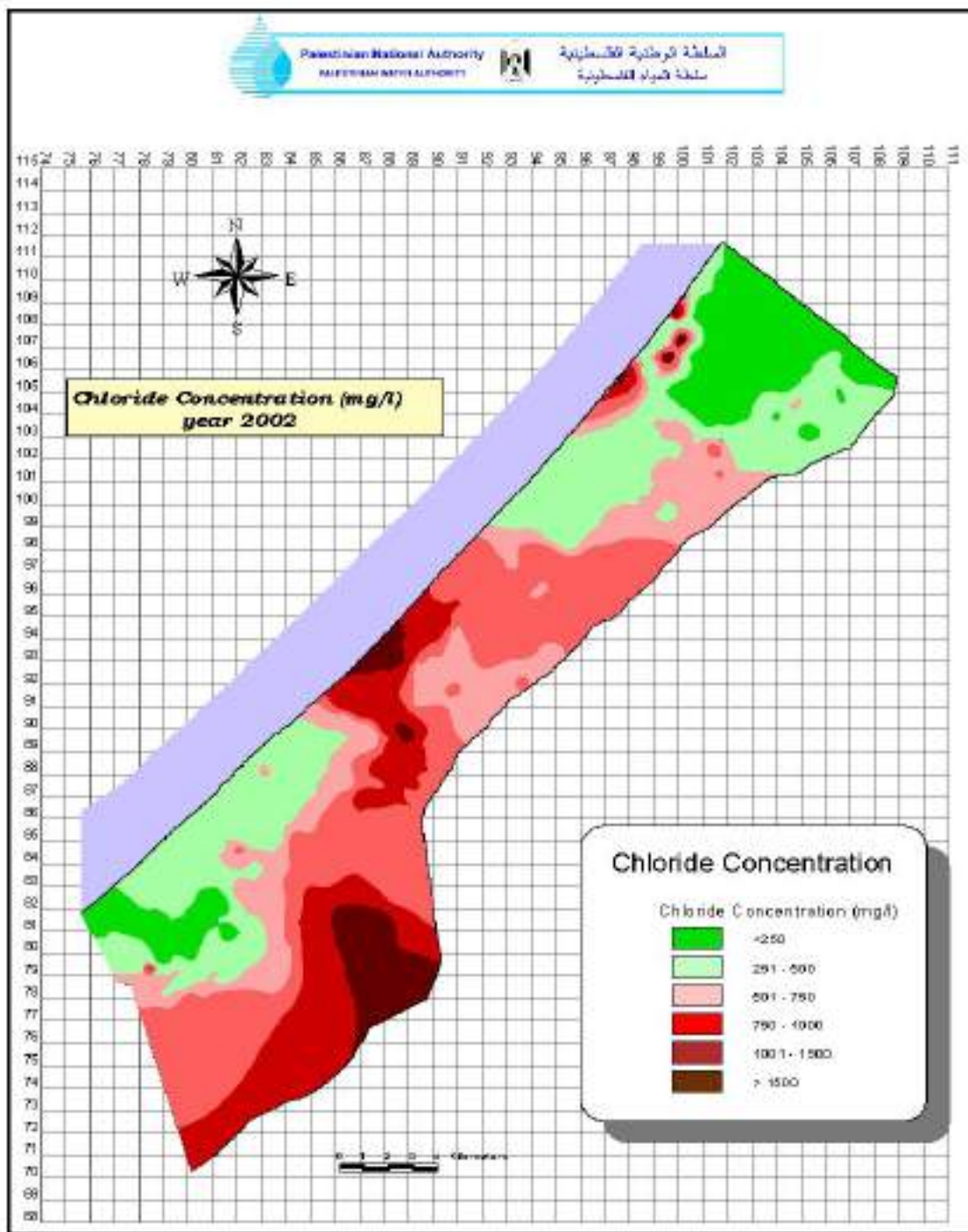


Fig (2.6) Chloride Concentration in year 2002.

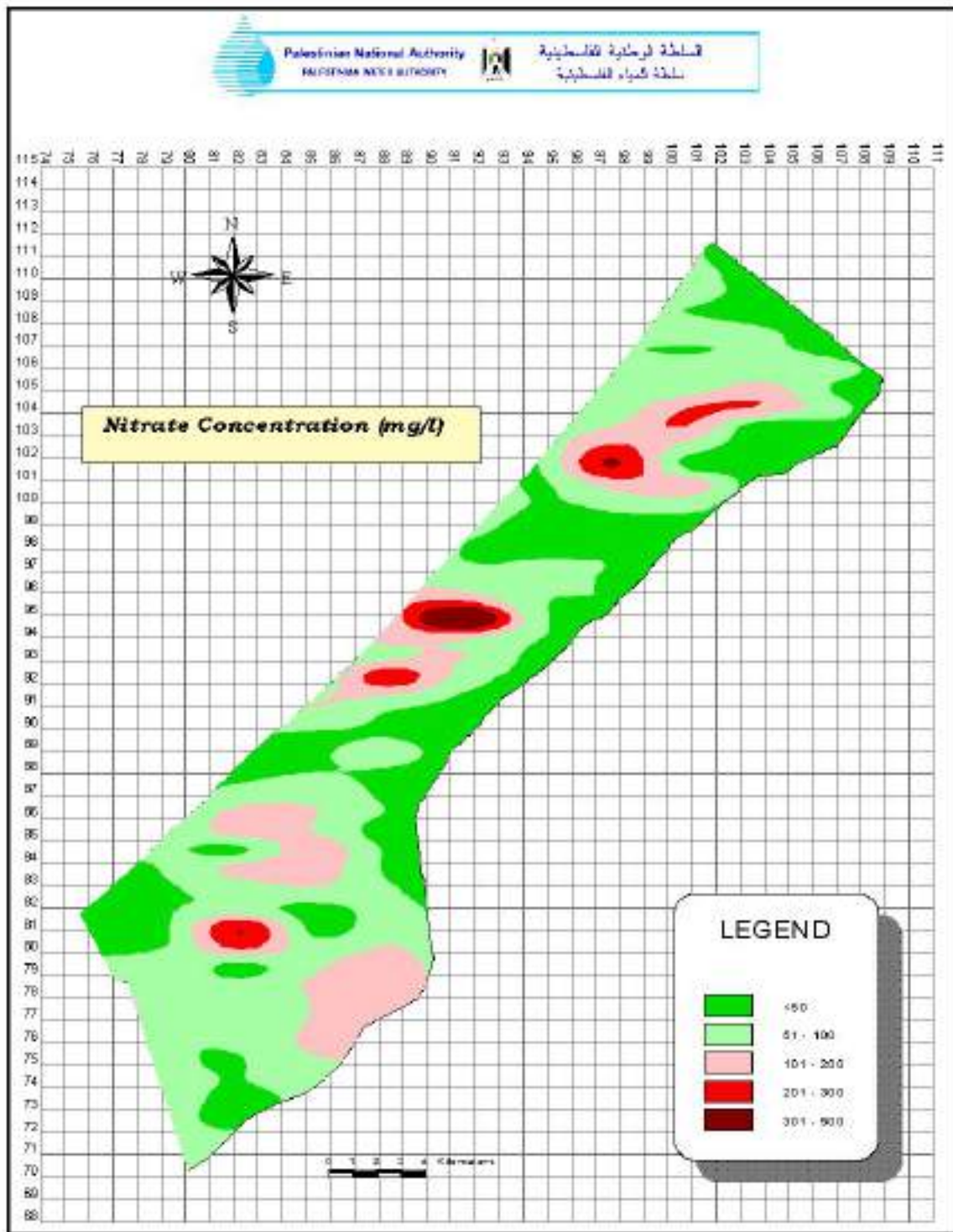


Fig (2.7) Nitrates Concentration in year 2002.

2.6 Needs for Water Demand Management in Gaza City

Water is an increasingly scarce resource in Middle East generally and in Gaza strip especially, the available water resources in Gaza strip is not adequate to meet human demand and agricultural needs.

As a competition between different users, domestic or households use has become more common nowadays in Gaza strip, thus water withdrawals for urban consumption are substantial element for WDM. Household's water consumption tends to increase in Gaza strip due to rapid population growth, and rising standard of living.

Clearly there is an urgent need for using practical actions to manage water demand to fulfill effective and efficient use. One of the most important actions is adapting WDM programs. Demand management technique used to reduce the consumption of water and to meet a water shortage. Therefore the money saved can be used for infrastructural development or to improve the water efficiency.

2.7 Current Water Demand Management Status in Gaza Strip

The Palestinian water authority PWA becomes the basis for decision on the structure and tasks of water institutions and PWA emphasized the use of appropriate technology in water saving practices and conservation .The objectives the Palestinian water policy are the followings: (PWA Water Policy 1997).

- Managing water as an economic commodity is an important way of achieving efficient use, encouraging conservation and protecting water resources.
- Save water and reduce the wasteful rate.
- To improve the efficiencies of water use in irrigated agriculture through adopting the proper technologies and strategies.
- To develop improved water supplies and cropping systems to better utilization of water resources.
- To develop legislation system aims at restricting water extraction.
- To protect aquifer from non-point pollution resources.

2.8 Public Awareness and Involvement in Gaza City

Carrying out public awareness programs is important to Gaza city for a number of reasons. There is a general lack of understanding and concern about the value and scarcity of water resources. Any significant changes in how water is conserved or protected require public support and participation .Public awareness activities seek to conserve and protect water resources through understanding the water situation and the shortages and scarcity of the resource. They raise community understanding and support for water allocation among competing sub-sectors and improve the likelihood of the public's helping to develop and accept new policies by providing information which seeks behavioral modifications, these programs may assist in the reduction of illegal water connection and the general misuse and damage of water measurement devices, there is also a need to increase understanding of water conservation issues in Gaza among a policy-makers and the private sector. The PWA believes that public awareness programs are a successful way of reaching Palestinian public as away of modifying undesirable behavior and reinforcing positive efforts. By supporting public awareness programs that encourage the conservation and protection of Gaza limited water resources and observation of its regulations. (Dadah, J2004)

The PWA has implemented partially an interactive awareness process to transfer important message and information to public, the awareness program also helps to foster positive attitudes regarding water service and use.

Given the political conditions, central objectives of awareness programs are enhancement of the public understanding regarding Palestinian water resources and water use and this continued effort to keep the public updated on water emergency procedures. (Dadah, J.2004)

The PWA is seeking to stress the value of water to public health and community development in the Palestinian lands. As demand increases due to social development and natural population growth, the WDM issue is constantly gaining importance. The PWA is trying to strive to utilize modern communication approaches in its public awareness program as:

2.8.1 Mass Media:

- Radio
- Public awareness slogans to promote efficient use of water seminars to acquaint the public with water sector issues
- Television
- Newspapers and magazines

2.8.2 Direct Communication with Public:

- Seminars and lectures in schools, collage and university to encourage water protection and efficient utilization of scarce water resources.
- Workshops in coordination with municipalities and local councils to improve water service.
- Participation in local and international.

2.8.3 Indirect Communication with Public

- Developing posters for stressing the value of water and public health issues.
- Brochures

The brochures aim to efficient water utilization in house gardens and houses in general and explaining methods for efficient utilization of water and protection from contamination.

2.9 Present Pricing System for Potable Water in Gaza City

The present pricing system of potable water in Gaza city is progressive according to use and water consumption block for household, trade, public and industry (Ghannam, M2005.).

There are three blocks (m³) :(0 -10), (11 – 30), over 30, for these blocks correspond three tariffs applied as indicated as follows in table (2.2):

Table (2.2) Tariff structure for Gaza municipality

Municipality of Gaza		NIS/m ³					
Municipality	Fixed Charge	0-10 m ³	11-20 m ³	21-30 m ³	31-40 m ³	41-50 m ³	>50 m ³
Gaza city	6	0.3	0.5		0.9		

The above system which is adopted by Gaza city municipality is not selected neither based on relevant studies and considerations and nor targeted which is not reflected in the social situation and economic aspects.

In this context from economic point of view, the water is one of the main challenges of future economic developments, the water shortage is influenced by water price which is low and can't cover the cost of water development project and operation and maintenance cost moreover the current pricing system in Gaza city depend on the subsidies given by donors and PWA. (Ghannam, M 2004.)

From socio-economical point of view, the current pricing system applied by Gaza municipality is not representing the economical situation of the Gaza people because it is support the minimum limit of water consumption for poor people.

Moreover the pricing system does not take the cost recovery of water facilities into account (Ghannam, M2004.).

2.10 Metering System in Gaza City

In Gaza city there is a marginal acceptance of metering system for households, through this system the users can pay their bills every two month, but their is no central metering for each zone to control the water use and estimate water losses by illegal users (Ghannam, M2004.).

2.11 Current Situation in Gaza City

The high population density in combination with poor water resources and years of heavy extraction has produced a crisis of absolute water availability in the city. This has led to unsustainable use of Ground water that resulted in aquifer deterioration and seawater intrusion, and thus, high pollution of water resources.

Municipality of Gaza produces about 27 MCM of fresh water annually. This amount of water is pumped from 29 water well allocated in Gaza and some of them in Jabalia.

The main source of Gaza city is from Ground water, for year 1998 to 2002, the well production is nearly 27.7 MCM per year, the maximum production is from July to October which indicate the higher consumed water is in summer as shown in Figure (2.8).

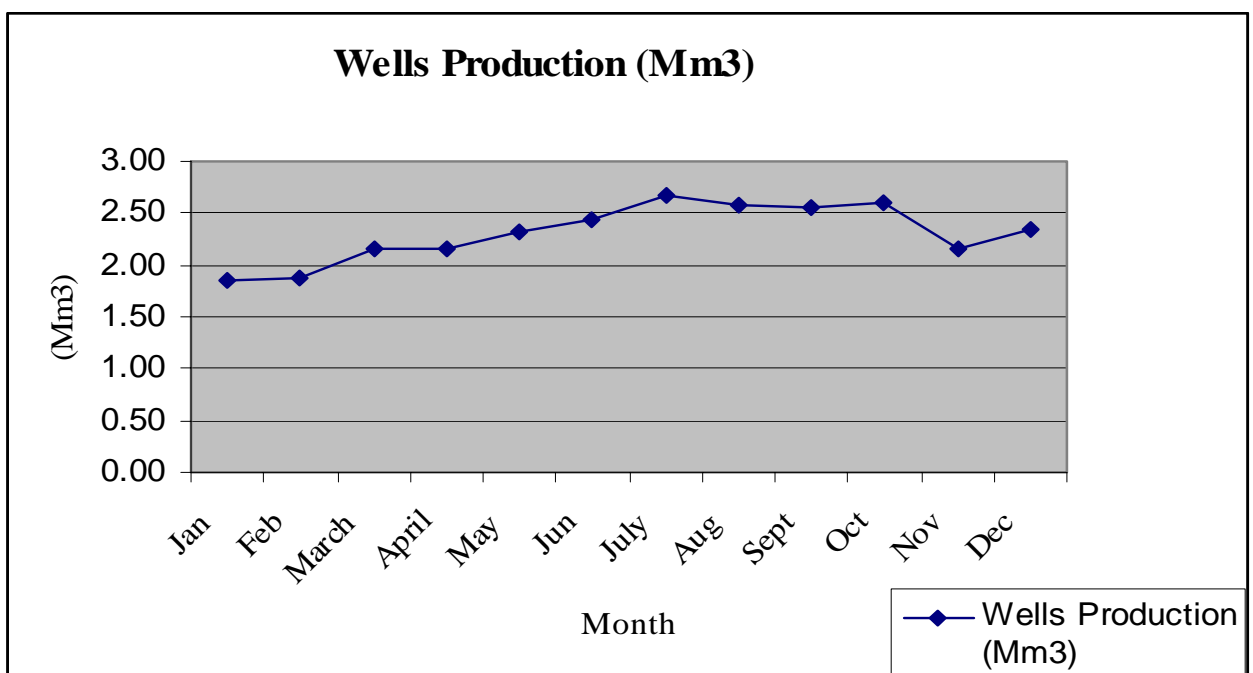


Fig (2.8): Gaza municipality wells production through year 2002.

Recharge to the Ground water in the city is primarily through infiltration of rainfall, return irrigation and waste water recharge. Table (2.3) shows the balance between consumption and recharge. The amount of returning water reaches 154.54 MCM in

2020, and water deficit is estimated about 107.16 MCM, which means water projects are needed in order to cover the deficit amount.

Table (2.3): shows the amount of water returning to aquifer until the year 2020 (PWA 2005)

Year	Natural Flow	water infiltration	domestic & industrial	flowage water	Aquifer Water	Irrigation Water	Total
2000	55.00	11.92	15.81	3.03	22.75	0.00	108.78
2001	54.81	13.88	18.26	3.49	22.81	0.00	113.25
2002	54.62	15.85	20.66	3.68	22.87	0.00	117.68
2003	54.43	17.73	23.02	3.87	20.22	2.71	121.97
2004	54.24	19.77	25.33	4.06	19.87	3.12	126.38
2005	54.05	22.01	27.59	4.25	17.25	5.80	130.95
2006	53.86	23.32	28.22	4.44	16.75	6.11	132.70
2007	53.67	22.50	28.79	4.63	15.69	6.96	123.25
2008	53.48	23.74	29.29	4.82	15.14	7.33	133.79
2009	53.29	24.91	29.72	5.01	14.21	8.06	135.20
2010	53.10	26.18	30.08	5.20	13.62	8.45	136.63
2011	59.91	27.16	30.84	5.39	11.58	10.26	138.14
2012	52.72	28.46	31.56	5.58	10.91	10.70	139.93
2013	52.53	29.78	32.22	5.77	10.22	11.16	141.68
2014	52.34	31.11	32.84	5.96	9.53	11.62	143.40
2015	52.15	32.45	33.42	6.25	8.83	12.09	145.08
2016	51.96	33.86	33.98	6.34	7.62	13.06	146.82
2017	51.70	35.27	34.49	6.53	6.34	14.11	148.51
2018	51.58	36.82	34.93	6.72	5.53	14.64	150.22
2019	51.39	38.38	35.32	6.91	4.81	15.18	151.99
2020	51.20	39.91	36.40	7.10	4.20	15.72	154.54

According to the criteria of WHO water quality for 25 water well in the Gaza city, only 8 well out of 25 wells have acceptable water quality. Degradation of water quality is the main problem facing water management of the Coastal aquifer. Trends in chloride concentration in the aquifer during 1984–98 are shown in figure (2.9). Concentrations in samples from most wells throughout the aquifer were upward or were about constant during the period. Upward trends were identified for 59 percent of the wells included in the analysis, and downward trends were identified for only 7 percent. No major spatial patterns were obvious except for the distribution of the largest increases, which seem more prominent in the central and southern parts of the aquifer. Localized pumping may superimpose “noise” on regional patterns and trends.

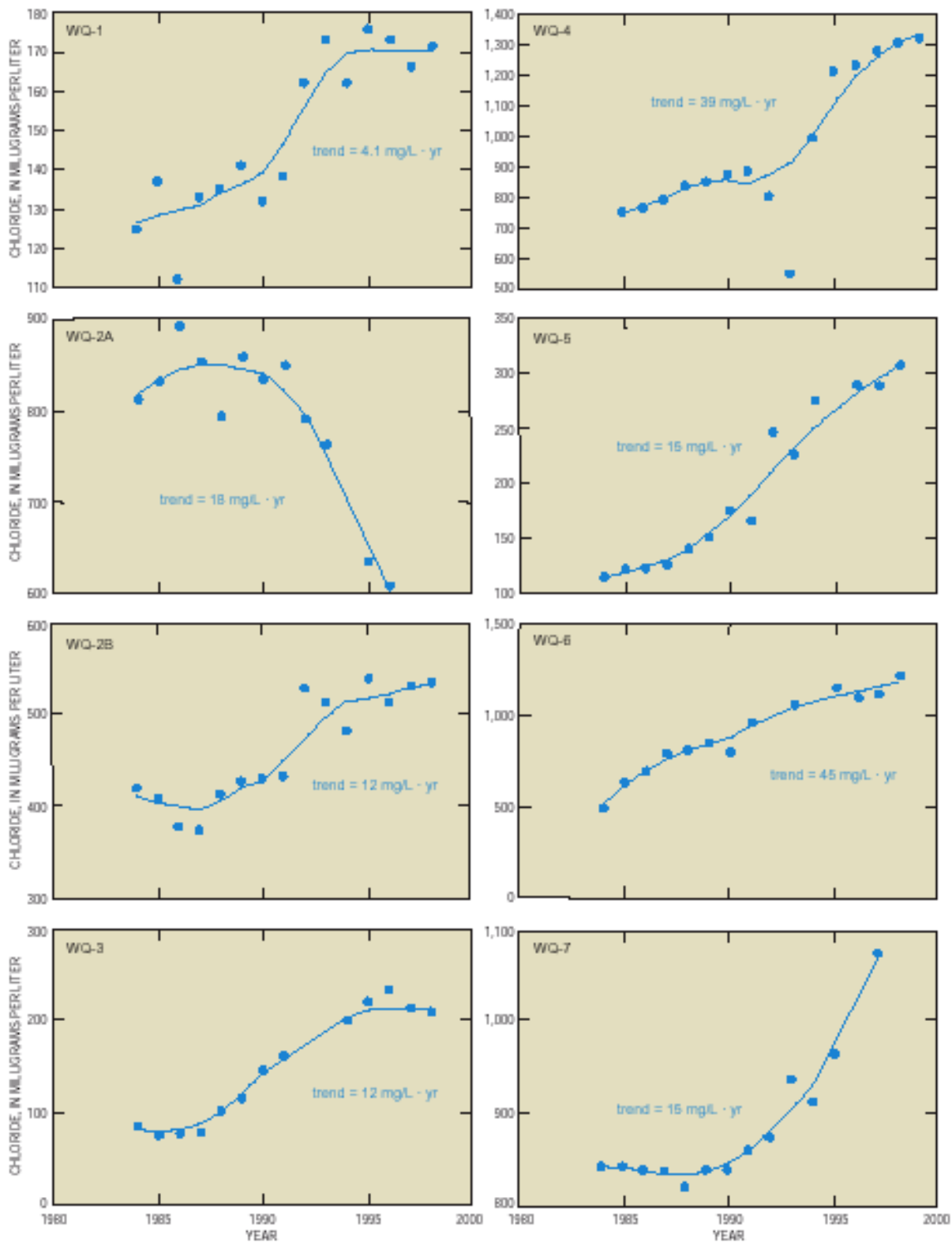


Fig (2.9).Trends in chloride concentration in the aquifer during 1984–98. (Elmusa, Sharuf,1997)

Table (2.4) shows the test results for water wells in Gaza city in different periods, these tests have been done by preventive health section of Gaza municipality.

Table (2.4): Water quality of Gaza wells.

Well	April 1999	October 1999	April 2003	April 1999	Oct 1999	April 2003	Max Cl	Max NO3	Status
	chloride	Chloride	Chloride	NO3	NO3	NO3			
Shaikh Redwan1	319	300		120	180			YES	Unhealthy
Shaikh Redwan1A	284	312		115	130			YES	Unhealthy
Shaikh Redwan2		259		120	172			YES	Unhealthy
Shaikh Redwan5	362	644		92	145			YES	Unhealthy
Shaikh Redwan7		469		188	200			YES	Unhealthy
Shaikh Redwan7A	483	246		158	120			YES	Unhealthy
Shaikh Redwan8	192	266		68	78			YES	
Shaikh Redwan9	156	161		88	85			YES	Unhealthy
Shaikh Redwan10	120	119		70	86			YES	
Shaikh Redwan11	78	91		71	100			YES	Unhealthy
Shaikh Redwan12	85	74		77	90			YES	
Shaikh Redwan13	461	469		88	130			YES	Unhealthy
Shaikh Redwan15	78	84		80	90			YES	
Shaikh Redwan16	71	77		50	97			YES	Unhealthy
SAFA 1	497	490		210	220			YES	Unhealthy
SAFA 2	426	434		160	155			YES	Unhealthy
SAFA 3				200					Unhealthy
SAFA 4	603	574		66	78				Unhealthy
SAFA 5	60	161		36	40				
Sheik Ejleen 1	707	784		92	120			YES	Unhealthy
Sheik Ejleen 2	390	385		56	65				
Sheik Ejleen 3	135	154		28	40				
Sheik Ejleen 4	206	235		85	86			YES	
Shejaeya 2	745	644			119			YES	Unhealthy
Shejaeya 3	774	651			82				Unhealthy
Shejaeya 4	461								Unhealthy

In term of projected water demand – supply for Gaza strip table (2.3) takes into consideration all available water resources in Gaza strip including Ground water, storm water, return irrigation and reuse of treated west water.

Table (2.3): Projected water demand-supply for Gaza strip. (NWP, 2000).

	Municipal & industrial water in (MCM/yr)				Agriculture in (MCM/yr)			
	2003	2005	2010	2020	2003	2005	2010	2020
Demand	65	84	111	182	91	92	88	80
Resources	48	59	71	77	91	92	88	78
Gap	-17	-25	-40	-105	0	0	0	-2

CHAPTER THREE

URBAN WATER DEMAND MANAGEMENT

3.1 Overview

In arid and semi arid regions of the Middle East, limited water resources pose a severe constraints on the people's economics and social progress, testing their resilience and threaten their livelihoods. The region is also subjected to frequent and severe droughts, the declining of available surface water and the over pumping of groundwater lowering the water table and causes an increase in water quality problems. On the other hand, the rapid growing of urban populations is increasingly becoming a problem for stakeholders and water sector institutions throughout the world, and it creates a difficult provision for them to ensure an adequate water supply and sanitation.

Therefore alternative and complementary approaches to managing water resources are needed to balance the supply and the demand for water in Gaza city.

The WDM offers one such powerful approach to positively influence water use and contribute effective water governance context. WDM is seen as the preferred alternative to meet increasing water demand and can be defined as any practice or policy implemented which results in water being used in a more efficient, equitable and sustainable way. It addresses technical, institutional, financial and social aspects to provide multi- sectoral and integrative effort to motivate and support water users to regulate the amount, quality and timeliness in which freshwater is accessible, consumed and disposed. With regard to the domestic consumers, water demand management is active tools to satisfy the water needs of urban growing populations (Overview Middle East Water Resources, water demand management 2004).

3.2 Water Demand Managements Measures

3.2.1 Water Conservation Measures

In house fixture and water saving measures.

3.2.2 Water Pricing Measures:

- Water tariff structures
- Water metering

3.2.3 Educational and Information

- Awareness raising
- Public involvement
- In school education
- Legal measures
- Rules and regulation
- That forms the basis of WDM policy (urban Utilities World Bank Publications).

