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# Water Desalination, Supplied Water Costs, Total Costs and Benefits

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# Chapter One

## 1. INTRODUCTION

### 1.1 BACKGROUND

Water supply and sanitation in the Palestinian territories are characterized by severe water shortage and are highly influenced by the Israeli occupation. The water resources of Palestine are fully controlled by Israel and the division of groundwater is subject to provisions in the Oslo II Accord.

The West Bank's main resource of natural water is groundwater from the *Mountain Aquifer*, most of it derived from rainfall and snowmelt on the Palestinian side of the Green Line. Israel abstracts about 80% of it. (World Bank, 2009). In Gaza, the only source of natural fresh water is the *Coastal Aquifer*, which is heavily over-exploited and salinated as the result of seawater intrusion. The development of seawater desalination is hampered by the blockade of the Gaza Strip, which is attended with import restrictions on construction materials and fuel needed for desalination.

Generally, the water quality is considerably worse in the Gaza strip when compared to the West Bank. About a third to half of the delivered water in the Palestinian territories is lost in the distribution network. The lasting blockade of the Gaza Strip and the Gaza War have caused severe damage to the infrastructure in the Gaza Strip. (United Nations, 2009). Concerning wastewater, the existing treatment plants do not have the capacity to treat all of the produced wastewater, causing severe water pollution. The development of the sector highly depends on external financing.

The water sector in the West Bank and Gaza has remained undeveloped over the past forty seven years of occupation. Since 1967 West Bank water resources have been controlled and managed by the Israeli Military Authority through a number of Military Orders. These orders have barred Palestinians from participating in the planning and management of water resources and prevented them from developing local water resources in concert with growing water needs.

During this time, management of public resources was completely within Israeli domain; decisions were made without Palestinian participation, and with little regard for Palestinian needs and