3.3 WDM Objectives

The main objectives of water demand management are:

- To contribute to more efficient and equitable provision of water services
- To protect the environment (aquifer quantity and quality)
- To achieve equity and fairness
- To make social development

3.4 Water Demand Management Tools

The water demand for domestic use can be controlled by an array of tools as shown below in figure (3.1).

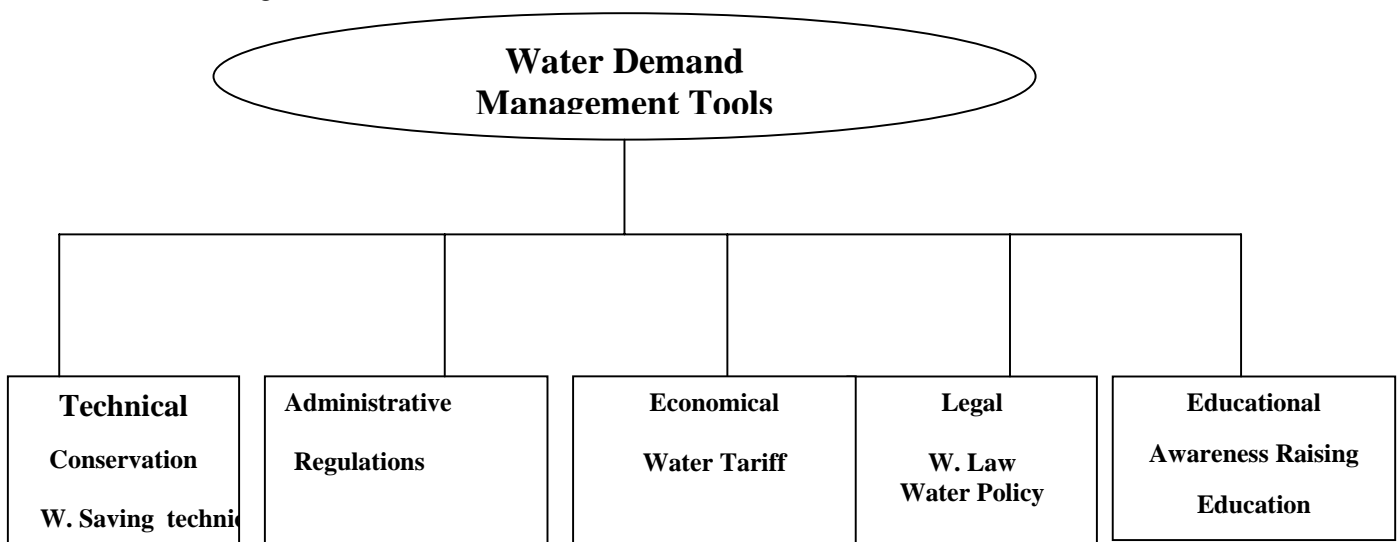


Fig (3.1) Water Demand for Domestic Use

3.4.1 Water Tariff

A tariff means a service charge that the municipality charges for the use of services. Tariff structuring depends on many factors, thus it is not possible to make “one size fits all” recommendations.

The process of tariff structuring is important in the promotion of the sector reform process.

The Main Objectives of Tariff Setting are:

- To recover the cost of service supplying
- To ensure efficient use of services by consumers
- To ensure access of all groups to basic minimum service needs

Pricing of water and sanitation services is based on a number of factors such as depreciation, operation and maintenance costs, re-investment and profit. The determination of price of the service for a particular segment of the customer profile may vary according to the objectives of the utility, political and social criteria. It is usually better if these criteria are transparent.

Tariffs should be transparent. Charges for water should be well explained for consumers to understand. People who understand their bills and the associated cost of service may be less likely to oppose rate increases. Transparent pricing also encourages consumers to conserve when prices rise and enables utilities to better assess customer demand and so plan for network expansion.

Regulators can help to utilize optimal pricing objectives by approving water tariffs that preserve the principles of marginal cost pricing, providing incentives for metering programs, and assessing penalties for poor quality of service.

Water tariff has a number of important consequences, which makes it a key instrument for the implementation of demand management. Changing in tariff structure of water can affect water consumption and WDM do the following.

- Increased price reduces demand.
- Increased price increases supply (firstly, because marginal projects may become affordable; and secondly, because it becomes attractive to reduce losses).
- Increased prices facilitate reallocation among sectors.

- Increased prices improve managerial efficiency.

The water price is composed of many different elements that reflect (financial) costs, such as economic costs, the economic value of the commodity, and the client's willingness to pay, which is the economic value for the water user. Water-user charges are often considered a central component of a WDM strategy. If water consumption is metered, then price can be used to modify water demand. The validity of this argument is debatable. In many cases, the relatively richer segments of the population benefit from subsidized water supply, while the poorer segments-often living in semi-urban areas are left unserved and depend on water vendors, who often charge many times the price of reticulated water. If the urban poor are dependent on reticulated water, there are several ways to protect them against increases in the average price of water, such as providing a minimum amount of water (a "life-line" quantity) at a subsidized price. These precautions are taken, increasing the price of water can allow the utility to enter into new service areas, thereby increasing rather than decreasing equity.

Household water demands are not evenly spread over time, changes seasonally, as well as within the day and, to a limited degree, within the week. Large costs will be faced if supply systems are to be constructed, maintained, and operated to satisfy the maximum peak flows experienced (Urban Utilities in World Bank, 2003).

3.4.2 Basic Types of Water Tariff Structures

There are many different types and styles for water tariff structures as explained in the following sub sections:

3.4.2.1 Single-Part Tariff (single-tariff pricing)

A method of pricing that consolidates rates across multiple service territories owned and operated by a multi-system that may or may not be contiguous or physically interconnected

Also known as "consolidated rates".

A single-part tariff consists of either:

1. A fixed charge – the monthly water bill is independent of the volume consumed (not based on measured water use).

2. A volumetric charge – this charge is made for the volume of water, which is measured through a supply point.

A uniform price volumetric tariff (unblocked) – all units of water are billed at the same Price.

An increasing linear tariff – unit charge increases linearly as water use increases.

Block-type structures – two or more prices, each applies to use within a defined segment (block) of monthly use. Unit charge is constant over a specified range of water use and then shifts as use increases.

Decreasing block pricing (or declining-block pricing) a pricing structure in which both the average and marginal price per unit decreases as consumption increases.

3.4.2.2 Two- Part Traffic

A pricing technique in which users pay a fixed sum for access to a service and pay another charge for each unit of the service they consume. The charge per unit may vary, making the system a multi-part tariff. Tariffs can be differentiated by type of user (residential or commercial, industry or tourism, for instance). In developing the tariff structure, municipalities and their advisors will need to consider the factors that will affect implementation. These may include.

The failure to link tariff regimes to productivity and thus ensure private sector incentives, the low metering levels in poor areas – thus undermining the “user pays” principle, the distortions that pro-poor tariff structures produce in the market incentives for the private operator, the lack of a clear mechanism for tariff setting and revision (Water service of Australia, 2003)

3.5 Water Metering

Metering is a fundamental tool for water system management and a prerequisite for efficient pricing systems. It provides information on the delivery efficiency of the water demand management. Metering can be installed at different locations and for different purposes:

- Source-water metering. Both the supplier and the customer benefit from these installations Source Metering is essential for water accounting purposes

- Service-connection metering. Informs customers about the quantity of water they are using. Suppliers can use these metering data to track water usage such metering is essential if consumer charges are to be based on the amount of water consumed.
- Public-use water metering. All water provided free of charge for public uses can be metered. This will allow the utility to account more accurately for water use. Lack of public-use metering UN-determines other conservation measures.
- Service-connection metering in combination with charging by volume can result in significant water savings However, metering requires considerable capital cost. Meter testing, calibration, repair, and maintenance programs are fundamental to ensure accurate water accounting and billing (Water conservation, World Bank, 2003).

3.6 Public Awareness and Education.

Public awareness it is critical to the success of any WDM programs, although their role in any savings may be difficult to estimate. Customers that are informed and involved are more likely to support WDM management goals. Information and education measures can directly produce water savings by persuading consumers to use less water, as well as support other conservation measures. For example it is widely believed that information plays a role in how water consumers respond to changes.

Public awareness is a means of informing and educating water users about the seriousness of the water situation, it is effective tool for managing water demand and can be used to help rationalize water consumption and encourage conservation at the household(WSA, 2003).

Public awareness programs could substitute for other demand management methods, including raising water prices, water saving devices and rationing water supply, which may be less acceptable to the general public. It is also a mean of directly confronting the degradation of the resource by having end users understand its implications and seeing themselves as caretakers who can protect the quality of water, neither contaminating it themselves nor permitting others to pollute it. In addition education and communication strategies are often designed to influence water demand patterns. These can take various

form such as educational materials distributed by water providers or the use of water efficiency labeling. It can be difficult to determine the effectiveness of an education and awareness strategy because it is often part of larger program implemented to reduce water demand.

3.7 Water Uses Regulations and Standards

Regulation and regulatory measures include the use of building controls and appliance performance standards and Regulations can be used to manage water during water scarcity or other water-supply emergencies. Typical restrictions in developed countries include bans on non essential (grass watering, car washing... etc); restrictions on commercial car washes, hotels, and restaurants; standards for water using fixtures and appliances; in some cases utilities may find it desirable to extend water-use regulations to promote conservation during non emergency situations. Not all of these are relevant in developing countries, where restrictions such as limiting access time to urban water are more common. Another type of regulation to impose standards on new developments with regard to landscaping, drainage and irrigation practices. Many water systems lack authority to implement this measure.

Utilities that have such authority must exercise it carefully. In general, restrictions on water use should be justified by the system's circumstances and should not unduly compromise the customer's rights or quality of service (Savenje 1997, IHE).

CHAPTER FOUR

RESULTS AND DISCUSSIONS

As an integral part of this research, a survey of (450) questionnaires were distributed and administered to water consumers within city limit of Gaza city.

4.1 Objective of These Parts

The objective for the above mentioned surveys is to determine the consumer behavior in water use, which can be used as a basic foundation for this research.

4.2 Methodology

A questionnaire with an interview was administered to stand on the opinions of the experts who deal with water resource management .The questionnaire was developed and designed in the Arabic Language.

According to the results of the interview with the experts, factors to be studied were determined and a questionnaire was developed for this purpose

A social survey approach was used to determine the consumer's behavior in water use.

Which was executed as follows?

- 1- Questionnaire design
- 2- Distribution and data collection of questionnaires
- 3- Data analysis and results

4.3 The Questionnaires Design

According to the review of literature related to the concern subject and after interviewing experts who were dealing or having contact with the subject at different levels, a questionnaire was developed with closed and open –ended questions .The questionnaire was designed in the Arabic language, as most of the target population were unfamiliar with the English Language (Appendix-c). Unnecessary personal data, complex and duplicated questions were avoided. In each questionnaire, an explanatory letter was attached to cover some ethical consideration and to facilitate questionnaire filling. The questionnaire consisted of five sections:

- 1- Personnel information:
- 2- General information about water networks in Gaza city:
- 3- Consumer opinion about services provided by authorities:
- 4- Consumption behavior (Inside & outside House)
- 5- Reaction of consumer with researcher

The first section was related with the personal information such as address, occupation, sex, age, number of family member, education, income.

The second section about general information such as meter, apartments, bill, capacity of containers, filter.

The third section about the consumer opinion such as quantity, meter check, awareness publication, collect bill, price.

The four section about consumer behavior such as house duties, fruit ,reuse , cleaning process, water network, leakage, faucets, toilet, ,shower, bathtub, washing machine, garden, car, sewer system.

The last section about reaction consumer with researcher like collecting data and paying small portion of poor people.

After data was received, it was tested and analyzed using the statistical package for social sciences (SPSS), 420 Consumers responded to questionnaire. The net size of the study sample was 407 questionnaires with a margin of error (5%) (An Introduction to research methods), also for reliability analysis a sample of 30 questionnaires was returned to the same consumers in order to check the questionnaire reliability instrument by studying and analyzing data results from (SPSS). The survey explored the following data items and with acceptable results as follows:

4.4 Personal Information

The study sample was distributed according to many factors such as living area, job title, gender, age, number of family members, education, and family income, as shown in figures (4.1& 4.2).

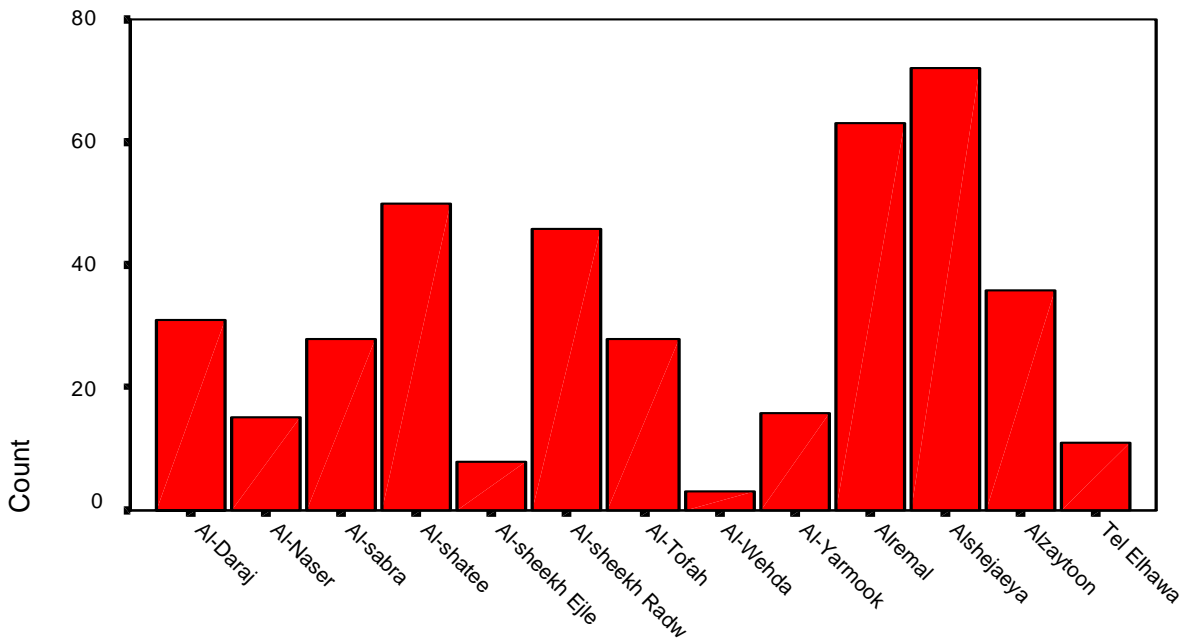


Fig (4.1) Living Area in Gaza City

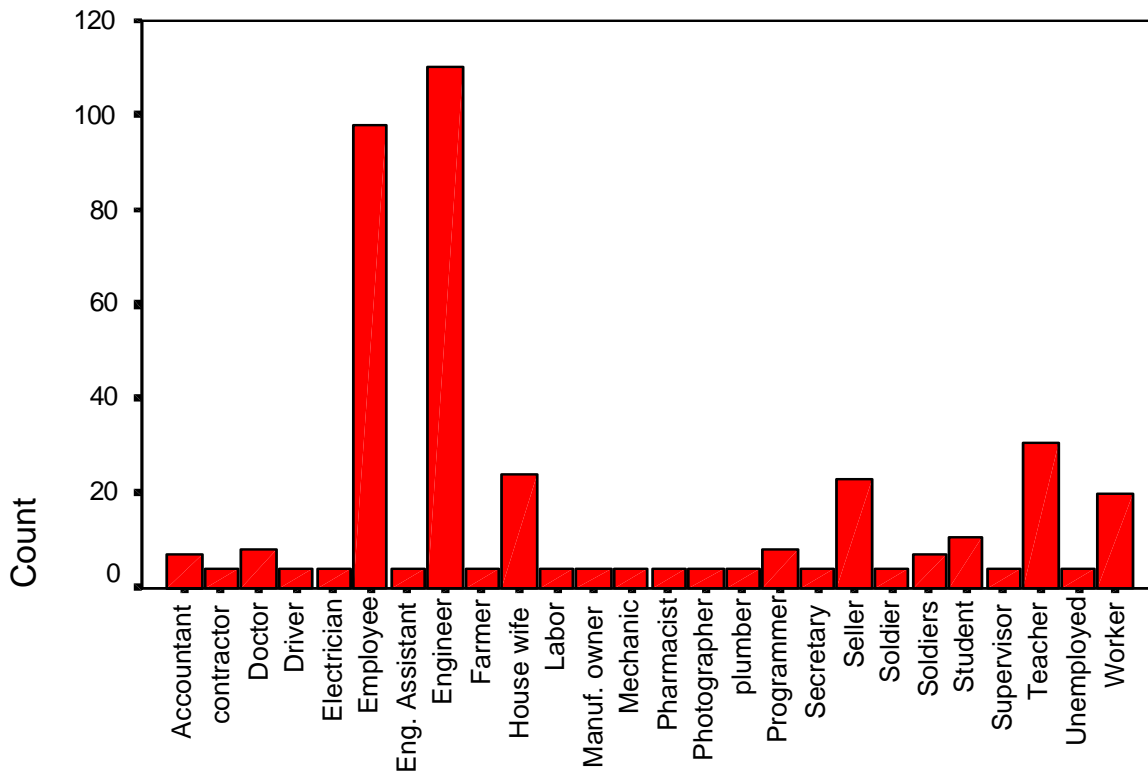


Fig (4.2) Job Title

The vast majority of the study sample (79.1%) was from males and interviews were administered with 407 consumers most of them (48.4%) were in the age category from (31-40) years, the Gaza discrete population is considered a very young with (75%) of the population less than 35 year old, these results shown in more details figure (4.3 & 4.4)

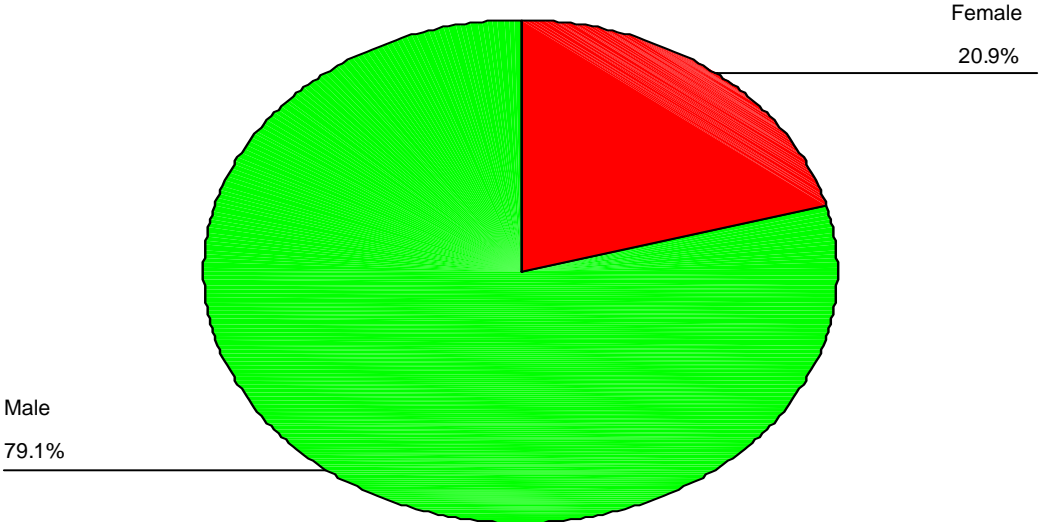


Fig (4.3) Category of Sex

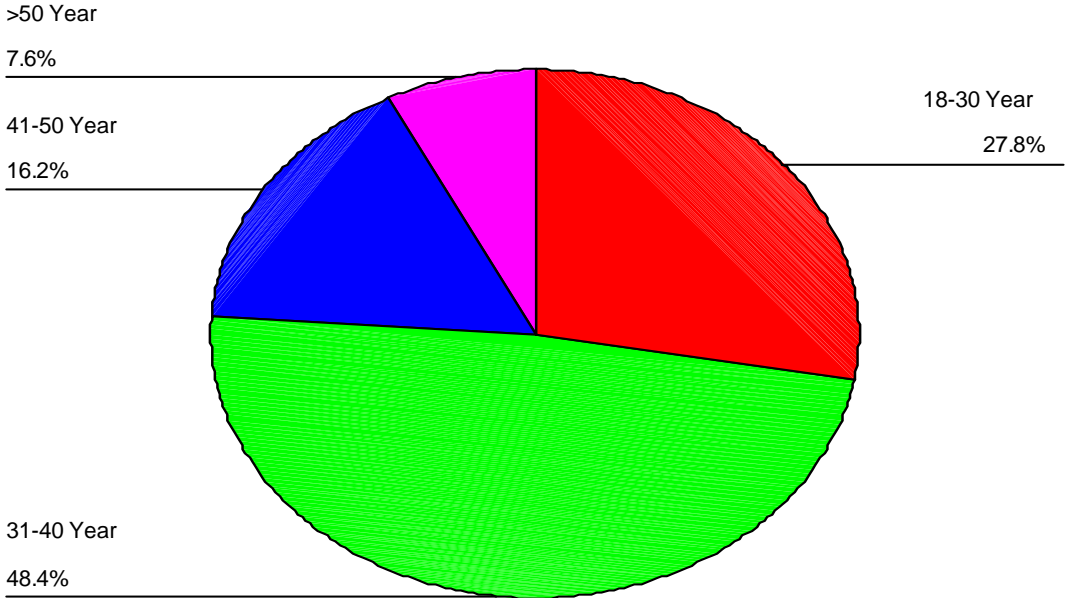


Fig (4.4) Category of Age

The sample is representative of the Gaza city population, also an average number of family members in the household is equal 6.7, as shown in figure (4.5).

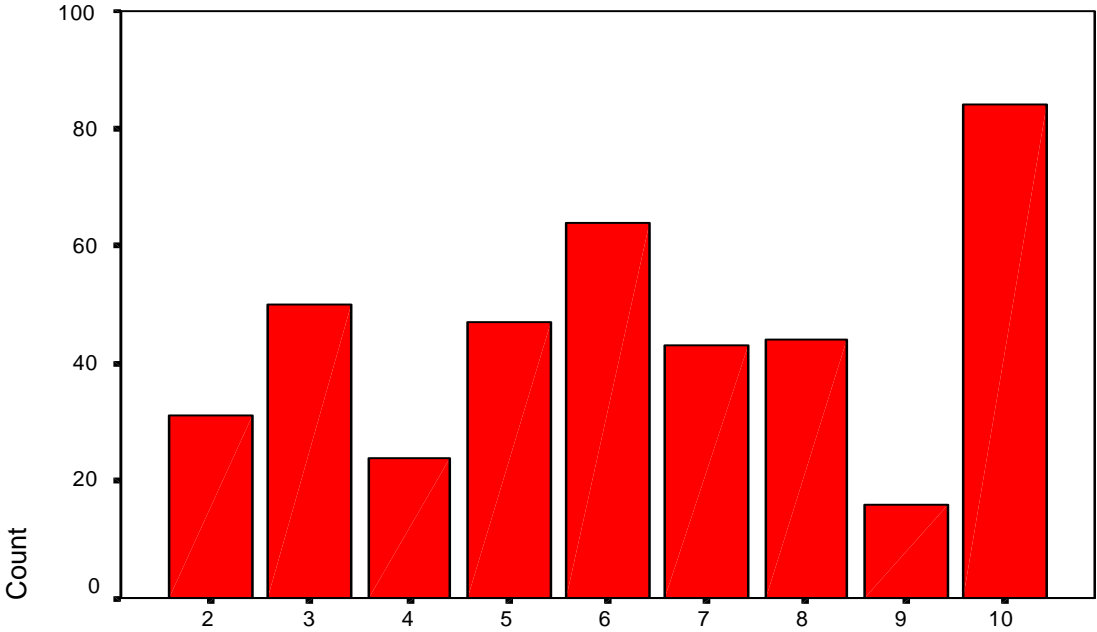


Fig (4.5) Number of Family Member

Distribution of the study sample by category of qualification as indicated in figure (4.6) shows that (70%)of the sample shows consumer have above diploma degree highly education society (PCBS, 1997).

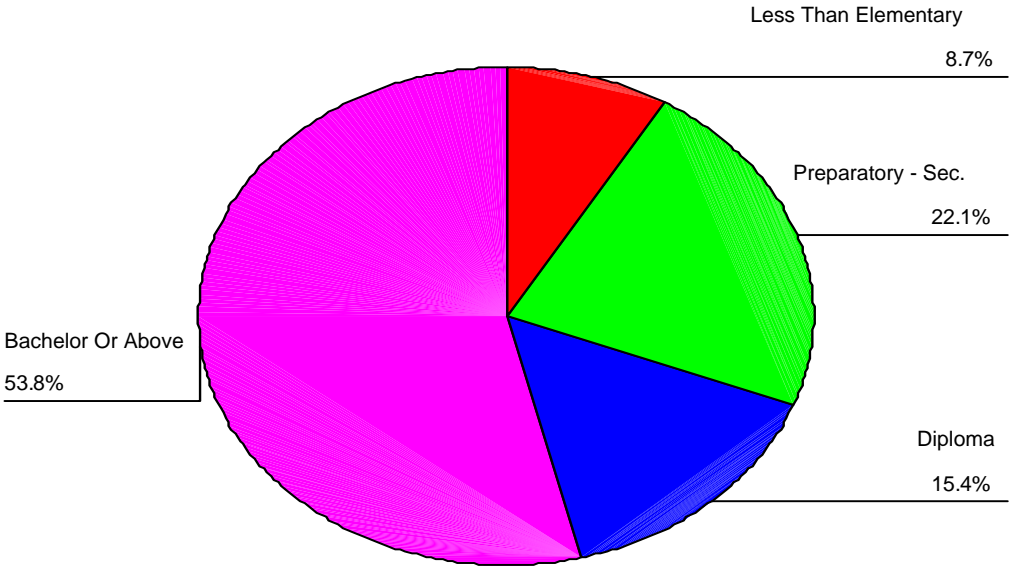


Fig (4.6) Education Level

Distribution of the study sample by category of income as shown in figure (4.7)

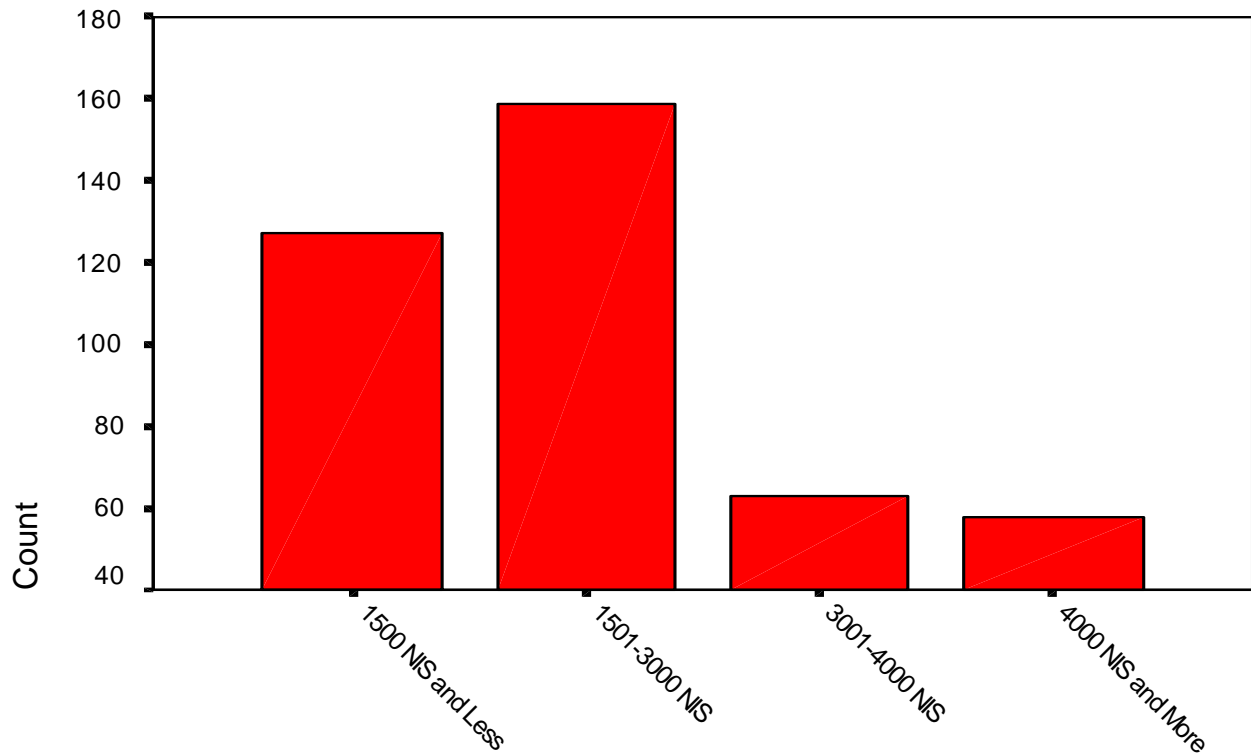


Fig (4.7) Income Category for Consumer.

4.5 General Information about Water Networks in Gaza City

4.5.1 Number of Water Meter in the Building.

Regarding the number of meters that available in the building, the responses of consumers were as follows:

(93%) of sample has one water meter in the building, the average number of building per water meter was 1.7, and average number of apartments per water meter is equal 2.3 apartment per water meter as shown in figures (4.8 & 4.9). This is a big scale that doesn't reflect the end use per person due to the several factors such as traditions and culture of Gaza city, high population density, bad economical situation, and vertical expansion

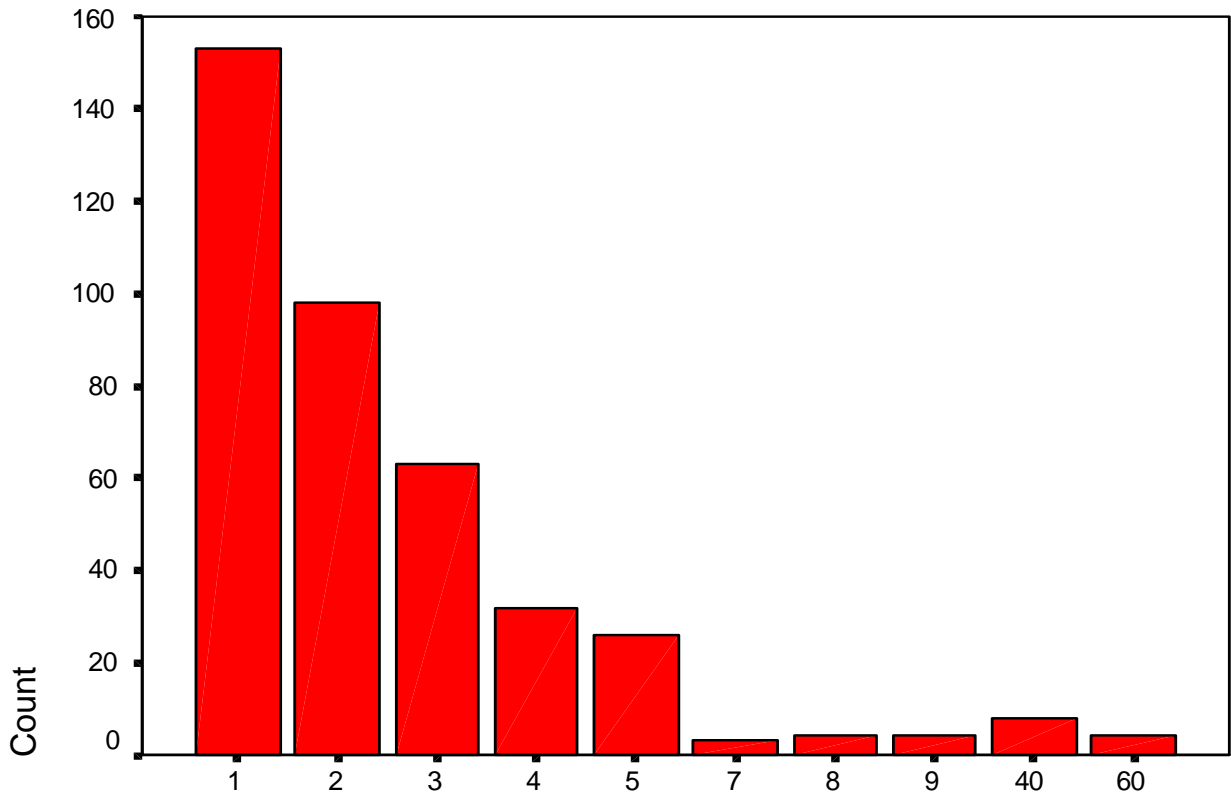


Fig (4.8) Number of Apartments per Water Meter

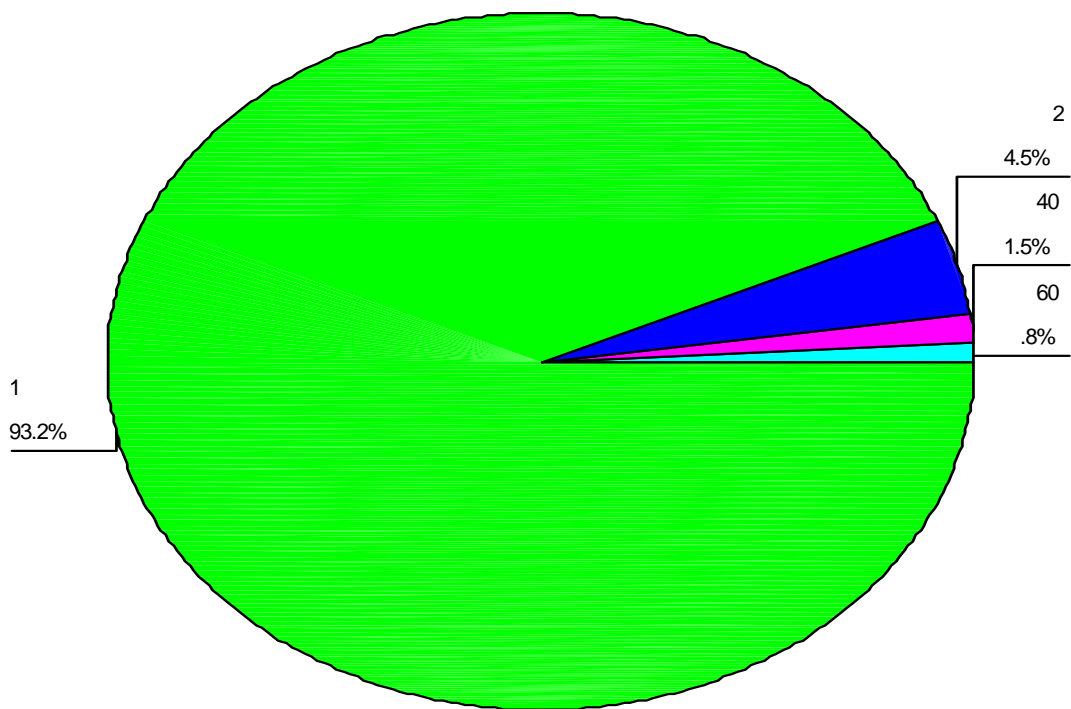


Fig (4.9) Number of Water Meter in the Building

4.5.2 Water Bill

Regarding the monthly bill value, the average water bill, results was as shown in table (4.1).

Table (4.1) monthly bill value

Less than 50 NIS	29%
(51-100) NIS	38%
(101-200) NIS	19%
Greater than 200	14%

It's obvious that (67%) of the sample have a bill value less than 50 NIS per month and (33%) have more than 50 NIS per month. This means that the bill price doesn't force the customer to direct and control of water usages (water price will include the cost, maintains, labor and operation) as shown in figure (4.10).

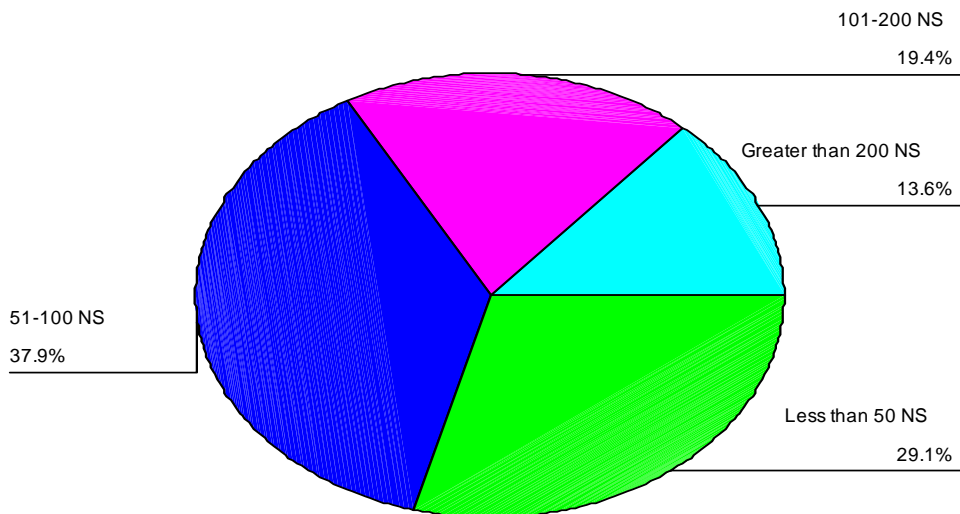


Fig (4.10) Monthly Water Bill

(57%) of the sample pay the bill whereas, (43%) doesn't pay and this mainly refer to economical reasons (57%), other see that the price is high (19%), as shown in figures (4.11 & 4.12).

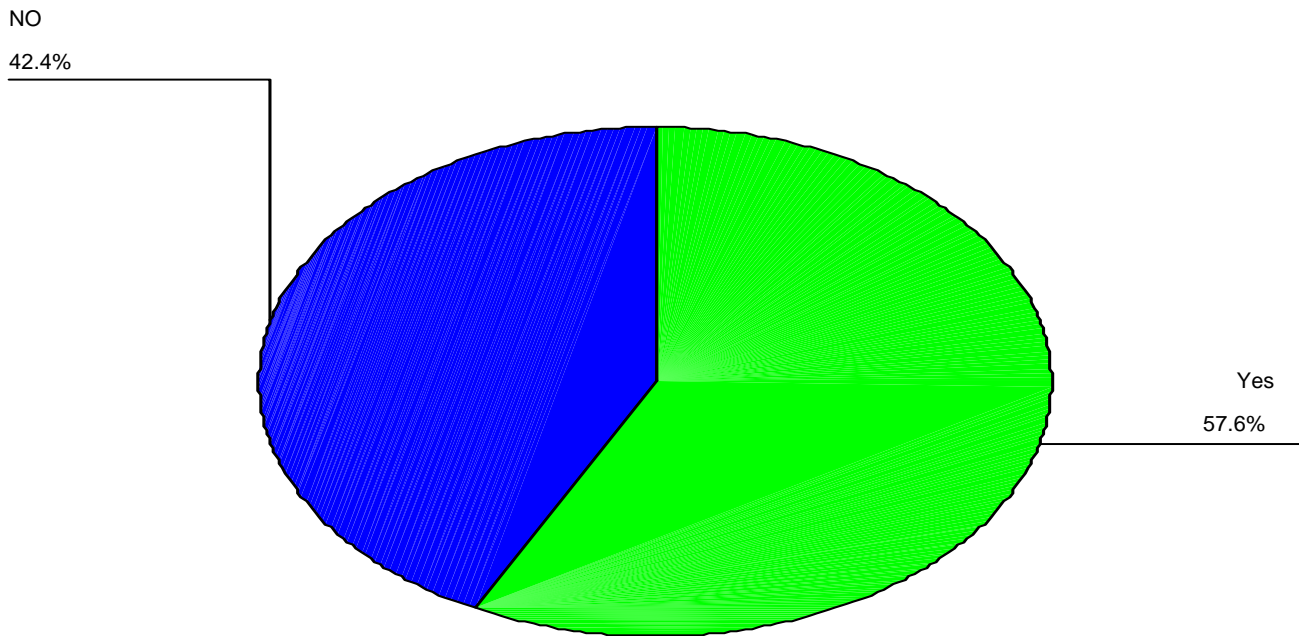


Fig (4.11) Pay Water Bill on Time

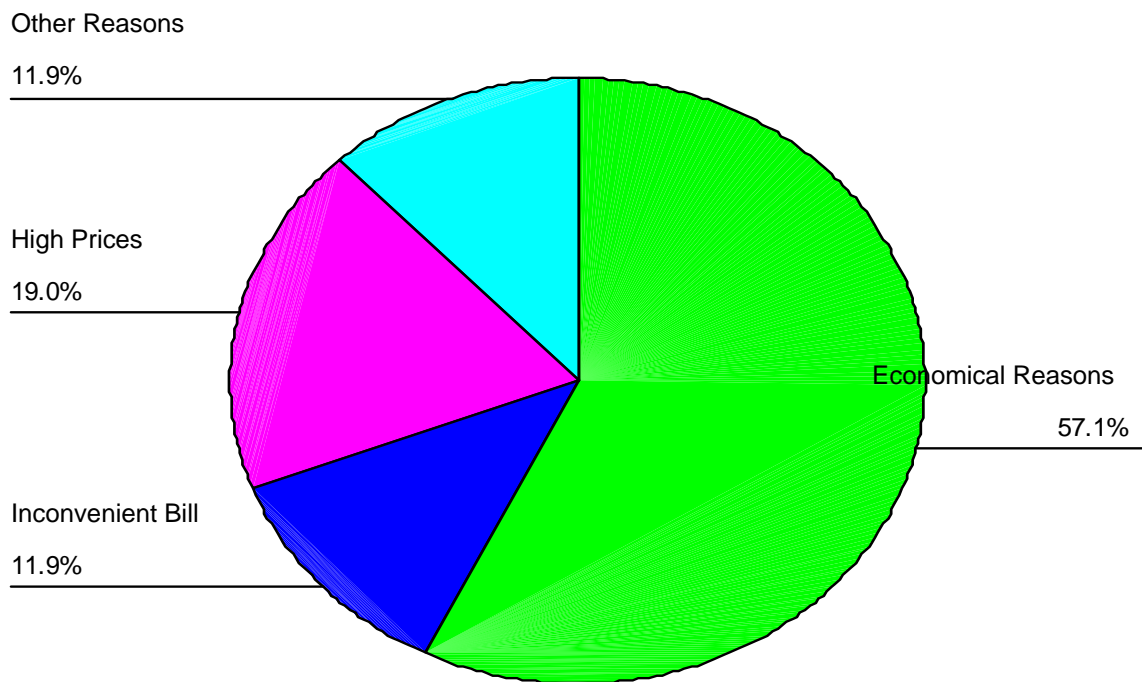


Fig (4.12) Not Paying Bill on Time

4.5.3 Storage Tanks per Apartment

When we asked about the storage tank in apartments we found that, the entire sample has a storage tank for their apartment as shown in figure (4.13). This is clearly that the consumer does not feel the real water shortage crisis.

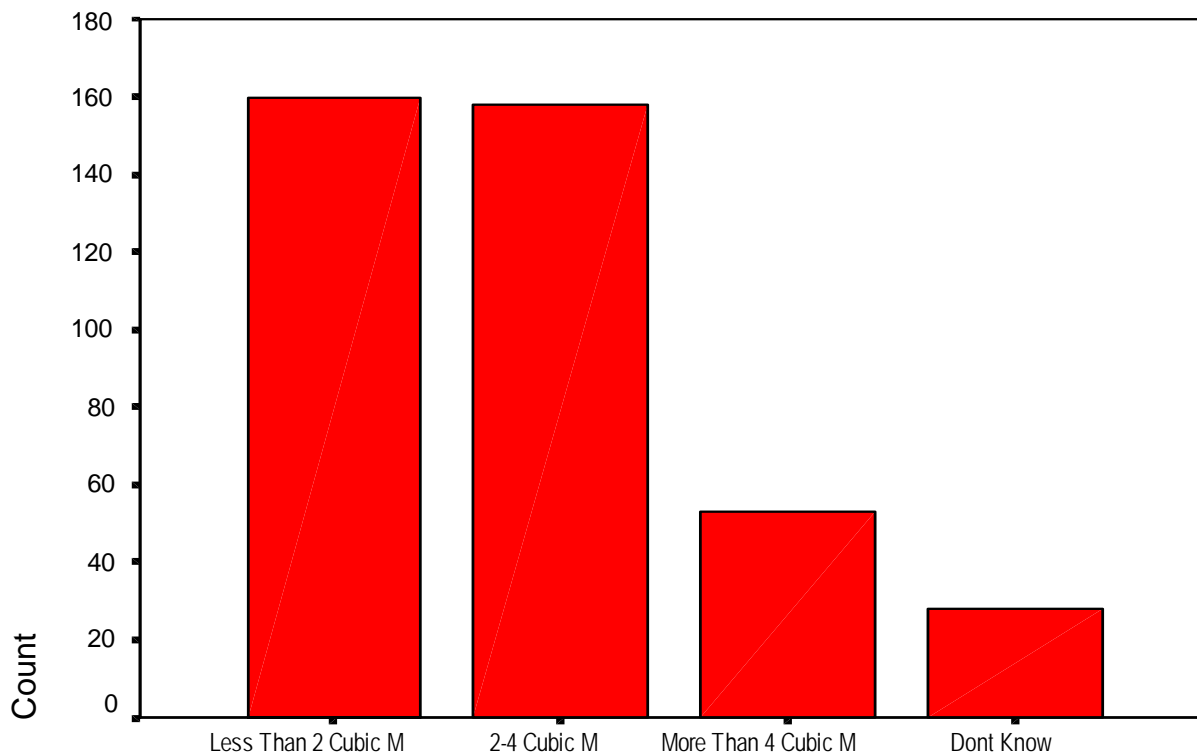


Fig (4.13) Storage Tanks for Apartment

4.5.4 Water Filter

When we asked about if there's a water filter in your apartment we found that and (59%) of the apartment has water filters, whereas (41%) of the sample hasn't, as shown and explained in figure (4.14). This means that water used for drinking and cooking is about three times the actual quantity needed for these purposes .

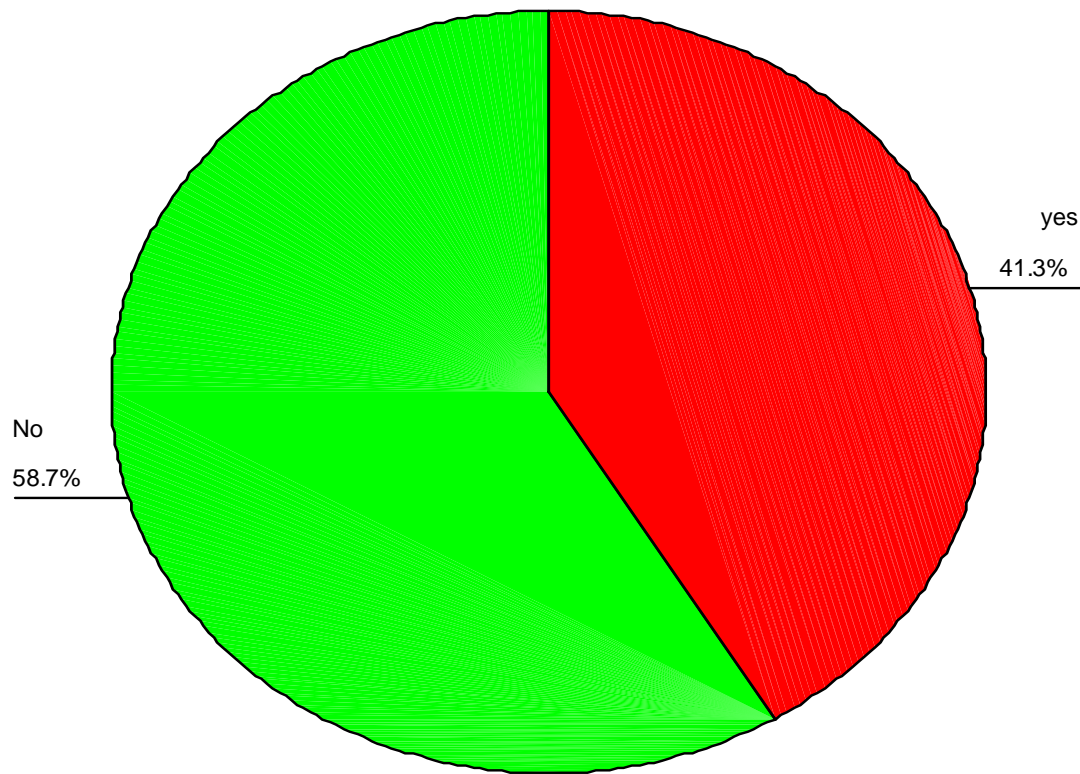


Fig (4.14) Apartment has Filter

4.6 Consumer Opinion in Water Demand Services

4.6.1 Quantity and Continuity of Water

Regarding the consumer's thought and opinion for the quantity and continuity of water that reach in the house, the results shows (60%) of the sample is satisfied about water quantity that arrive their apartments, whereas (34%) are not satisfactory, as shown in figures (4.15 & 4.16).

By studding both figures, it is clearly that there is a problem in water quantity and continuity, that needed to reach consumer's house; and this explain the reasons behind the availability of water tanks in the apartment.

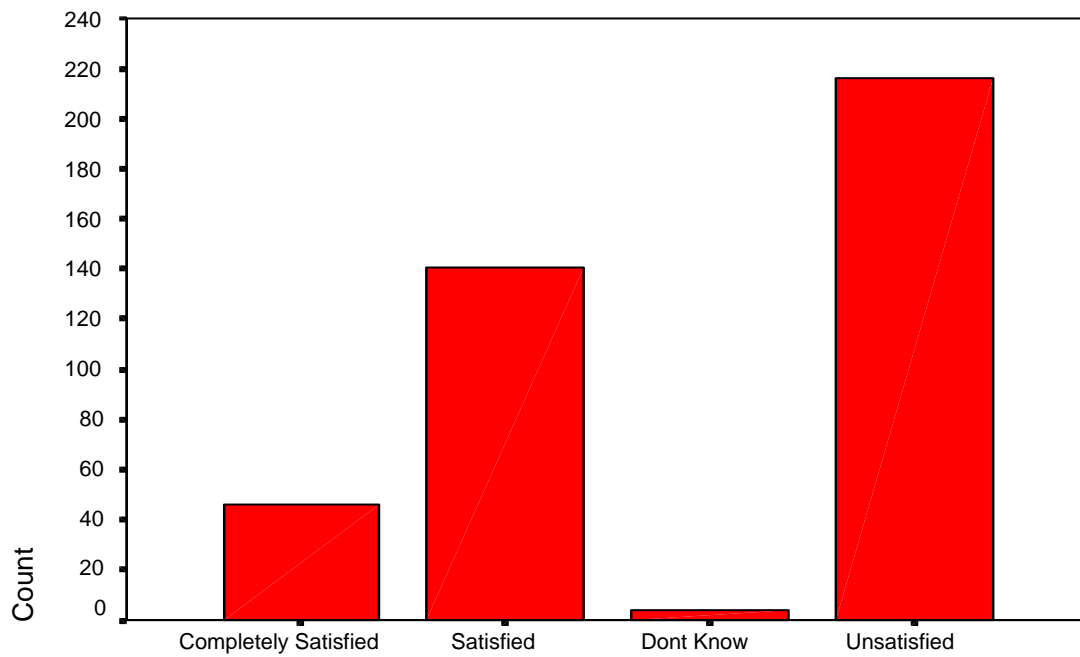


Fig (4.15) Satisfaction about Water Services

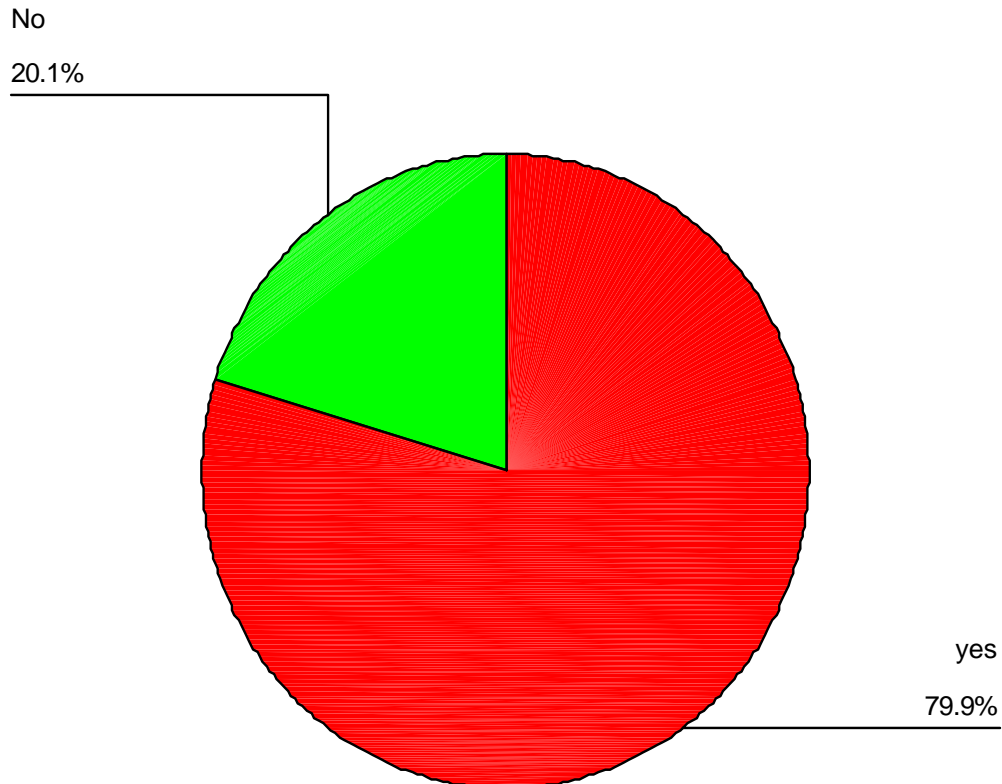


Fig (4.16) Water Enough for Apartment

4.6.2 Meter's Check

Concerning whether the related authorities perform regular meter's check up we found that, during this survey it is obvious that water meter checking is not satisfactory. (72%) of the water meters are not checked by any related agency, as shown and demonstrated in figure (4.17). Also it's clearly shows that there is no control, mentoring, and follow up for meters check up.

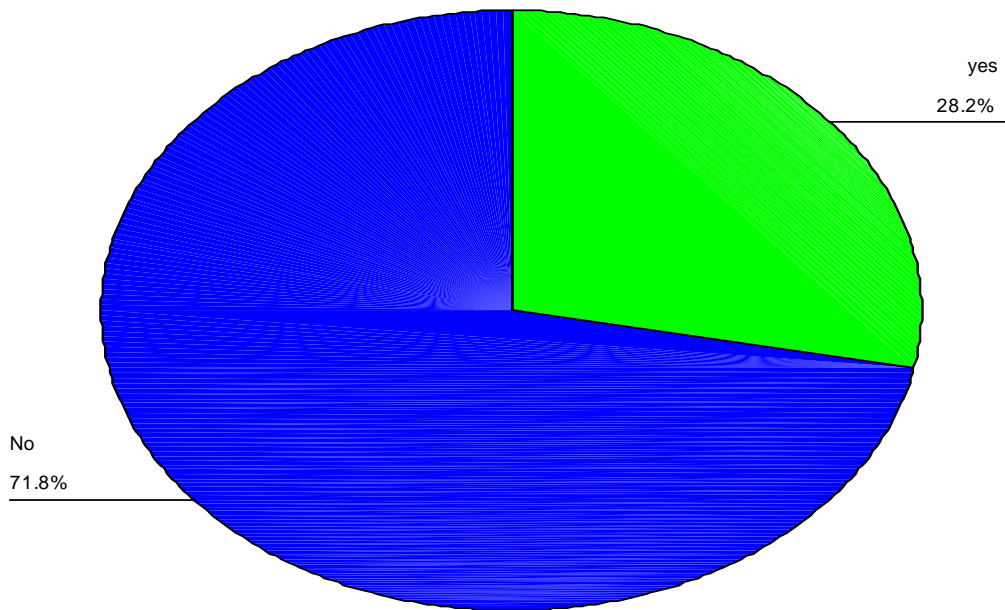


Fig (4.17) Meter Checked

4.6.3 Water Handout

Concerning consumer participation in lectures, seminars, or workshops concerning water consumption awareness, the results showed that , there is defection from related agency in water use awareness, where about (94%) of the sample did not receive any handouts and about (90%) of the sample didn't attend any meeting as shown in figures (4.18 & 4.19). It is clearly showed that water consumers behave incorrectly, since no indication for any efforts of public awareness, therefore this can lead to a large quantity of water consumption.

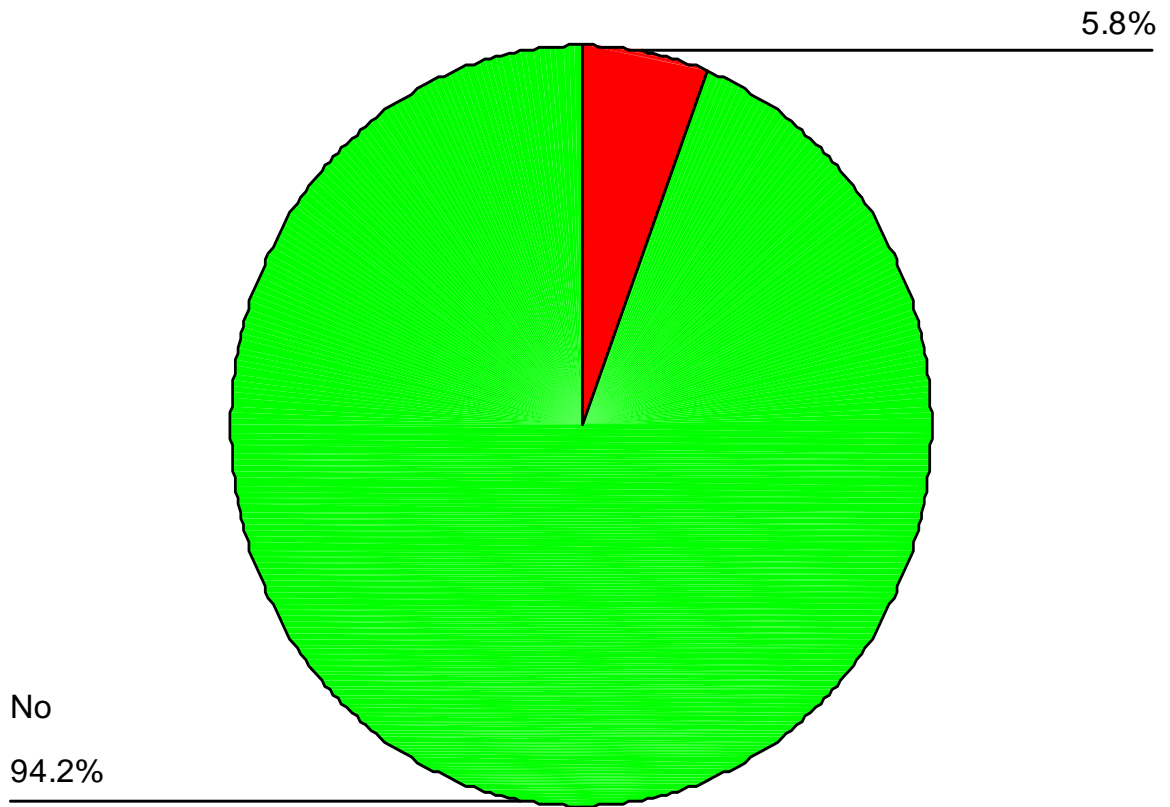


Fig (4.18) Received Handout

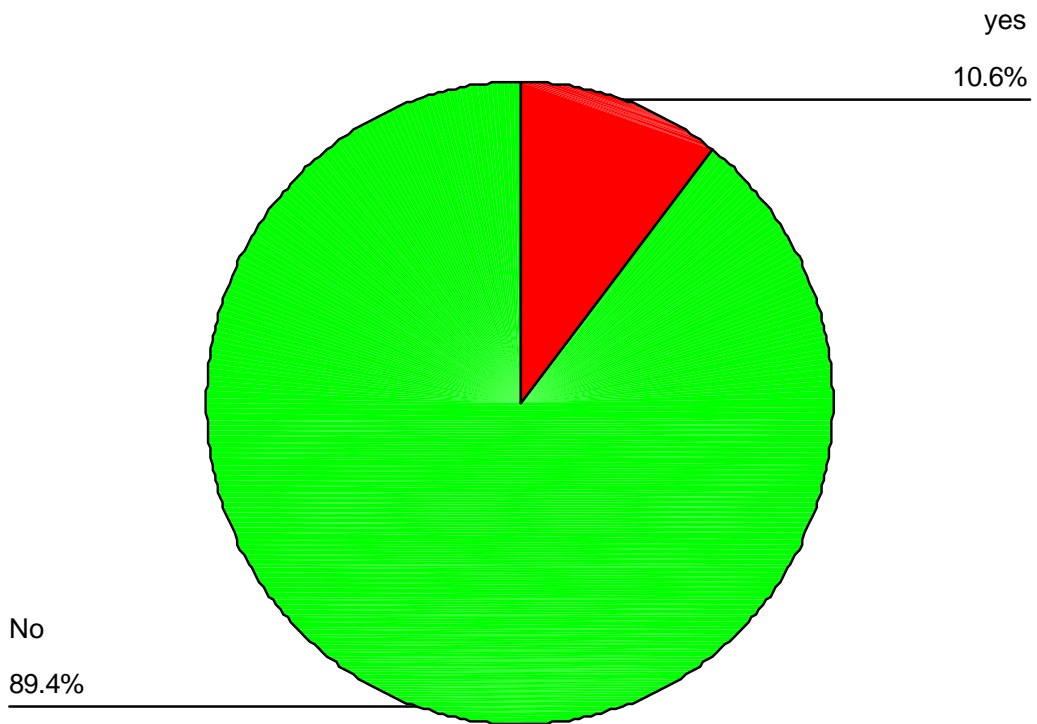


Fig (4.19) Attended Meetings for WDM

4.6.4 Water Bill

Regarding whether consumer receives cycle bill on the prescribed time we found that, (86.5%) said Yes, while (13.5%) said No, as shown in figure (4.20).Therefore there is a good efforts in mailing bills on time in order to reach water consumers.

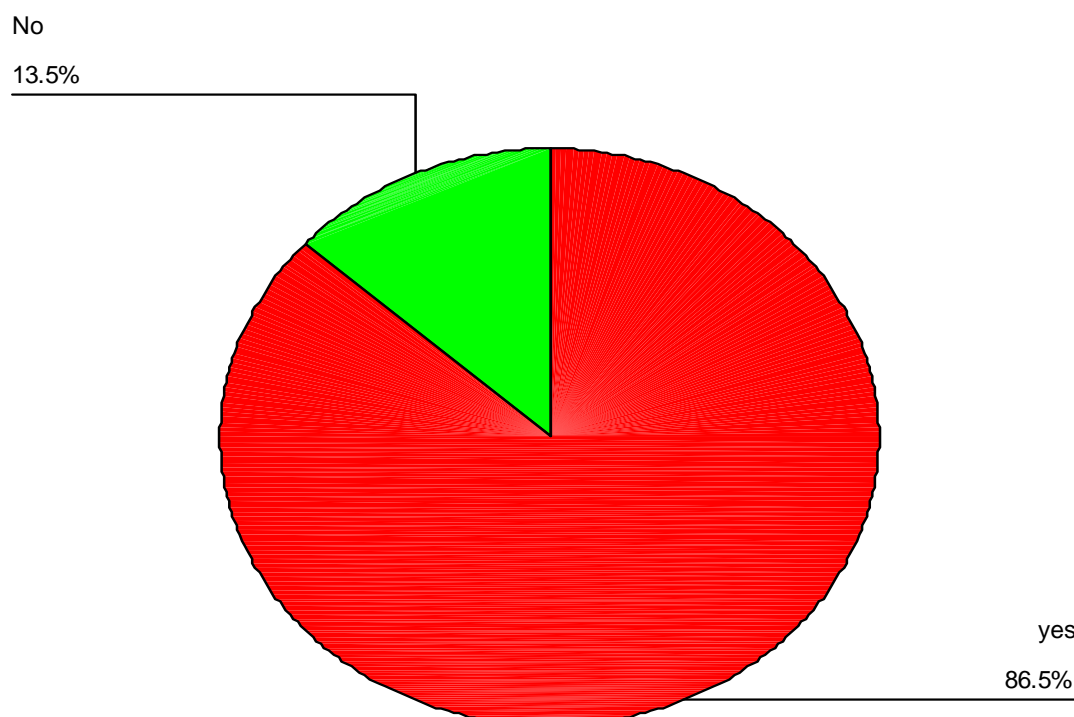


Fig (4.20) Receiving Water Bill on Time

Concerning if there is strong authority that grantees the collection of bill fees, the results showed, the following figure (4.21) shows consumers opinion on the idea for authority power to collect tariff. Clearly water consumers like a good system that can help them in paying tariff on time.

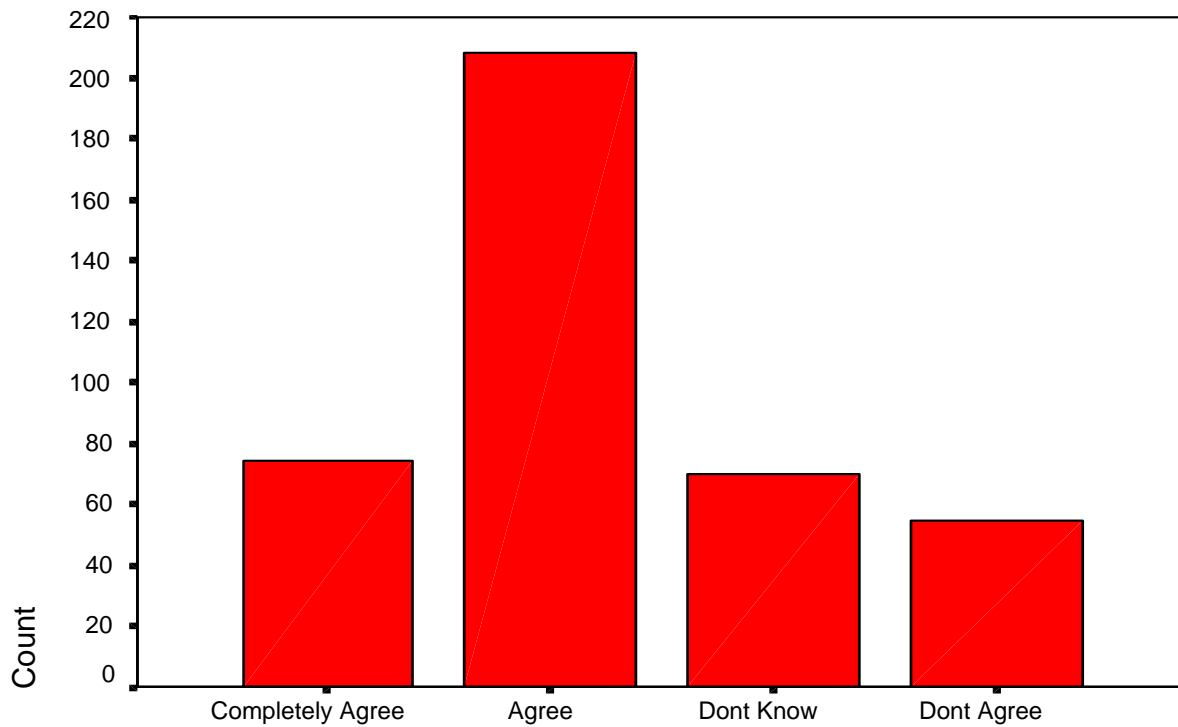


Fig (4.21) Government Collecting Water Bill

In reference to whether increasing water prices will decrease water quantity which consumed by a family, the results showed that there is indirect relations between tariff increase and water quantity consumed as shown in figure (4.22) is supporting that. The figure confirms that majority of water consumers rejects any increase in their water tariff.

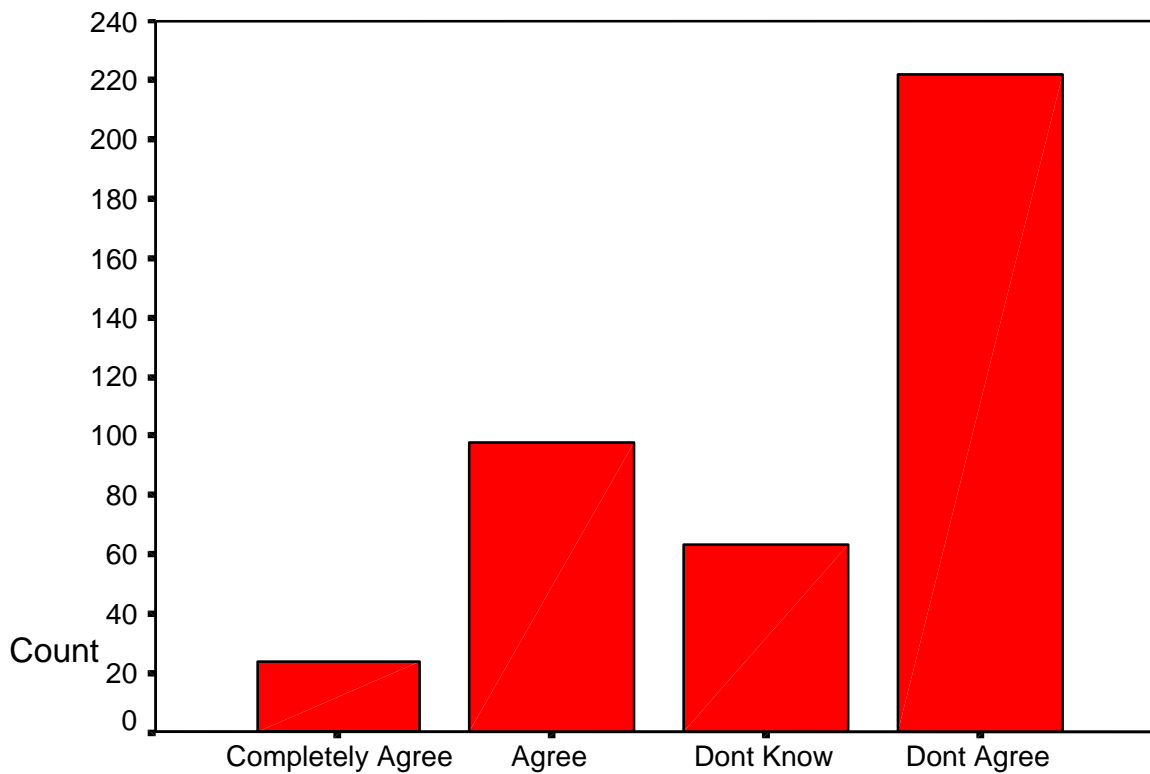


Fig (4.22) Water Price will Decrease Water Demand

4.7 Consumer behavior indoors.

4.7.1 House Work

Concerning who is performing house duties (Clothing Wash, Cooking & Cleaning), the results showed that, it was clear from the individual samples that the woman is the main component of performing house duties such as (87%) of housework is done by woman and (11%) is done by both housewife and husband, as shown below in figure (4.23). It is clearly obvious that the house wife is the key element in the apartment, which has an important role in the quantity of water consumption.

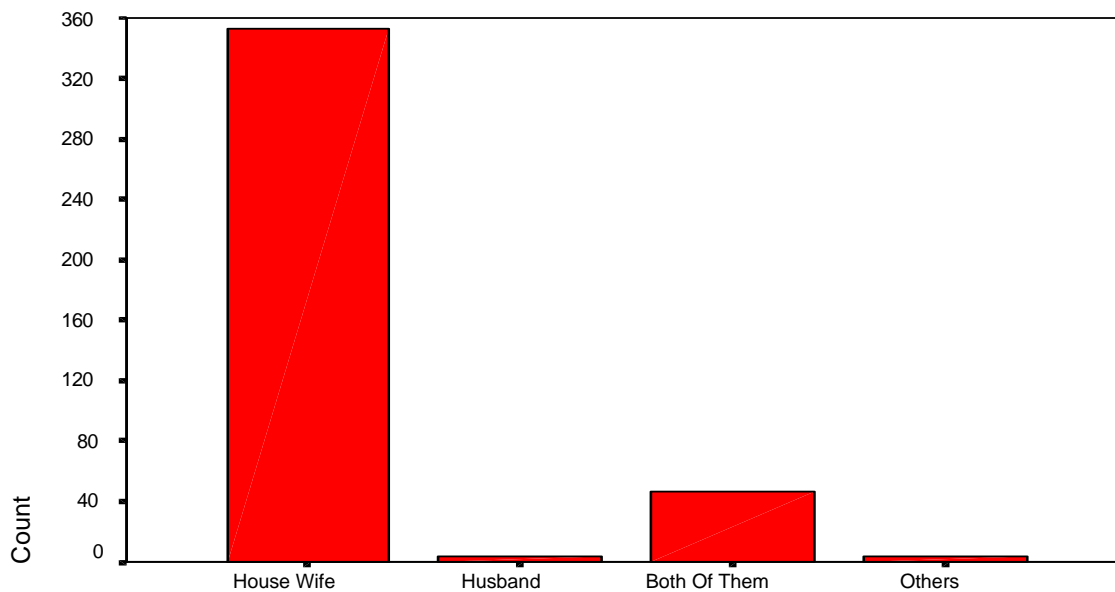


Fig (4.23) House Work

These women in development issues are important to water supply and sanitation, since women are the main drawers and user of water (Katko, 1991).

4.7.2 Fruit and Vegetables Cleaning

Regarding the fruit and vegetables that washed in house, the results showed that, the way of washing fruits even though their (66%) of the samples individual's acts by washing fruits directly beneath the faucets tips. On other hand (34%) of the sample individuals washes fruit into a bucket, and also its important to mention that approximately (90%) of the samples individuals don't reuse the fruits washing while (10%)of the samples individuals reuse the fruit washing water. It is clear that consumer wash under supply high percentage and this a lot of waste of water, as shown in figures (4.24 & 4.25). It is clearly

that most of water consumers tend to use an easy and most convenient way in washing fruits and that is simply by using the faucets.

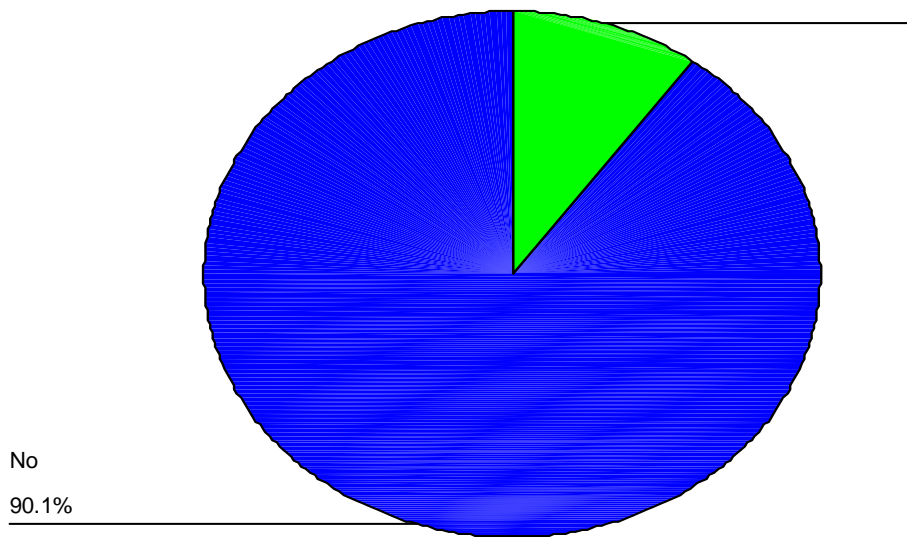


Fig (4.24) Fruits and Vegetables Cleaning

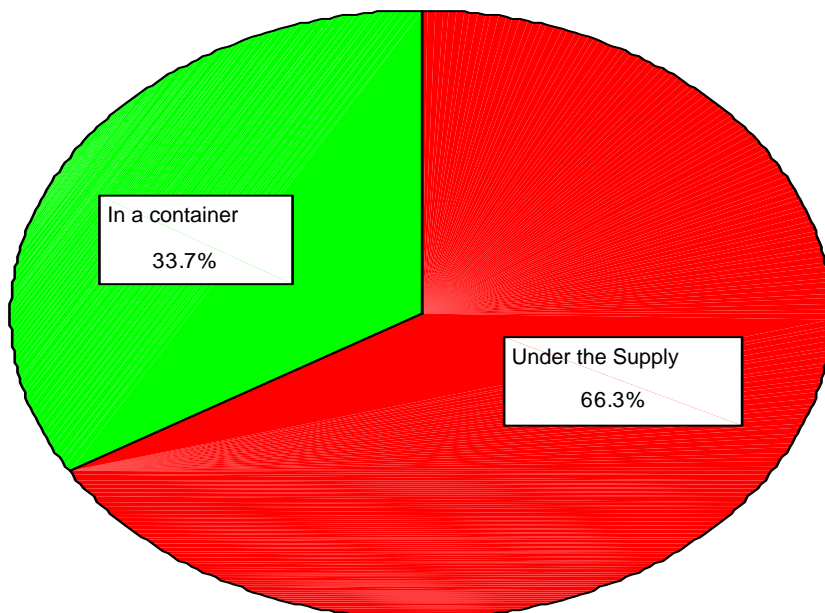


Fig (4.25) Reuse of Fruit Cleaning Water

4.7.3 House Cleaning

Regarding cleaning process done for entire house including living room, and halls, the results showed that, cleaning house done as shown in figure (4.26) it was noted that most of water consumers depend on water hose in cleaning houses and halls.

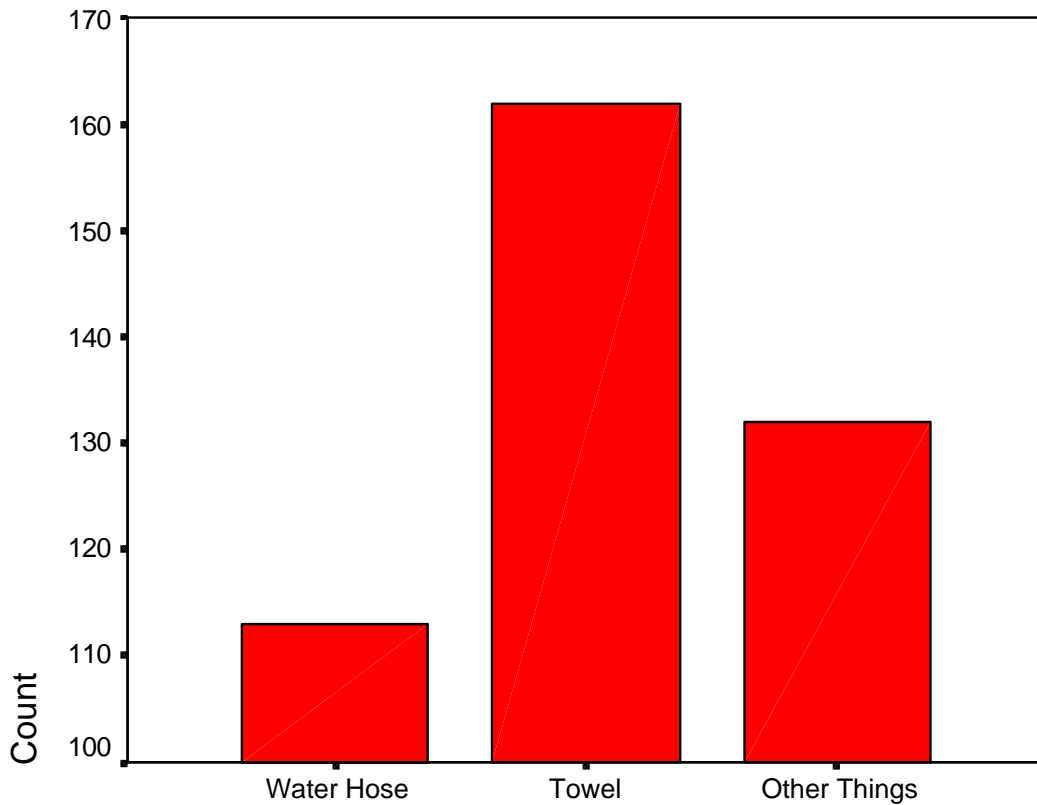


Fig (4.26) House Cleaning

4.7.4 Water Supplies

Concerning if the case of existing problem in internal water network, is this problem corrected quickly, the results showed that, (85%) of sample individuals do repair water supplies fast while (15%) do not, as shown in figure (4.27), shows a lot of water consumers usually repair water supplies as fast as they can, and this is really a good sign for understanding the importance of water management. As the figure, shows a lot of water consumers usually repair water supplies as fast as they can, and this is really a good sign for understanding the importance of water management.

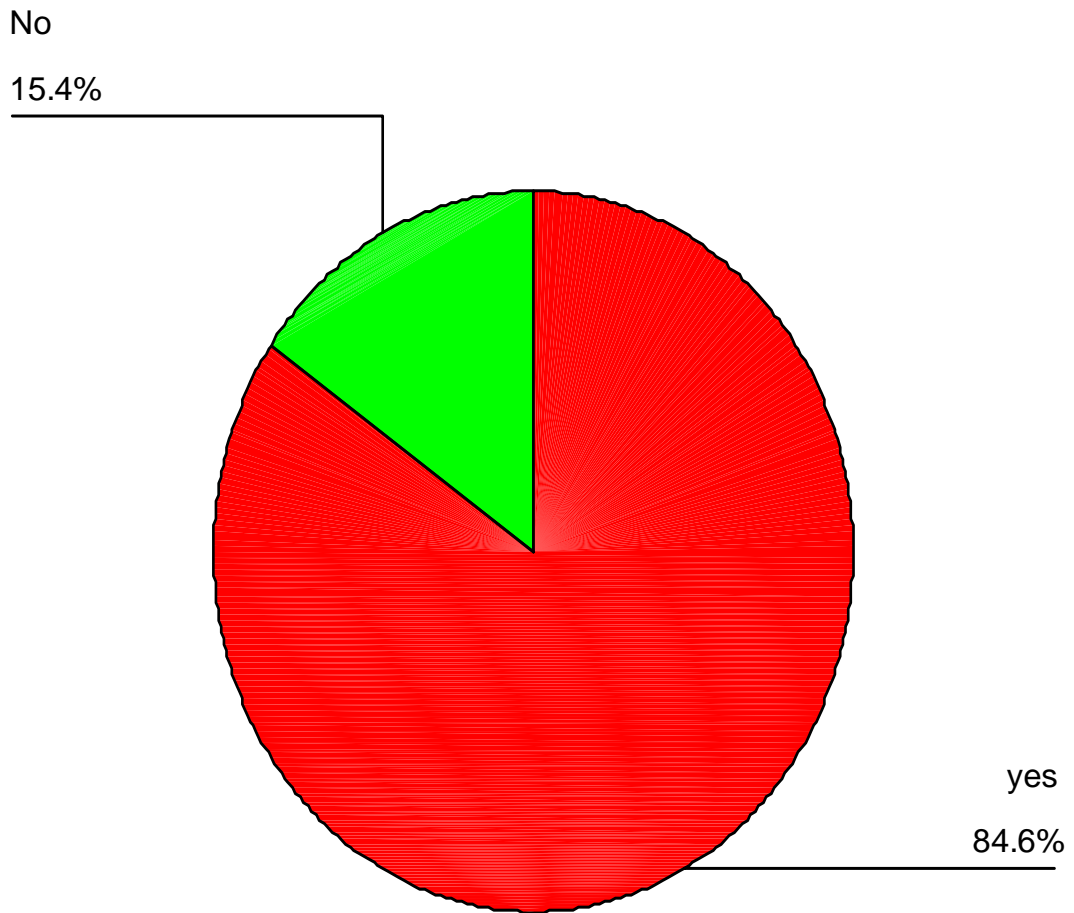


Fig (4.27) Repair Water Supplies

4.7.5 Leakage in Bathroom

Regarding a leakage in toilet inside the house, the response showed that, (67%) sample individuals can discover leakage in toilet while (32%) do not, as shown in figure (4.28). From the figure, majority of water consumers have no way of finding out any leakage in their toilet, which can be referred to a lack of public awareness.

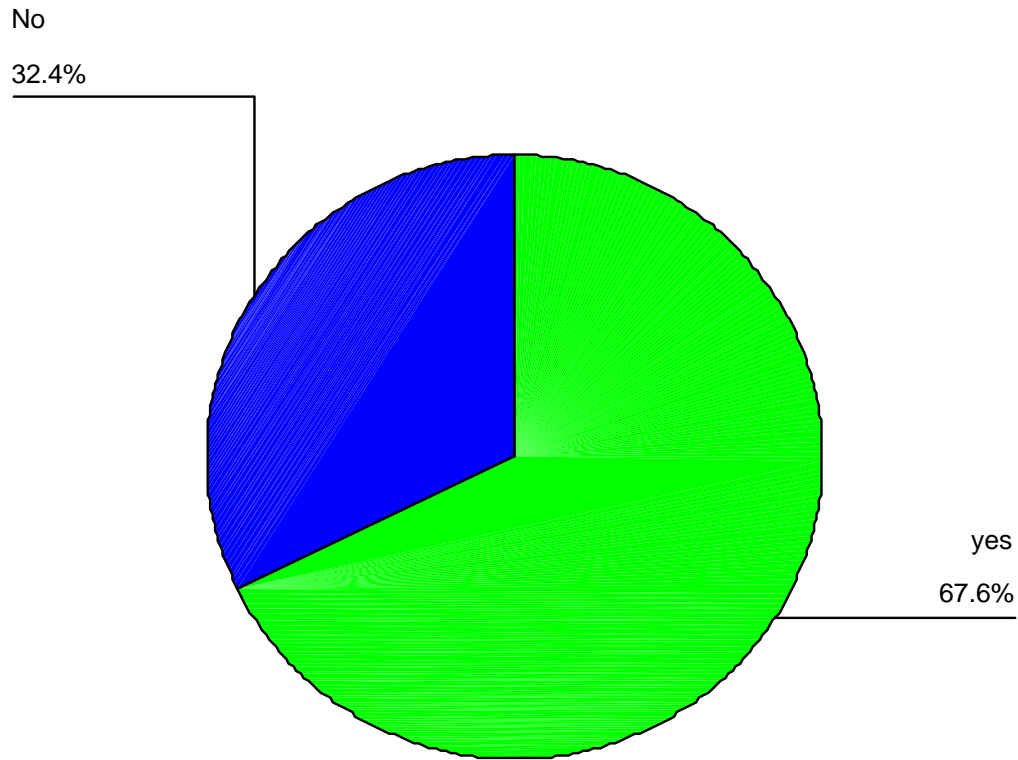


Fig (4.28) Discover Leakage in Bathroom

4.7.6 Faucets

Regarding the efficiency of house faucets we found that (74%) of sample individuals hasn't loses in faucets tips while (26%) has and the sample individuals opinion of their faucets tips type. Water consumer's opinion as shown in the table (4.2); confirm the usage of the best brand name of fixtures that available in the market without knowing or following certain international standards and specifications for selecting these fixtures.

Table 4.2 Water consumer's opinion

1- Excellent	28%
2- Good	38%
3- Medium	32%
4- Don't Know	2%

With reference to the question concerning, opening faucet in a way that suitable to your need usage, the results showed that (89%) of sample individual think to open faucets tips suitably, while approximately (11%) say no, as show in figures (4.29 & 4.30).

Clearly consumers usually do not close water faucet during (shaving, wadu, etc...), which can be referred to a lack of public awareness. This issue is really important since can help in water saving and management

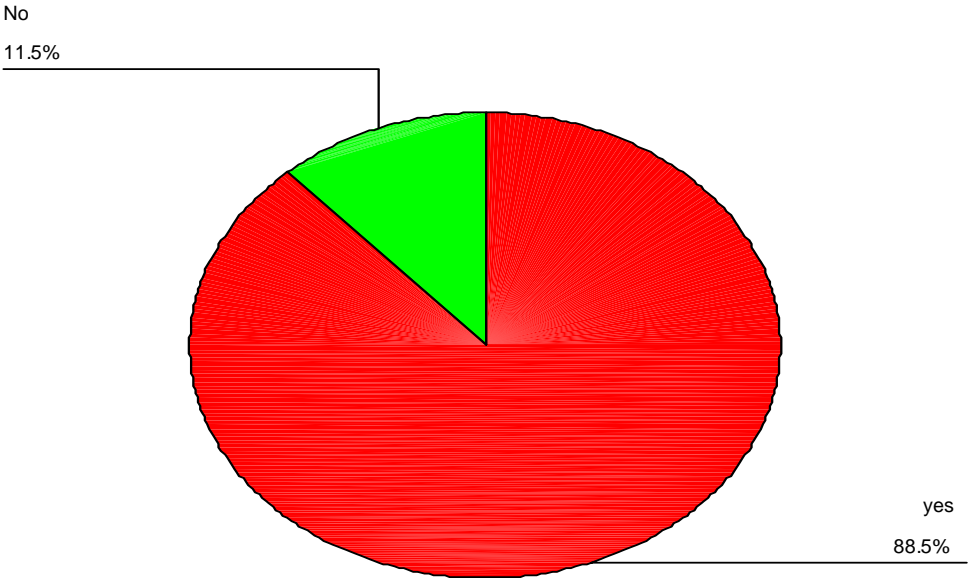


Fig (4.29) Open Water Supply Suitably

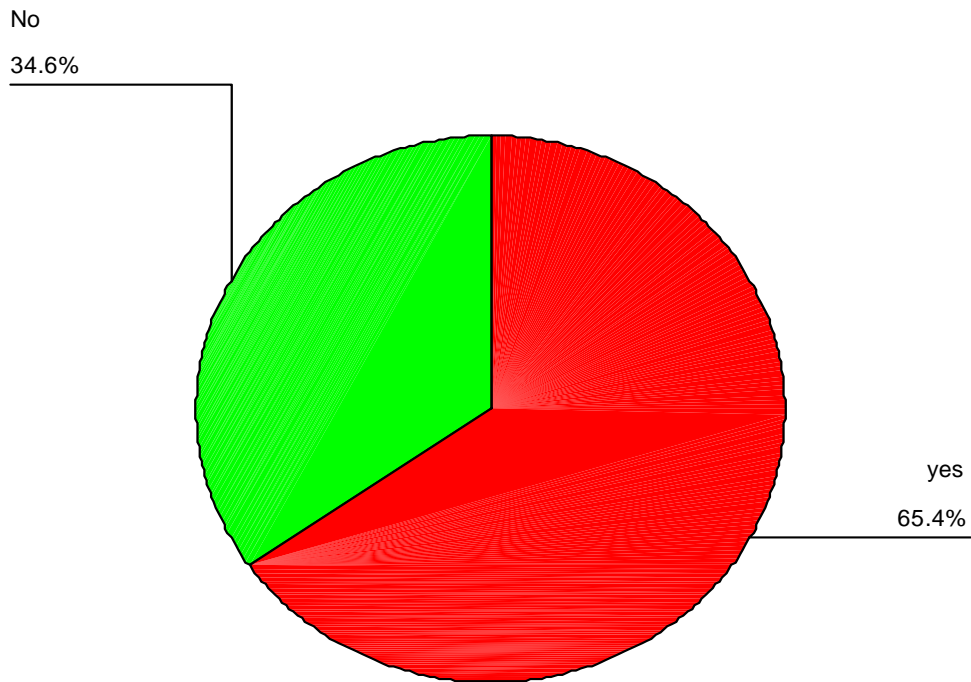


Fig (4.30) Close Water during Shaving

4.7.7 Shower

Regarding weekly average number of usage of the house shower for each member of a family summer and winter times, the results showed that, the average numbers of weekly bath is given in table (4.3).

Table 4.3 Numbers of weekly bath

Summer season	5-6 Time/week/person
Winter season	3 Time/week/person

And the average no of weekly bath in winter is equal 3 and average no of weekly bath in summer equal 5.6, as shown in figures (4.31 & 4.32). It is noted that, a large quantity of water is wasted during taking a shower, due to a lack of public awareness, also majority of water consumers are not using special types of shower head which can help in minimizing water waste during showers.

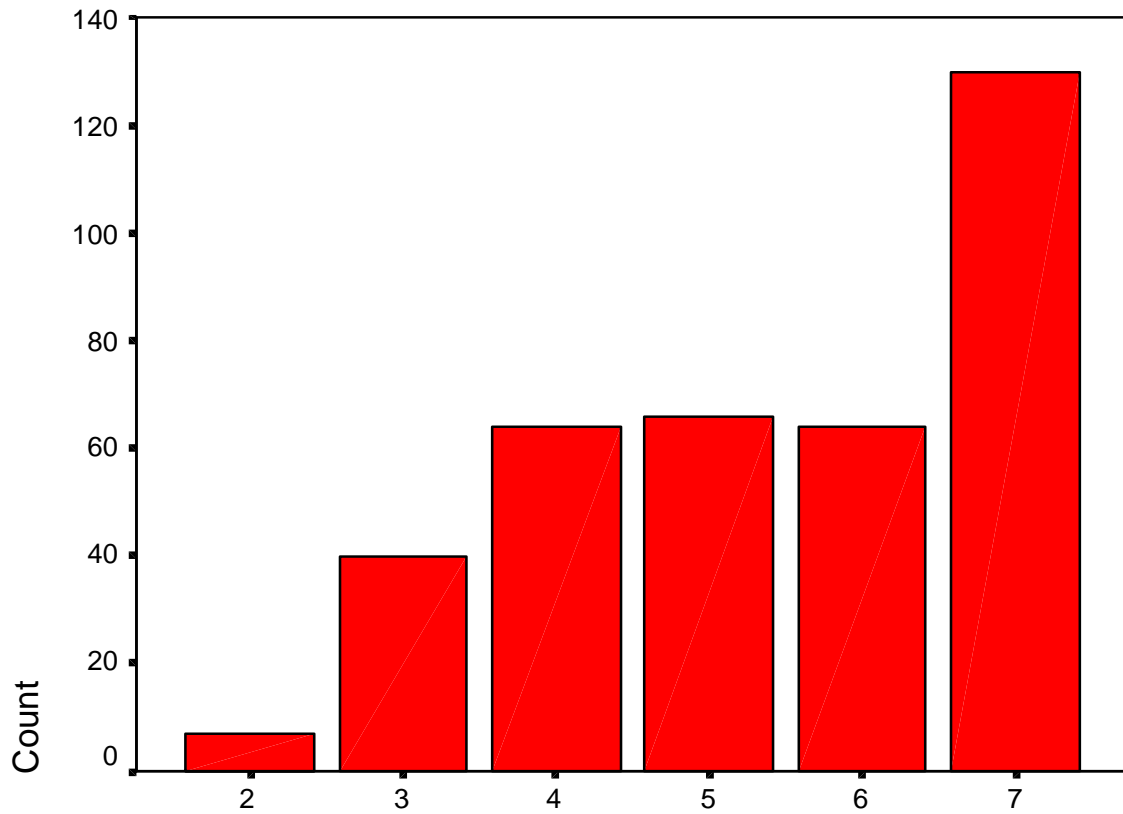


Fig (4.31) Weekly Baths in Summer

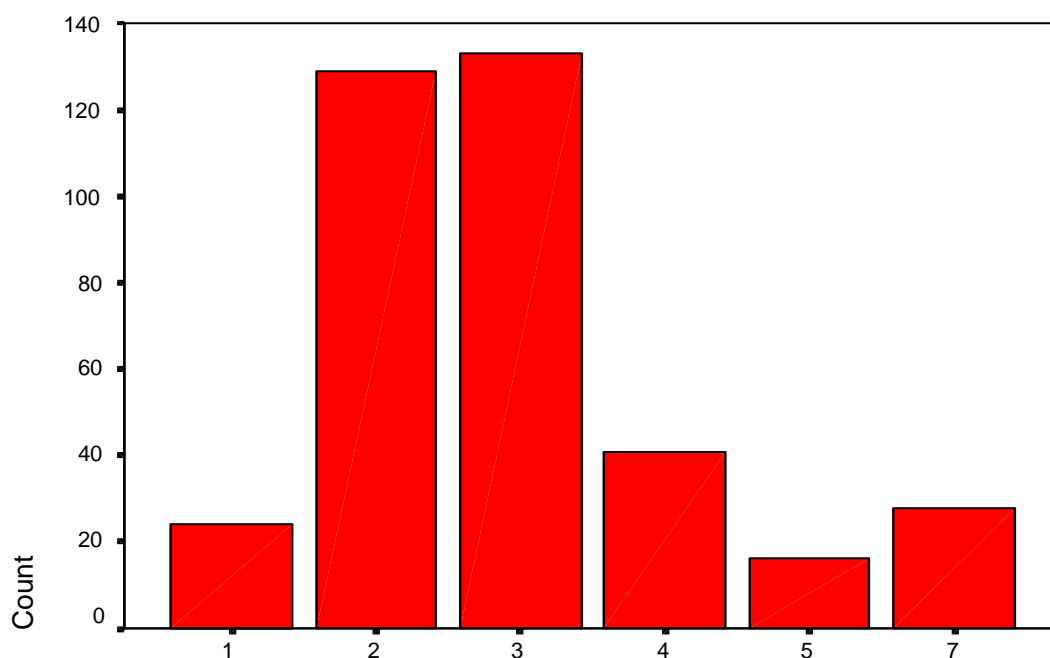


Fig (4.32) Weekly Baths in Winter

Regarding whether shower continuously running during the duration of bath we found that, approximately (78%) of the samples individuals does not close the showerhead while taking a shower, while approximately (22%) close the showerhead.

Regarding the average time used for the individual, the results showed that, the average of shower time is equal 15 minutes per shower.

4.7.8 Bathtub

In reference to the question if there is any bathtub inside your apartment, the results showed that there is approximately (78%) of the sample individual have bathtub in their apartment, and approximately (22%) do not have.

Concerning the question, how many times each family member uses the bathtub weekly, the results showed that average number of weekly bath tub usage equal (1.3) time for each person per week.

Regarding whether it's possible not using bathtub inside house, the results showed that, although approximately (75%) of the samples individuals whom has a bath tub said they can drop off from their houses as shows in figure (4.33).

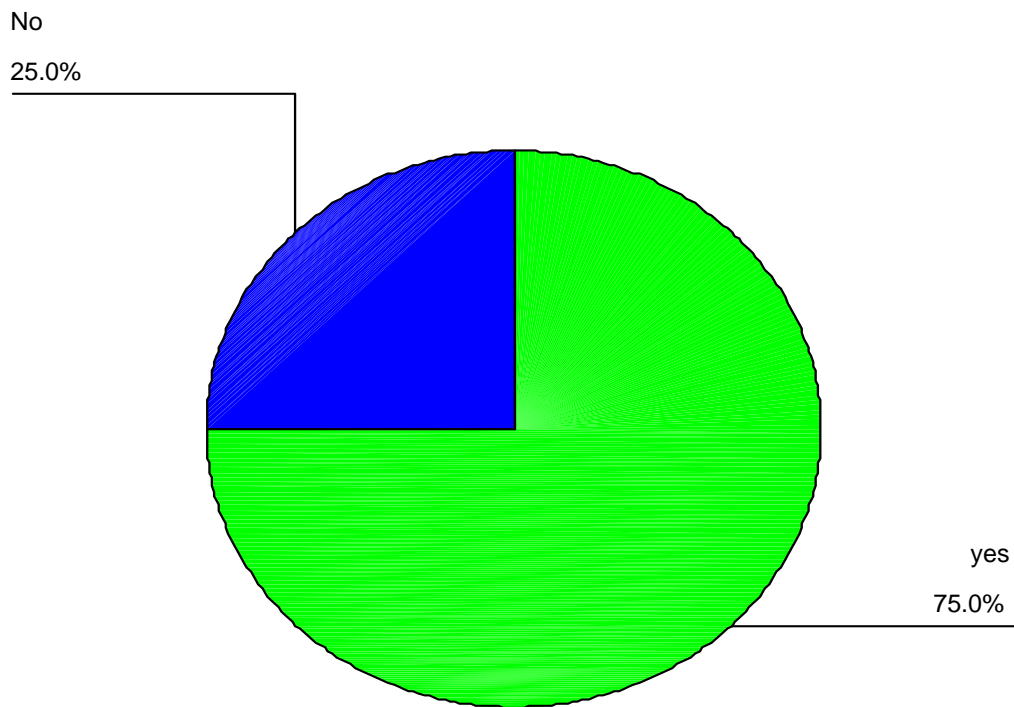


Fig (4.33) Bathtub be Removed

Regarding the reuse the water accumulated in bathtub after shower for house cleaning or toilet we found that, there is no significant reuse and utilization of the bathtub. Even though the survey shows that (90%) of the samples individuals don't benefit from the reuse of waters bathtub also (10%) do benefit, which is shown in figures (4.34 & 4.35).

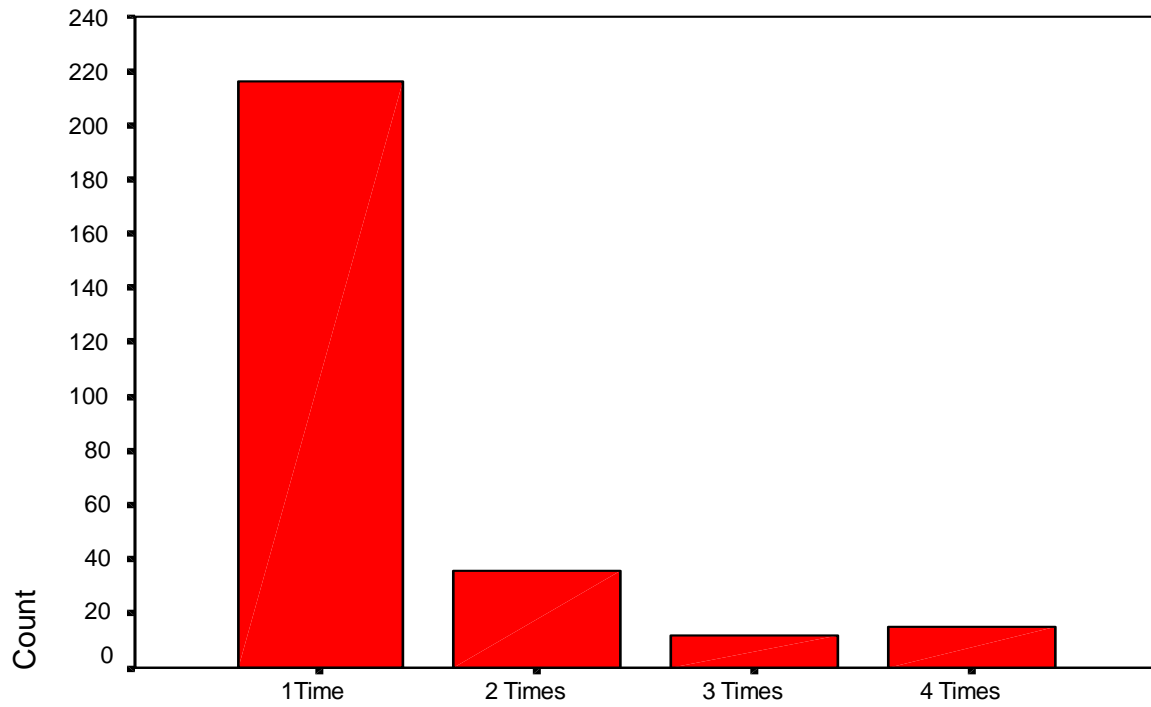


Fig (4.34) Weekly Bathtub Usage

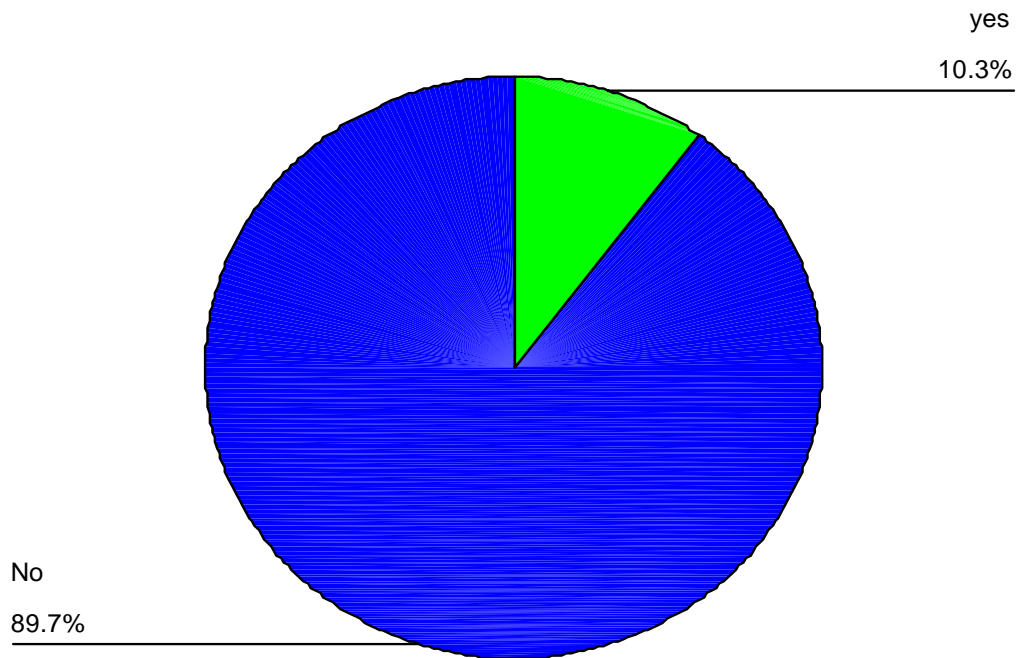


Fig (4.35) Reuse the Bathtub

4.7.9 Washing Machine

Regarding the type of washing machine in your house and how many times the washing machine utilized weekly we found that, (57%) Some of the samples individuals use an automatic washers machine, (19%) Some of the samples individuals use a semi-automatic Washers machine and (24%) Some of the samples individuals use a regular Washers machine and the average number of washing cloth per week to each family is equal (3.4) as shown in figureS (4.36 & 4.37) time per week some citizens are using automatic washing machine, which consumes a large quantity of water, also it was noted that no record for any related studies or research about the suitability of these machines to our society in spite water crisis in our region.

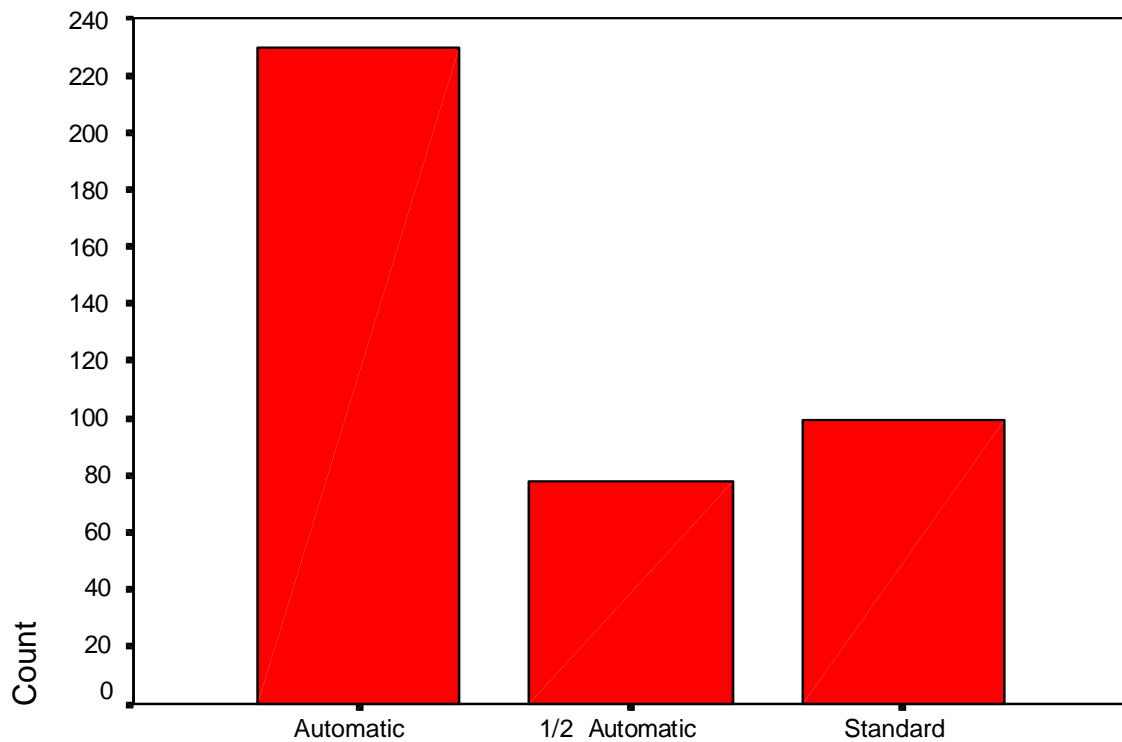


Fig (4.36) Washing Machine Type

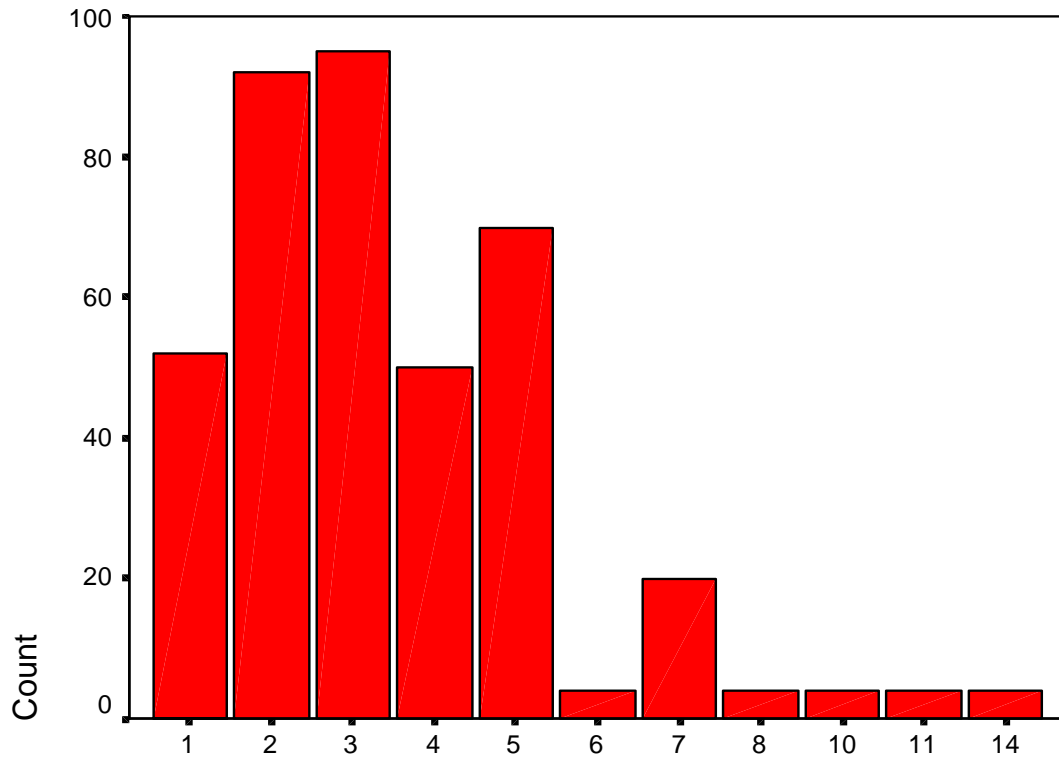


Fig (4.37) Laundry Times

Concerning reuse the water accumulated from cloth washing or house cleaning, toilet or ...etc, the results showed that. There is no reuse of the washer's water in an active way, even though (89%) of the samples individuals don't benefit of reuse the washer's water, while (11%) of the samples individuals do benefit, as shown in figure (4.38).

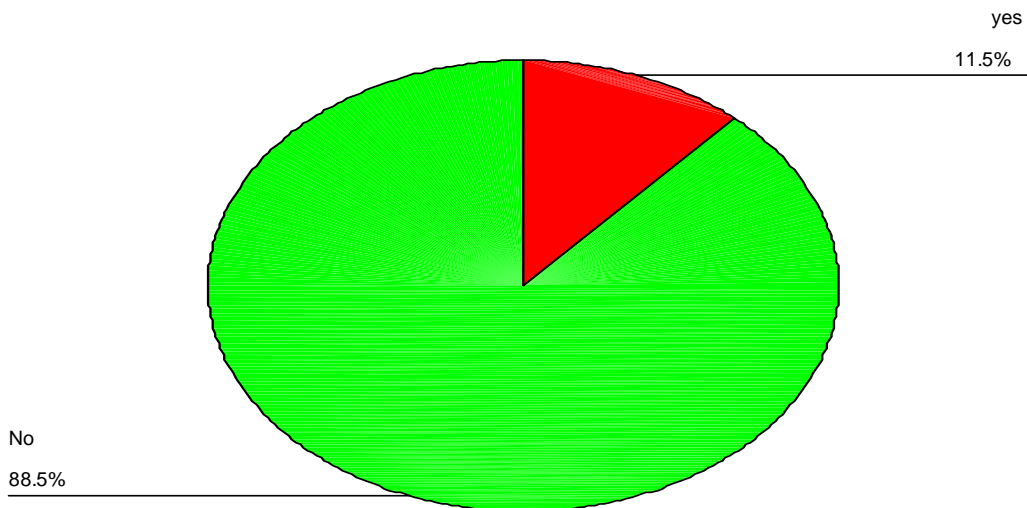


Fig (4.38) Reuse the Washing Machine

4.7.10 Garden Irrigation

Concerning if the consumer has garden in the house and how do irrigations your garden we found that (51%) of the sample individuals have a house garden, but (49%) don't have, (63%) Some of the samples individuals do irrigations by a hose, (15%) Some of the samples individuals do irrigations by a bucket also (6%) Some of the samples individuals do irrigations by a sprinkler and (16%) Some of the samples individuals do irrigations by other things, as shown and demonstrated in figures (4.39 & 4.40).

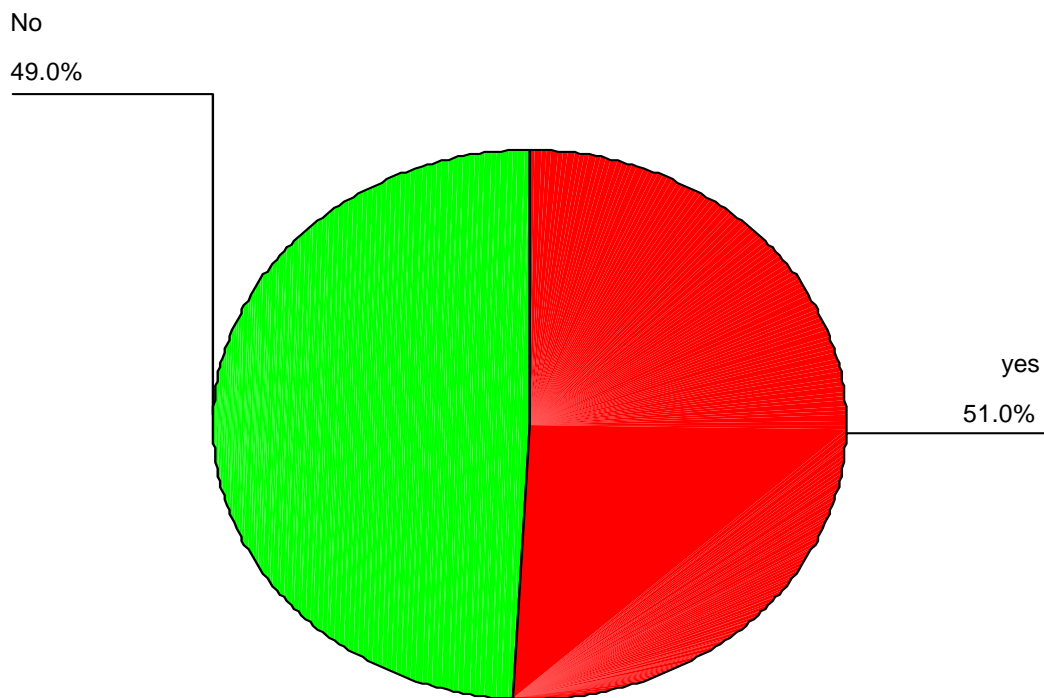


Fig (4.39) Garden in the House

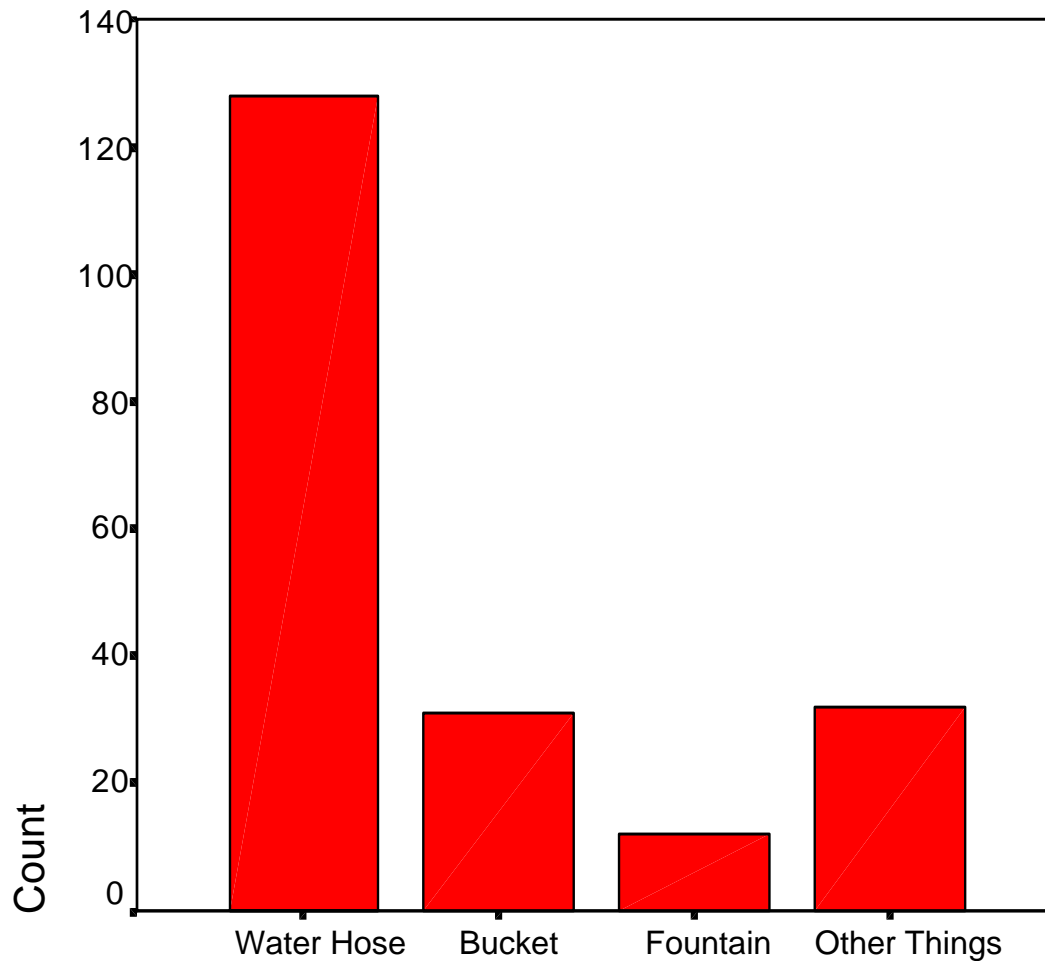


Fig (4.40) Garden Watering

4.7.11 Car Cleaning

Regarding whether the consumer has private car and the way wash cars, how many times do you wash your car per month we found that, (51%) of the samples individuals do not have cars and (49%) they have, the way of washing cars is as follows: (62%) of the samples individuals use a hose while washing cars, and (38%) of them use a bucket, the average numbers of cleaning car is equal (2.6) time per month, which is shown and explained in figures (4.41 - 4.43).

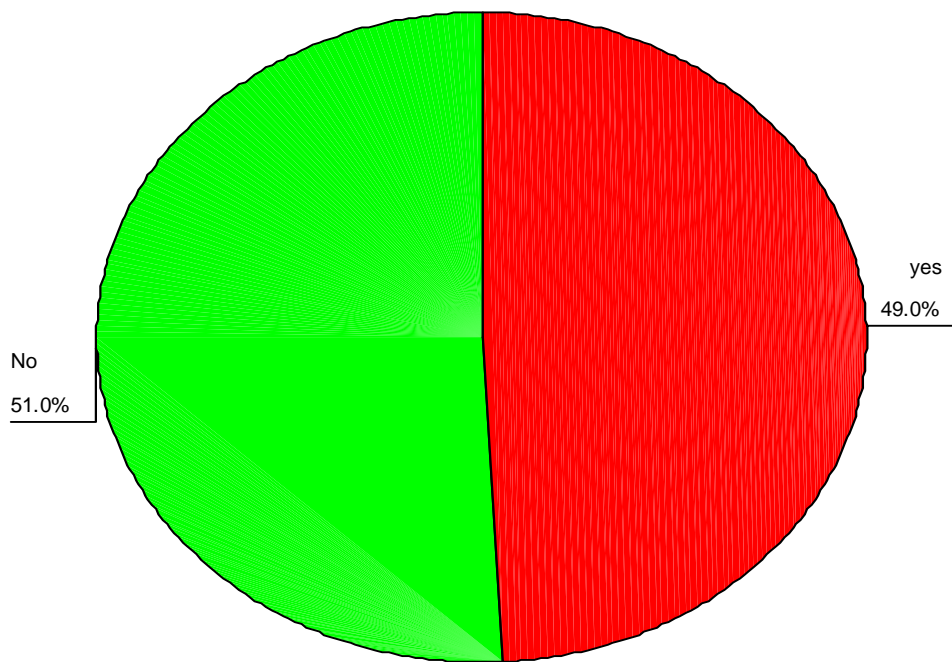


Fig (4.41) Do you have a Car

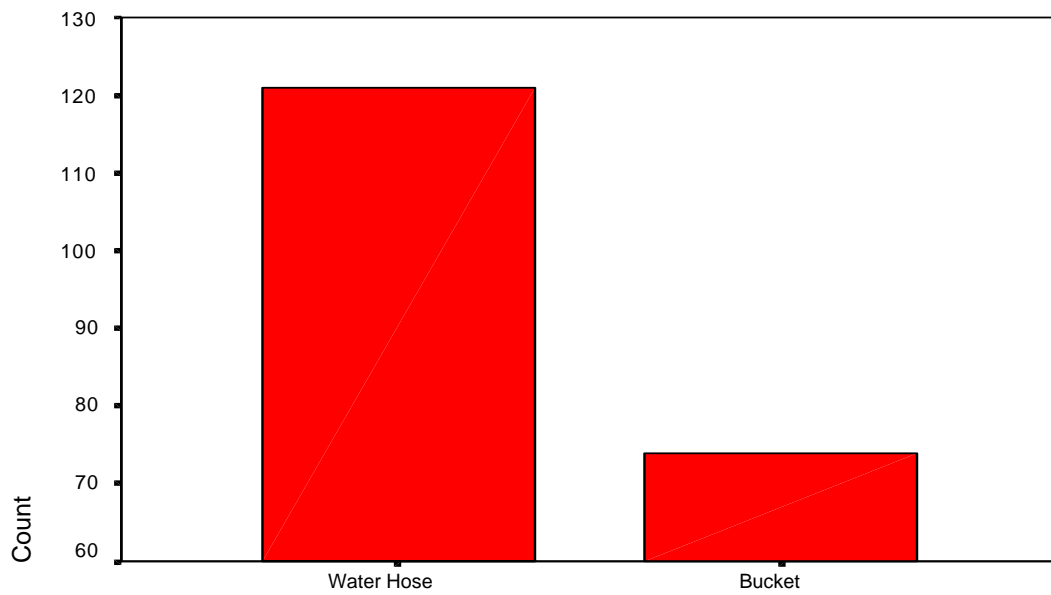


Fig (4.42) the Way to Clean a Car

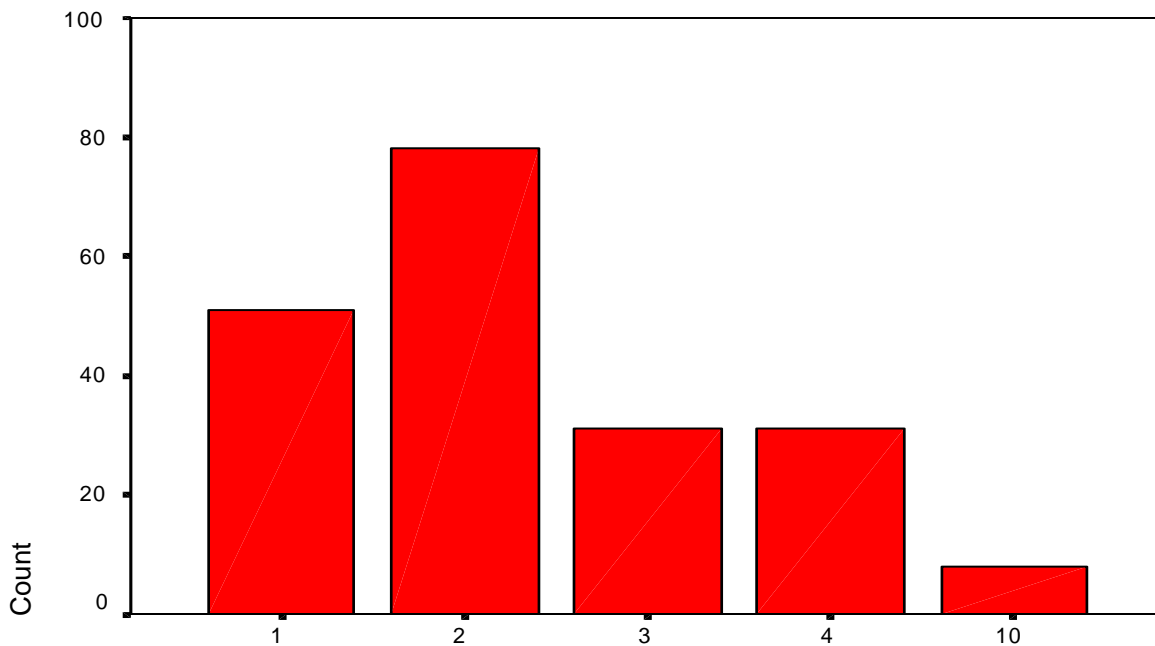


Fig (4.43) Monthly wash

4.7.12 Water Sewer System

Regarding the type of waste water sewer networks in your house we found that (79%) of the samples individuals take advantage of a public sewer network, while (21%) of the samples individuals using a septic tank, as shown below in figure (4.44).

With the infrastructure development of implementing sewer system instead of septic tank, citizens are encouraged to consume more water in contrast of. Septic tank, since the septic tank will quickly and easily can fill up, in addition it is more expensive to suck it.



Fig (4.44) Waste Water Sewer

4.8 Reaction of Consumer with Researcher:

4.8.1 Information Collection

In reference to the question of whether consumer can help in the process in collecting information about water quantities through we found that, information or database regards the water management request the results was (46%), the percentage of the samples individuals don't want to help of collecting information, while (54%) of them want to help by the following, (16%) of them by the inter net, (17%) of them by the phone, (20%) of them by the other ways.

4.8.2 Paying Small Portion

Concerning the consumer if he can help in paying small portion of poor or needy people's bill we found that regarding the social mutual support fund, it was noticed that (43%) of the sample individuals showed an interest in paying a small portion to be used towards paying some of the poor families bill, while (57%) expressed no interest in doing such that, as shown in figures (4.45 & 4.46).

Regarding the question of whether the consumer is willing to pay an extra amount of money which can be applied towards paying a water bills for the needy users, majority showed their willingness to do so, which is a positive attitude coming from the Islamic religion which required Moslems to pay their charities and donations regularly in order to help others. Clearly, religious causes are the main power derive for Arabic World

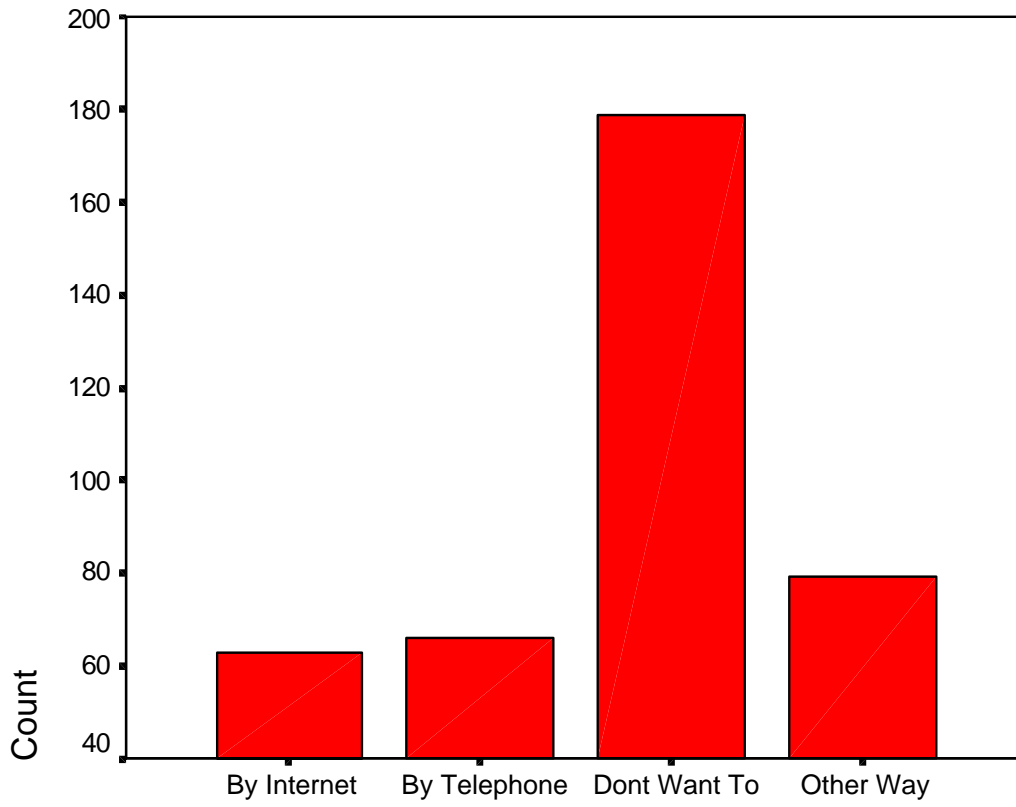


Fig (4.45) Help with Water Information Collection

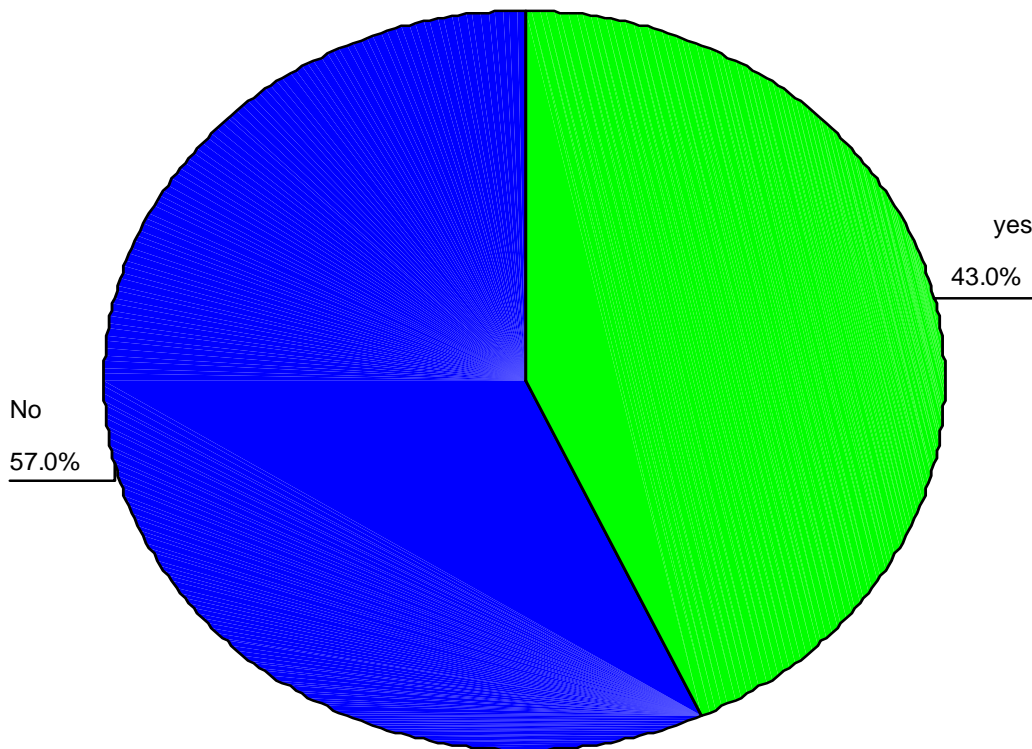


Fig (4.46) Help with other Water Bill

4.9 Must Take Some of the Actions:

To reduce the use of some of the fixtures inside the house

4.9.1 The bathtub

- There is approximately (78%) of the sample individual have bathtub in their apartment, and approximately (22%) do not have.
- Although approximately (75%) of the samples individuals whom has a bath tub said they can drop off.

4.9.2 Type of Washing Machines:

- (57%) some of the samples individuals use an automatic washers machine
- (19%) some of the samples individuals use a semi-automatic washers machine
- (24%) some of the samples individuals use a regular washers machine.
- The average number of washing cloth per week to each family is 3.4 time per week

4.9.3 The Irrigation System

- (63%) some of the samples individuals do irrigations by a hose.
- (15%) some of the samples individuals do irrigations by a bucket.
- (6%) some of the samples individuals do irrigations by a sprinkler.
- (16%) some of the samples individuals do irrigations by other things.

Also we do have reached some of the important results, that we will need to accomplish abase of information (data base).

- The average of shower time is equal 15 minutes per shower.
- The average number of weekly bath tub usage is 3 time person per week
- The average number of family equal (6.7) person.

4.10 Effect of the Instructions on the Consumers Behavior

After the distribution of survey questioner to water users in Gaza city in addition to a brief awareness brochure that comprising guidance and directions for better usage of water. Another set of questions were give to consumer for the purpose of extracting their reaction towards the above mentioned guidelines and awareness instructions which hoped and intended to improve some of their practices in water usage and consumptions, and the outcomes as follows:

4.10.1 Statistical Method Used for Consumer Behavior

Two related sample test have been done using the (SPSS). It relates cases before and after the instructions.

4.10.2 Add Colored

(49) Out of (139), consumers said they will add color material to their toilet tank, which is (31%).

Frequencies

			N
Water lose in bathroom -	Negative Differences	a	0
Water lose in bathroom	Positive Differences	b	49
	Ties	c	90
	Total		139

4.10.3 Using the shower instead of the bathtub

(123) consumer out of (196), said they are using shower instead of bathtub, which is (62%).

Frequencies

			N
No of tub use -	Negative Differences	a	0
No of tub use	Positive Differences	b	123
	Ties	c	73
	Total		196

4.10.4 Sweeping the Floor Instead of Using the Water Hose

(88) Consumer out of (156) said they are sweeping the floor instead of using the water hose, which is (64%).

Frequencies

		N
House Cleaning after - House Cleaning	Negative Differences ^a	0
	Positive Differences ^b	88
	Ties ^c	48
	Total	136

4.10.5 Using the water Bucket to Clean the Floor Instead of the Hose

(85) Consumer out of (148), are using water bucket in cleaning the floor instead of water hose, which is (53%).

Frequencies

		N
House Cleaning after - House Cleaning	Negative Differences ^a	0
	Positive Differences ^b	85
	Ties ^c	63
	Total	148

4.10.6 Using Bucket to Clean the Car

(71) Consumer out of (154) said they using water bucked to clean their car, which is (44%).

4.10.7 Close the Water During the Shower

(143) Consumers out of (243) said they close the water during the shower, which is (59%).

Frequencies

		N
Close water during shower - Keep the shewar open?	Negative Differences ^a	0
	Positive Differences ^b	243
	Ties ^c	102
	Total	245

4.10.8 Cleaning the Fruit Inside a Bucket

(132) Consumers out of (208) said they was fruit inside water bucket, which is (63%).

Frequencies

		N
How fruit cleaning - How fruit cleaning	Negative Differences ^a	0
	Positive Differences ^b	132
	Ties ^c	76
	Total	208

4.10.9 Taking Shower for the Shortest Time

(137) Consumers out of (203) said they take shower minimum time, which is (64%).

Frequencies

		N
shower time after - Avarage bath time	Negative Differences ^a	0
	Positive Differences ^b	137
	Ties ^c	66
	Total	203

4.10.10 Using Valve to Close the Water During Shower

(165) Consumer out of (267), are using water valve to close the water during shower, which is (57%).

Frequencies

		N
Use shower stabilaizer - Keep the shewar open?	Negative Differences ^a	0
	Positive Differences ^b	165
	Ties ^c	102
	Total	267

4.10.11. Reasons and Arguments to Water Demand Management

The feedback of several surveys and interviews with water's consumers in Gaza city reflects the following interesting findings:

- (58%) of water consumers said, it's due to a religious reasons, that make them to pay attention and utilize to WDM and (42%) of water consumers, said, it's an economical and national reasons, behind utilizing WDM, as shown in figure (4.44).

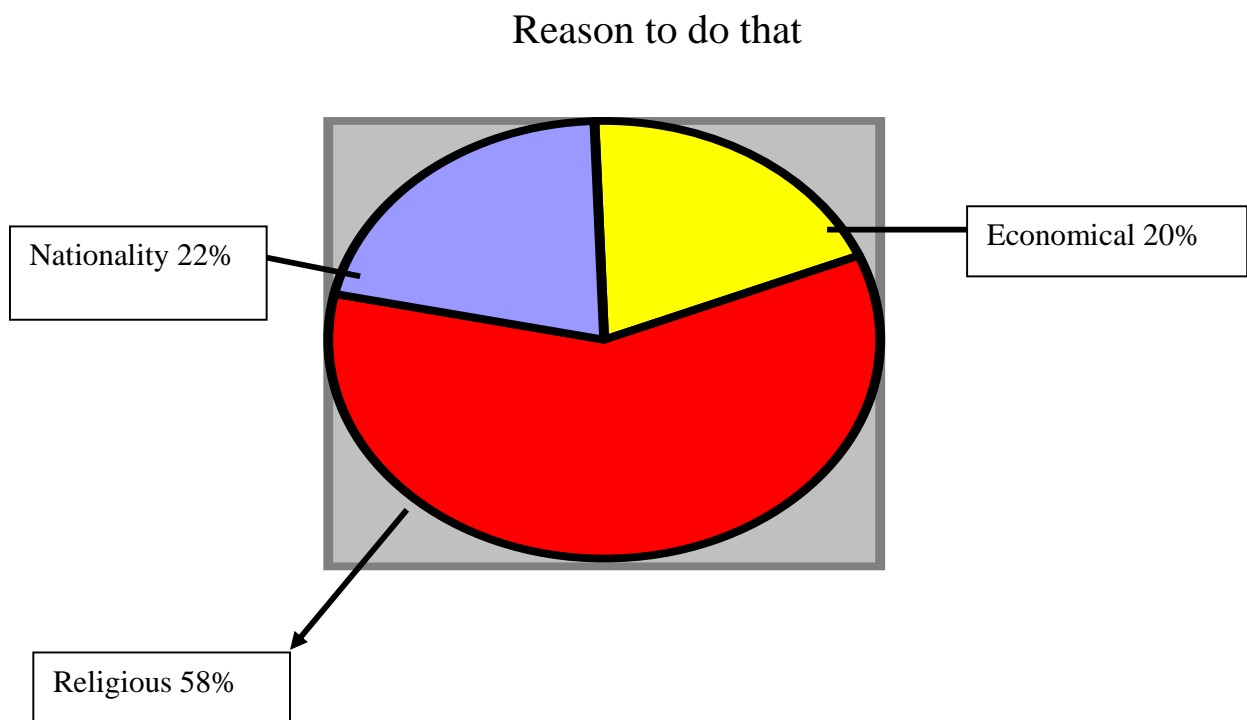


Fig (4.45) Reason to do that

4.12 Discussions

As a result from consumer's surveys, we can summarize the following important results:

First, the bill price doesn't force the customer to direct and control the water usages (water price includes the cost, maintenances, labor and operation), and it is clearly that the consumer doesn't feel the real water shortage crisis.

Second, there is a problem in water quantity and continuity, that reaches households; and this explain the reasons behind the availability of water tanks in all apartment.

Third, it is obvious that there is no control, monitoring, and follow up for meters check up, this can lead to a large quantity of water consumption.

Fourth it is obvious that there is a general trend to use modern water technology in consumers daily life as using showers for long times in household in addition to the use of full automatic laundries and bathtubs.

Fifth, the consumer's trends to follow up a convenient measures such as, rinse of vegetables and fruits directly under water tab, also cleaning the apartment, watering gardens, and washing cars using water hose.

Sixth, with respect to water reuse in house hold, there is a small portion of water consumer's trends to reuse water in their daily use.

Seventh, there is a small portion of water consumers want to participate in a mutual support.

Finally, according to the surveys that described the effect of the instruction on the consumers behavior, it is clear that awareness programs plays an a active role in improving and directing consumers the trends and bad behaviors of the consumer, so we should concentrates on awareness in our WDM programs. The interesting thing is that, the above obtained research results and findings confirm that the religious causes are the main power derives for Gaza city population.

Recommendations

As a strong recommendation and based to previous discussion, it is obvious that there is an urgent need for the following activities:

- 1- Public awareness campaigns, should be made as this research concludes with strong recommendation of an establishment of WDM, along with following urgent related activities:

- Awareness and promotion
- Education and training
- The formulation and application of implementation incentives to influence the demand for water.

Bill Design

- Should include number of consumers per each water meter
- Restudy of price slides (Ghannam,M2004)

Awareness

- Awareness should be a regional awareness
- Awareness should be concentrated on woman
- Awareness should be through schools and universities.
- There should be a continuous follow up and the feedback of each campaigns, should be recorded for the benefit from it and study its effect on consumers behavior.
- Suggest an installation of private water meter for each apartment where PWA can help in that for instance, by waving the application fees and or installation for new customers.
- Suggest of continuous public awareness through mosques, houses, and schools.

CHAPTER FIVE

Key players in Gaza Water Demand Management

Some questionnaires has been developed and distributed for some governmental agencies such as PWA, and Gaza municipality to investigate the extend efforts that invested towards WDM. In addition some interviews were conducted with some officials with above mentioned agencies.

5.1 Data Collection

Various data and information were gathered related to water demand from different water institutions as PWA, Gaza municipalities and consumers etc.

The collected data comprise annual rainfall, water pricing structure, domestic water demand and metering system.

5.2 Gaza Municipality and Palestinian Water Authority Interview

A set of questions were designed and developed for the main WDM agencies in Gaza city as an important component for this research in reference to their response.

The following feedback is obtained from the different surveys which were conducted to PWA, and Gaza municipality as shown in table (5.1).

Table 5.1 Gaza Municipality and Palestinian Water Authority Interview

Question	PWA	Gaza Municipal
1- What are your policies and strategies for water demand in your organization?	No records for special policies conceiving WDM ,but there is polices for water division in general	Not available, only meter, a distribution will be conducted to different areas through the control of certain valves, which will be opened and then shut down.
2-Are these policies and strategies are implemented in Gaza city?	No, but it's implemented in a small scale and partially due to the absence the law	In some certain times, these policies will not implemented due to lack of water as well the lost portion of it.

3-If the answer is No, why not?	Due to the absence of a law	
4-Is there any financial support for water demand management for the water?	No, there is no such system	They have Health department
5-What are the resources of financial support for a management request for the water?	Not available	Not available
6-What is your organization role in the area of public educational and guidance, and to what extend your follow up and evaluation system is working?	There is a role in the agriculture sector. Not available for house use	Due to the current situation, there is no activity in this regard.
7-Did your organization ever tried to use the price of water as a mean to better guide the usage of water?	There are studies but it's not implemented	No
8-If the answer is no, why not?	The reason is due to the current economical situation and also the absence of the regular bill.	Not available
9-What are the control means used to better guide the usage of water?	Not available(N/A)	Not available, only meter, a distribution will be conducted to different areas through the control of certain valves, which will be opened and then shut down.
10-What are the monitoring means used to better guide the usage of water?	Not available and not implemented as well.	Not available
11-In your opinion, what are the best methods for collecting information to be utilized in Data Base for the study of W-End Use?	Not available(N/A)	Meters readings
12-Is there any scientific studies were done related to this subject?	Yes, a study was done by WSSPS company, but it is not implemented yet.	NO

13-What do you think of establishing a Water Demand Management Unit, and why you think it's important?	Is not exists yet in the Authority of Palestinian Water,	There is no special budget in order to activate this administration, as well the traditional classical style of Governmental work.
14-What are the standards needed for the actual cost of cub/ liter of water?	labor, administration, maintenance, purifications	Electricity cost, Transportation cost, labor, administration, maintenance, purifications
15-A study of possible establishing a task force for making some changes in the technology used.	It's possible to do it with some other potential partners, for example some studies was conducted by (BECDAR)	It's possible to do it with some other potential partners
16-Whats possible establishing a task force for educating the public awareness in different communities within Gaza city	It's possible to do it with cooperation with some organizations that has similar interest , such as (school , women unity)	It's possible to do it
17-The possibility of conducting a study for reusable of washing machines water to feed the toilet systems	It's possible to do it with cooperation with some organizations that has similar interest , specially with Gaza municipality	The cost in this case will be more than the cost of purifications and filtrations.
18-Redesign the bill so that it includes the consumes number for each meter	Gaza municipality	Currently not exists , but it's a good idea to be implemented
19- Make the bill (3 NIS) or the bill in the other design	Gaza municipality	It's impossible in case of the continuity of the quality of water as well the quantity of it.
20- The bill must include warnings and penalties when a customer exceeds the usage of allowed quantities of water (80 Liter/person) and then move the customer to a more expensive price.	There are segments within consumption which increase by consumption in G. M	There are segments within consumption which increase by consumption

21 -Water Demand Management Unit must maintain a complete system in analyzing data from previous years and analyze the new items that the change study brought up and then try to forecasting the future of this project, which will help in making good and successful planning for the future	This can be done through the administration unit of water resources of Authority of Palestinian Water	This can be done through the administration unit of water resources of Authority of Palestinian Water
22-Studies of the average for daily usage and consumption as well monthly and yearly (it must has documented reports)	Yes its exists	There is a monthly report for the last eight (8) years in Authority of Palestinian Water
23-The average usages and consumptions of a house, School, hospitals and public gardens.	Not available, due to the existence of private wells which supply these organization	Meters were installed for all of the public organizations, in order to know the actual consumptions2005.
24- What are the percentage of the customers who usually paying their bill?	There are a report for each two months (for each bill cycle)in G.M	There are a report for each two months (for each bill cycle)
25-Reasons for not paying	- The economical situation - The current disorder situation in the territories	- The current bad economical situation - The current disorder situation in the territories
26- Is there any relation between the current economical situation and the quantities of consumptions?	Yes there is direct proportion such as:	Yes
27- Information about leakage, measurements and follow up.	Total billed quantity/ Total produced quantity	No flow up

5.2.1 Gaza Municipality and Palestinian Water Authority Interview Results

1. Some written policy, strategies and objective without any implementation of policies and strategies related to WDM, but there are other policies and strategies for water in general, which can be summarized as follows:
 - Managing water as an economic commodity is an important way of achieving efficient use, encouraging conservation and protecting water resources.
 - Save water and reduce the wasteful rate.
 - To improve the efficiencies of water use in irrigated agriculture through adopting the proper technologies and strategies.
 - To develop improved water supplies and cropping systems to better utilization of water resources.
 - To develop legislation system aims at restricting water extraction.
 - To protect aquifer from non-point pollution resources.
2. There is a financial support for water division in general, but no such support for WDM.
3. There is a study, which was concluded for the increasing prices for water consumption in order to support WDM. But the water authorities indicated that currently it will not be able to implement any policies related to prices increase during this current hardship economy.
4. Municipals do not have any mean or mechanism to monitor or control water's consumption, except close and open switching valves for few hours.
5. No record for continuous on going public awareness for WDM.
6. There are certain special meters for public buildings, such hospitals, schools, but not for all other companies' buildings.

5.3 Water Meters Interviews

Some interviews were conducted with some water meters officials, and the outcomes and the official responses are as follows:

1. There are schematic diagrams available for the major and minor water meters networks in the area.

2. The major water meters and the minor ones are both accurate and reliable, but no record exists of regular follow up for these meters.
3. The following table represents types of water meters used in Gaza and the percent usage of each one of them as shown in table 5.2

Table (5.2) Types of Water Meters Used in Gaza City

Type of Meters	Number of Meters
Arad	80%
ABB	15%
Socam, Precifello	05%

4. The following table (5.3) presents technical specifications of the meters used in Gaza city.

Table 5.3 Technical Specifications of Waters Meters

The pressure Test	16 Bar
The maximum average of continuous flow	5 m ³ /hr
The minimum average of continuous flow	200 Li/Hr
The minimum average of flow that the degree of accuracy is $\pm 2\%$	50 Li/Hr

5. Concerning the accuracy of house water meters, it was noted that there are no regular check up for such thing.
6. No indication of any measurements for the leakage within the customers' meters.
7. No standard procedures or any mechanism used in checking.
8. Standard specifications and procedures are followed (such as ISO 4064) in the installations of these meters.

9. Regarding the regular period for the municipal of Gaza city to replace old meters by brand new ones, it was noted that it is not restricted, bounded or limited to specific time or period.

5.3.1 Water's Meters Questioner Analysis

During discussion meeting with the authority responsible for water's meters, their answers to our related questions were direct and frank as follows:

- Although main water's meters exist, but no such follow up to track down its accuracy, also no such mechanisms for mentoring either water network or the meters map or network inside town.
- No specific mechanism for either regular or random check up inside houses except when user contact municipal, also they do not have any certain method for testing houses meters to know the water's leakage measurement.
- They indicated that they are following certain standards and specifications for meters installations and that is (ISO 4064), on the other hand no specific time limits for replacing meters.

Also the metering sample questionnaire survey showed the following two major concerns:

- There is no indication for any mechanism to follow up and mentoring for water's meters inside the Gaza city houses.
- There is no indication for any efforts to mentoring and following up with Water's meters networks that exist within the population zones of Gaza city, which if exist may help in knowing the quantity of water as well the leakage inside the Gaza city.
- Concerning the types and kind of meters used, they are three types, which was not studied and analyzed to know its exact accuracy.

CHAPTER SIX

WATER FIXTURE & DEVICE MARKETING

Some data was collected related to water fixtures and devices from sales representatives; moreover several interviews took place with different individuals.

6.1 A general Survey for the Water Device Marketing Identities in Gaza City for Fixture and Device

The researcher investigated all the related components. That has direct relation with WDM, among that are fixtures which help us in using water through different types. The aim of that is to establish a linkage between quality of fixtures and WDM, therefore several questionnaire surveys were distributed to the sales representation of fixture while was filled is based questioner survey to them on presenting, during our meeting with them, and the results come out as follows:

1. Not all fixtures available in the market having high quality.
2. The consumers normally prefer fixtures that have good brand name.
3. Also the consumer normally prefers fixtures that have good price tag.

6.1.1 Toilet

Toilet types according to quality	Size(L)	Price	Quality	Average sales	Source
Lovski	4.5	85	Excellent		Israel
Katy	4.5	110	Excellent		Israel
Ramallah	4.5	70	Good		Ramallah
Sbadeeni	4.5	75	Good		Israel

- It is possible to import toilet with a size less than (4.5) liter, as long as it will not be less than (4) liter, and the problems and troubles that may phase this suggestion is that, if the quantity of water was less than four (4) liter, it will not be enough to go through the full cleaning cycle which originally it was designed for.

6.1.2 Faucets

About the faucets types according to quality as:

Faucets types according to quality	Price Israel	Quality	Source
Hama	24	Excellent	Israel
Yooham	16	Good	Israel
Icon	16	Good	Israel
Chinese Product	10	Not good	China

- Regarding the existence of valve control for faucets, it was noted that neither there is a valve control nor any types are known for such thing.
- It is possible to import other types of faucets that have high quality, for the following reasons:
 1. The Chinese product not reliable, has a lot of failures
 2. The quality of the structure materials for this product is bad.
 3. Easily and quickly can be broken in addition it has a water leaks.
- Also in this regards , the following suggestions are important:
 1. Establishment of a center for quality testing and certifications, where thiscenter has a role of a management over a production and import of such a product.
 2. No record of any study about the usage and utilizations of fixtures

6.1.3 Showers

Showers types according to quality	Price (NIS)	Quality	Source
Hama	18	Excellent	Israel
Icon	12	Good	Israel
Yogam	12	Good	Israel

The following notes are important:

- No indication of a valve control for showers.
- Regarding the types for these valves, Hama company was able to design a removable head in the shape of a cylinder, that can rotate while it is in position, which can enlarge and minimize the passage of water, during the duration of showers.
- Also it was noted that it is not possible to import other types of faucets that have high quality.
- Similarly it was not possible to import other types that have a relatively less consumptions.

6.1.4 Washing Machines

Machines types	Average of water consumptions (Cup/Cycle)	Price	Quality	Average sales	Source
Full Automatic	50	\$ 400 – 700	Good	Relatively Low	Germany, China, Egypt
Semi-Automatic	25	200 - 400	Good	Relatively High	Germany, China, Egypt

The following issues are important and essential in the selection and usage of washing machines:

- Instructions available in the user's manual (Catalog) that related to the usage of these machines and that can help in minimizing the quantity of water used.
- The reflections on the improper ways of consumers use to these machines, which consume a large quantities of water, according to the maintenance and services that sellers can provide to customers.
- Whether it is possible to import a good quality of washing machines that can consume a relatively less quantity of water.

6.2 After Meeting the Marketing Agents in Gaza City the Interview Results as Follows:

1. Fixtures and device are available in different kinds and brand names such as (Turkish, Ram Allah, Egypt, Israel, China).
2. Consumer purchase health equipment on pricing bases and according to his understanding, the price means quality.
3. Citizens depend while buying fixtures on plumed and sales person advices, also it was noticed that citizen prefer to buy Israeli products, sales representative don't know the average water consumed by fixtures.
4. Fixtures available in the market have problems as water leakage.
5. Fixtures have no control valves or switches for average quintets of consumed water.

6.3 Education (School, University) Questionnaire

As an essential and important part of this research, a several visits to different school zones were executed for the purpose of investigating the issue of WDM, the outcome of these visits and meetings were very disappointed, as headmasters mentioned, which can be summarized as follows:

- They never received any awareness publication or brochures in reference to WDM.
- They expressed their concerns of quality of water, which is un filtered and can be considered un healthy for drink.

CHAPTER SEVEN

CONCLUSIONS AND FUTURE RESEARCH DIRECTIONS

Summary

This chapter presents the findings of study, which clearly show that the citizen behaves in reference to indoor water as if no crisis or sharp shortage for water within the city of Gaza. The consumers is not feeling the magnitude of the water problem since water is available in the house around the clock, in addition to the use of nice fixtures that equipped with high technology. Also no restriction on water prices or penalizing customers with an excessive record of water use. Clearly it was noted that there are a great deal of laziness and carlines among governmental related authorities in the area of WDM.

The survey responses and outcome shows the following issues and concerns:

The average number of building per water meter is equal 1.7 and the average number of apartments per water meter is equal 2.3.

Regarding the consumer's thought and opinion for the quantity and continuity of water that reach in the house, the results shows (60%) of the sample is satisfied about water quantity that arrive their apartments, whereas (34%) are not satisfactory.

Concerning whether the related authorities perform regular waters meter's check up we found that, is not satisfactory. (72%) of the water meters are not checked by any related agency. Also it is clearly shows that there is no control, mentoring, and follow up for meters check up.

Concerning consumer participation in lectures, seminars, or workshops concerning water consumption awareness, the results showed that, there is defection from related agency in water use awareness, where about (94%) of the sample didn't receive any handouts and about (90%) of the sample didn't attend any meeting

Concerning who is performing house duties the results showed that, it was clear from the individual samples that the woman is the main component of performing house duties

such as (87%) of housework is done by woman and (11%) is done by both housewife and husband, and (2%) other

Regarding the fruits and vegetables that washed in house, the results showed that, the way of washing fruits even though their (66%) of the samples individual's acts by washing fruits directly beneath the faucets tips. On other hand (34%) of the sample individuals washes fruit into a bucket, and also its important to mention that approximately (90%) of the samples individuals don't reuse the fruits washing while (10%) of the samples individuals reuse the fruit washing water.

Concerning the existence of problem in internal water network, the results showed that, (85%) of sample individuals do repair water supplies fast while (15%) do not.

Regarding weekly average number of usage of the house shower for each member of a family summer and winter times, the results showed that, the average numbers of weekly bath , the average number of weekly bath in winter is equal 3, in summer equal (5.6). Regarding whether shower continuously running during the duration of bath we found that, approximately (78%) of the samples individuals doesn't close the showerhead while taking a shower, while approximately (22%) close the showerhead.

And the average of shower time is equal 15 minutes per shower.

The results showed that there is approximately (78%) of the sample individual have bathtub in their apartments and approximately (22%) do not have, also the average number of weekly bath tub usage equal (1.3) time for each person per week, and approximately (75%) of the samples individuals whom has a bath tub said they can drop off.

Regarding the type of washing machine in houses, we found that, (57%) some of the samples individuals use an automatic washer's machine, (19%) some of the samples individuals use a semi-automatic Washers machine and (24%) some of the samples individuals use a regular Washers machine and the average number of washing cloth per week to each family is equal 3.4 time per week

Concerning if the consumer has there garden in houses and the way of irrigations we found that (51%) of the sample individuals have a house garden, but (49%) do not have, (63%) some of the samples individuals do irrigations by a hose, (15%) Some of the samples individuals do irrigations by a bucket also (6%) Some of the samples

individuals do irrigations by a sprinkler and (16%) Some of the samples individuals do irrigations by other things.

Regarding whether the consumer has private car and the way wash cars, (51%) of the samples individuals don't have cars and (49%) they have, the way of washing cars is as follows: (62%) of the samples individuals use a hose while washing cars, and (38%) of them use a bucket, the average numbers of cleaning car is equal (2.6) time per month.

Finally, Some written policy, strategies and objective without any implementation of policies and strategies related to WDM, but there are other polices and strategies for water in general, which can be summarized as follows: Managing water as an economic commodity is an important way of achieving efficient use, encouraging conservation and protecting water resources.

To improve the efficiencies of water use in irrigated agriculture through adopting the proper technologies and strategies.

7.1 Conclusions

This thesis investigate the current WDM situation in Gaza city and the available tools which can be applied to control water demand in term of wise use of water under the existence of water shortage.

In fact, there are some important findings as:

- There is no systematic WDM program in Gaza city.
- There is no effective water pricing system to act as efficient WDM instrument.

Based on the responses of 407 consumer surveys.

- The majority of people which was represented by the survey have a broad support and satisfaction with practicing WDM measures under national programs driven by religious attitudes.

There is any governmental monitoring for importing water fixtures and devices in term of quality and, fitness for use; moreover there is not any details specification and standards for water fixtures and devices.

7.2 Recommendations

Based on the results and findings of the research, there are some deficiencies related to WDM activities, in order to improve and activate the current situation some recommendation were suggested as follows:

- It is recommended to establish WDM unit related to PWA as a regulator for water sector to be responsible for adopting, follow up water awareness raising, education and training programs for enhancing water use in Gaza city, these programs should be directed to water users.
- It is recommended to develop effective water pricing system reflect the economical situation of Gaza people in addition to be a good instrument for WDM.
- It must be a good cooperation between governmental water institutions as PWA, consumers and the public to ensure the success of any future water management program.
- Awareness program should focus on Household, Mosques in and universities.
- It is recommended to put incentives for consumers who are not exceeding a certain limit of water to encourage them for following WDM measures.
- Continuous public awareness and monitoring is important for public institutions and users.
- It should be activate WDM researches especially for consumer use to identification of the actual factors which influence on it.
- It should be regular monitoring for metering system for all water users (domestic, commercial and industrial).
- It is highly recommended to establish water data bank in related to PWA.
- Suggest an establishing of a computerized data base for customers, where this data base can contact consumers, either by sending an e-mail or by an automated phone messages which can be displayed as a message in the mobile and or regular phone call.
- Suggest of re-studying the adopted samples the municipals currently using for the purpose of encouraging consumers for not exceeding economical samples, also having price increasing for next sample, which can help in figuring difference between the two samples

7.3 Future Research

The future research directions for the researcher of this thesis are to research and investigate the following:

- The possibility of establishment of a central water meter for each zone or neighborhood that can help in figuring out water leakage.
- A pilot program for an installation of electronic meter, that can be operated by smart cards, similar to Jawal Cards, also a very restrict monitoring and checking of an illegal installations.
- Utilizations of an approval specifications and standards for fixtures.
- Interviewing PWA, and brainstorming for some options and searching for possible funding avenues for helping and supporting citizens in replacing current Fixtures with one that has high quality.
- Conducting an extensive research for the possible establishing of a center for quality fixtures testing, which reach us through crossing borders without mentoring and its approved by certain agency that is authorized by Palestinian Authorities. This Center role is studying an essential issues related to fixtures equipments.

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Appendix- A

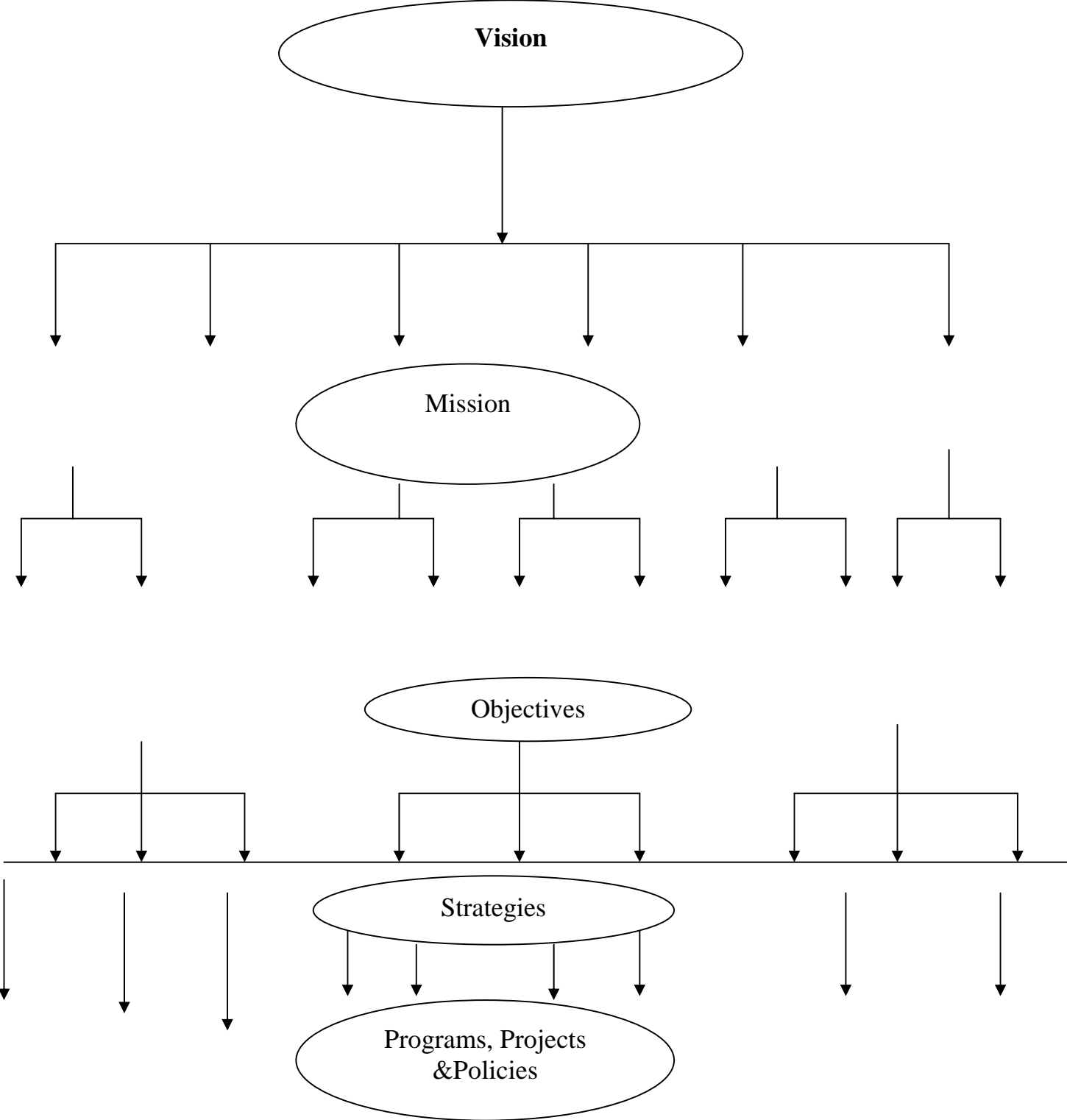
Approach to WDM Framework

The out comes of the different survey questionnaire , which was studied deeply and analyzed by (SPSS)program, also the consumer comments were seriously considered and investigated all of that suggests of important actions and measures must take place in order to accommodate all of the related problems to water demand management .

As a results to this an extensive practical research, which was conducted based on a scientific investigation the following approach is proposed:

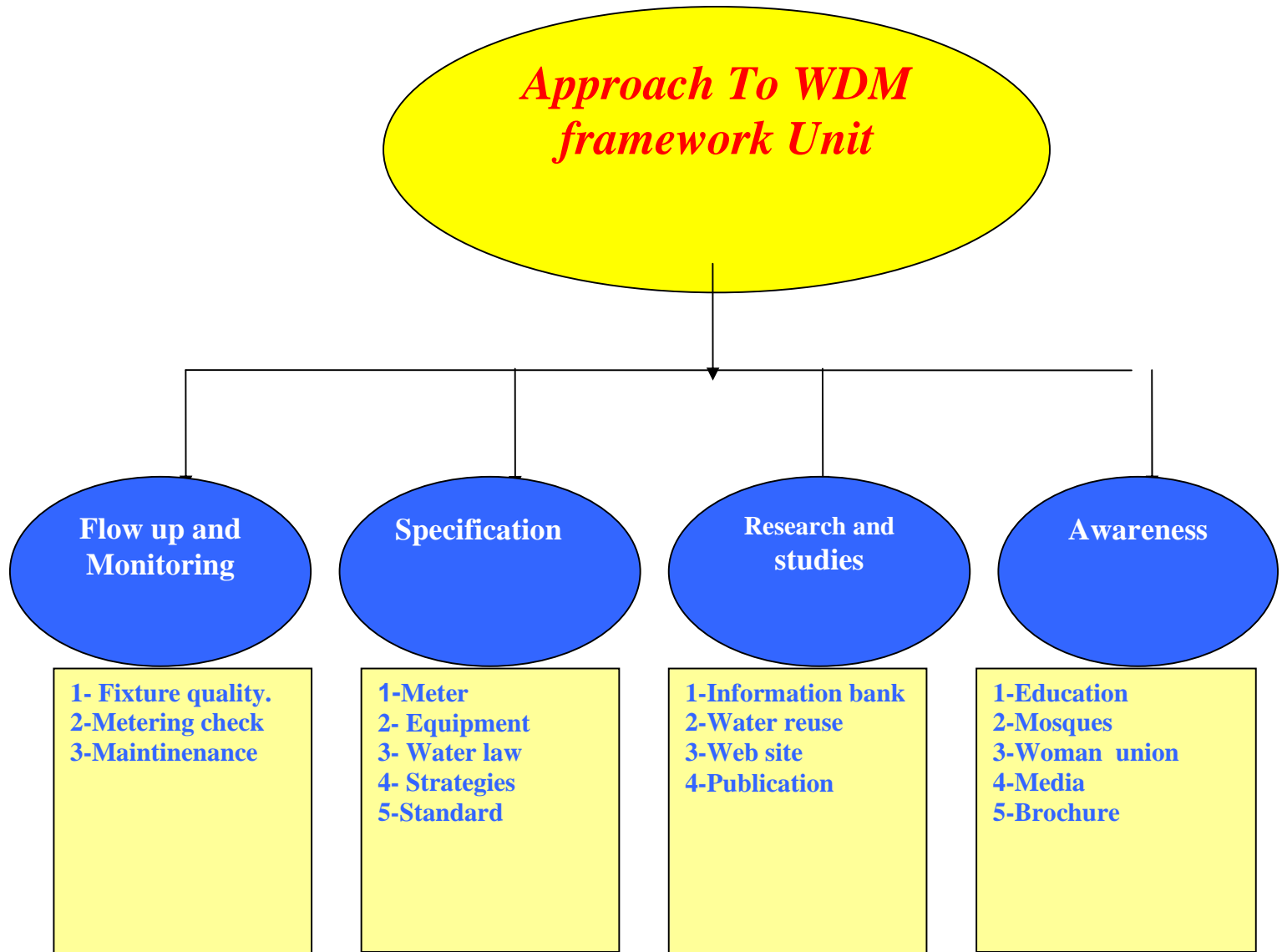
Graphical Results Summary

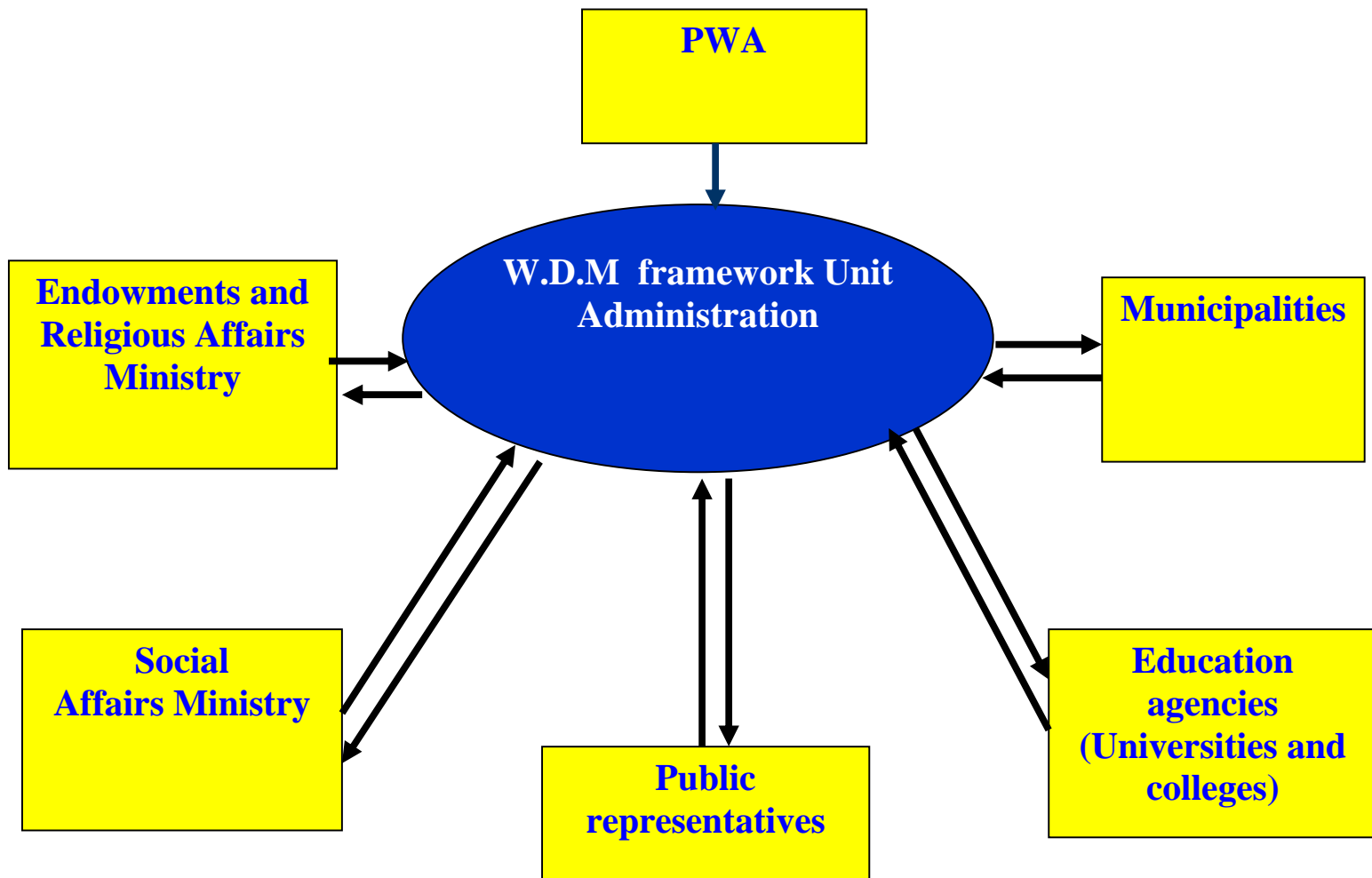
The level of the proposed a approach can be presented graphically as shown in figure below.



Practical Approach Implementations for Research Results

As the proposed approach was presented both, theatrical and graphical in the previous sector, the present new method can be presented in more practical and possible establishment methods, with specific tasks and measure which can grantees the success of the results of this research as in figure below.





Appendix - B

ACRONYMS AND ABBREVIATIONS

WDM	Water Demand Management
CAMP	Coastal Aquifer Management Program
M₃ per day	Cubic meters per day
l/c/d	Liter per capita per day
MCM/yr	Million Cubic Meter per year
Mg/L	Milligrams per Liter
NIS	New Israeli Shekel
PNA	Palestinian National Authority
PWA	Palestinian Water Authority
ppm	Part per million = (Mg/L)
SPSS	Statistical Package for Social Science
WHO	World Health Organization
WDMFU	Water Demand Management Framework Unit
UN	United Nations

Appendix - C

A special Survey about Water House consumption

Dear Fellow Citizen,

- We appreciate your valuable time, so we are gratefully thankful for your involvement in filling the enclosed sampling survey, as an integral part for A masters Thesis which is a partial requirement for earning a masters of Science in Civil Engineering, with specialization of Administration of Water Resources, College of Engineering, Islamic University of Gaza, Gaza city.
- The goal of this research is a study of Water Demand Management in Gaza city.
- We encourage you to use your best judgment and accuracy in filling the enclosed survey, and that will help us in reaching the best results, which can benefit all.
- All of the collect information from this survey will be used only for this scientific research.
- We promise to inform you with the outcome of this research, based in your request as compliments to your valuable efforts in this process.

4. Is the cycle bill paid on time?
Yes No

5. If the answer to previous question is No, Why?

1. Economical reasons 2. Bill Charges are not convincing
3. High Price 4. other reasons

6. What are the total capacities of containers that serve your apartment?

1. Less than two Cup 2. 2-4 Cup
3. More than four Cup 4. I don't know

6. Is the capacity of water containers in your apartment good enough to meet your
require water needs.

Yes No

8. Is there a water filter in your House?

Yes No

Consumer opinion about services provided by authorities:

9. What is your thought about the quantity and continuity of water that reach
your house.

1. Completely satisfied 2. Satisfied
3. Not satisfied 4. I don't know

10- Did the concerned authorities perform regular meter's check up?

Yes No

11- Did you received any awareness publications about water consumption
guidance from the concerned authorities?

Yes No

- 12- Did you ever participate in lectures, seminars, or workshops concerning water consumption awareness.
 Yes No
- 13 Did you receive your cycle bill on the prescribed time?
 Yes No
- 14 Did you think there is strong authority that grants the collection of bill fees.
 1. strongly agree 2. Agree
 3. don't agree 4. I don't know
- 15 Do you agree that increasing water prices will decrease water quantity which consumed by a family?
 1. strongly agree 2. Agree
 3. don't agree 4. I don't know

Consumption behavior (Inside & Outside House)

- 1 Who is performing house duties (Clothing Wash, Cooking & Cleaning).
 1. Housewife 2. Househusband
 3. Both 4. Others
- 2 How the fruit and vegetables will be washed in house.
 1. Direct by Faucet 2. In a water container
- 3- Can the washed water for fruit and vegetables be reused in house (such as garden irrigation or cleaning activities)
 Yes No
- 4 How the cleaning process done for entire house including living room,

and halls.

1. By water hosed 2. Water towel 3. others means

5 In the case of existing Problem in internal water network, is this problem corrected quickly?

Yes No

6 Can you discover a leakage in toilet inside the house?

Yes No

7 Is there any leakages from house faucets?

Yes No

8 What is the efficiency of house faucets

1. Excellent 2. Good 3. Average 4. I don't know

9 Do you really pay attention to close water faucet while you are doing (Dish washing, teeth brushing, Shaving, Making Wudu, ...etc)

Yes No

10 Are you thinking of opening faucet in a way that suitable to your need usage?

Yes No

11 What is the weekly average number of usage of the house shower for each member of a family?

Summer time _____ times.

Winter time _____ times.

12 Is shower continuously running during the duration of bath.

Yes No

13 What is the average time used for the individual?

1. Less than 10 minutes 2. 11-16 minutes
3. 17-22 minutes 4. 23-30 minutes

14 Is there any bathtub inside your house?

Yes No

- 15 How many times each family member uses the bathtub weekly?
1. One time 2. two times
3. Four times 4. four times
- 16 Whether it's possible not using bathtub inside house
Yes NO
- 17 you reuse the water accumulated in bathtub after shower for house
cleaning or toilet.
Yes NO
- 18 What is the type of washing machine in your house
1. Full automatic 2. Semi- automatic 3. Regular
- 19 How many times the washing machine utilized weekly?
Answer: _____ Times.
- 20 Do you reuse the water accumulated from cloth washing or house cleaning,
toilet
or ...etc.
Yes NO
- 21 Is there garden in your house
Yes NO
- 22 In case the answer for question number 21, how do water your garden?
1. By hose 2. a container
3. Water fountain 4. Others
- 23 Do you own Private Car?
Yes No
- 24 In case the answer for question # 23 how do watch your car?
1. By hose 2. a container
- 25 How many times do you watch your car per month?

Answer: _____ Times.

26. What is the type of waste water sewer networks in your house.

1. Underground sewer Networks 2. Septic tank
3. others

27 Is the issue of water consumption awareness usually discussed among your family members.

Yes No

Reaction of consumer with researcher:

1. Do you think it's possible to help us in collecting information about water quantities through?

1. Internet 2. Phone
3. other means you may suggest 4. Don't want to help

2. Can you help in paying small portion of poor or needy people's bill

Yes No

My dear fellow citizen, please check out the items that you be able to do in your home

(/) Check your home faucet and plumbing in order to avoid any water leakage.

When I am in the process to buy new washing machine, I make sure it will have the following features:

() Switch to select load size, () Switch to select the type of clothes

() Switch to control water level

() Installation of a water efficient shower head with a low rate of water flow

() Use a special type of a shower head with a control valve or a sensor that will stop the flow of water when a shampoo or a soap are in use.

() Check house toilets periodically for leaks, and repair them promptly.

() Car cleaning by using a water packet.

() Dish washing by filling water sink with a water and leave in it the dishes, that hard to clean for short time.

() Rinse fruits and vegetables in a pan to reduce water consumptions.

() Don't wash the frozen food immediately, rather, leave it outside for sometime or move it from the freezer section down to the fridge side.

() Checking for a leaks in toilet's container (this can be done by adding a color material to that container, which will appear in the bottom of the toilet within 30 minutes in case of leakage).

() Making sure the toilet handset is always in the right position, and not down, which can leads to a water leakage.

- When you are using washing machine, make sure you are using a full load.
- Leave the most dirt cloths in water for a while before put it in washing machine.
- Use a shower instead of bathtub, but if you really need to use the bathtub, don't fill it in completely.
- During the course of shower, you will close faucet and open it accordingly on different periods, which will improve water consumption.
- Reduce your shower time.
- using a pan for washing my head instead for a full bath for my body.
- placing a plastic bottle filled in with water in the toilet tank, witch can reduce amount of water consumed.
- using a broom for house cleaning the house and halls instead of a water hose.
- Cleaning the house by a pail instead of a water hose.

What is the reason which encouraging you to do that:

- Economical Causes
- Religious Causes
- National Causes

APPENDIX D

Researcher Curriculum Vita

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Education:

- **M.S. Civil Engineering, Islamic University of Gaza**
Expected Graduation Date: August 2005
Area of Concentration: Water Resources Management
MS Thesis: Water Demand Management in Gaza City

B.S. Chemical Engineering, Texas A&M University, Texas, USA

Graduation Date: August 1994

- **Diploma, Italian Institute for Foreign Trade- Training Directorate, Reggio Emilia, Italy.**
Subject: “Training Course on Export Promotion, Management and International Marketing”
Date: October 13- December 5, 1997

Relevant Masters Course Work:

- WRSM 6311: ground Water
- WRSM 6312: Surface Water
- WRSM 6322: Administration of Drink Water
- WRSM 6331: Caring of Water Resources
- WRSM 6334 Water Rights & Environmental Law

- WRSM 6341: Quality of Water
- WRSM 6344: Water Modeling
- ECIV 6310: Statistical Methods in Engineering

Relevant Areas of Expertise:

Researching for new methods, techniques and alternates for Water Demand Management in Gaza Strip.

Relevant Work Experience:

- Deputy General Director for Research& Developments, Ministry of Housing and Public Works.
April 2003- Present
- Director Quality Assurance, Ministry of Housing and Public Works, Gaza City.
June 2001-April 2003
- Director of Specifications, Ministry of Housing Public Works, Gaza City.
January 1999- June 2001
- Director of Laboratories, Ministry of Housing and Public Works, Gaza City.
October 1996- January 1999
- Director of General Union for Palestinian Engineers (GUPE), Gaza City
October 1994- April 1999

Active Research

- Water Demand Management in Gaza Strip
- Quality Assurance, Measurements and Specifications

Publications & Reports

- Quality Control of Concrete Blocks, Gaza City, 2004
- Quality Control of Clay Blocks, Gaza City, 2003
- Quality Control of Paints, Gaza City 2002

Training, Workshop, Seminars

- "Environmental Aspects relevant to road design and implementation", 2004.
- "MS Excel XP (Entry)", Islamic University of Gaza, 2004, Gaza City.
- "Quality Management systems ISO 9000:2000", by Engineering and Consultant Team, August 10- 22, 2003, Gaza City.
- "Optimal Water Irrigation", conducted by Union of Agriculture Works Committee, 2003, Gaza City.
- "Access for Data Based Design", by Governmental Computer Center, 2002, Gaza Strip.
- "Effect of Road Work on Environment", by World Bank, 2002, Gaza City.

Professional Memberships:

- American Society for Chemical Engineers, USA
- American Society for Civil Engineers, USA
- Member of General Union for Palestinian Engineers (GUPE)

Registration & Certification:

- Registered Professional Engineer in Engineering Syndicate, Gaza Strip

Software Skills:

- Operating Systems: Unix, Windows 9x/ NT/ XP, DOS
- Programming Languages: C++
- Software Packages: Microsoft Office
- Expert in **Processing Mod-flow** (*A Simulation System for Modeling Groundwater Flow and Pollution*)
- **MS Project** Software (for Management applications)
- Expert in **SPSS** Software (for Statistics applications)
- Expert in Internet Applications

Hobbies and Interest:

- Reading Books, Journals and Articles on Water Management and Quality Assurance
- Enjoying Learning and Implementing State -of - the Arts Technologies.
- Playing Basketball, Soccer and Swimming

Future Goals & Desire:

- To establish A water Demand Management Units WDMUs for within the Municipal cities of Gaza Strip.
- To establish a dynamic first class Web site for Water Demand Management (WDM), that can help in public awareness for the population of Gaza Strip.
- To Establish a Water Demand Management Clubs within Gaza Strip, which will help in awareness as well implementation of the concepts of WDMUs?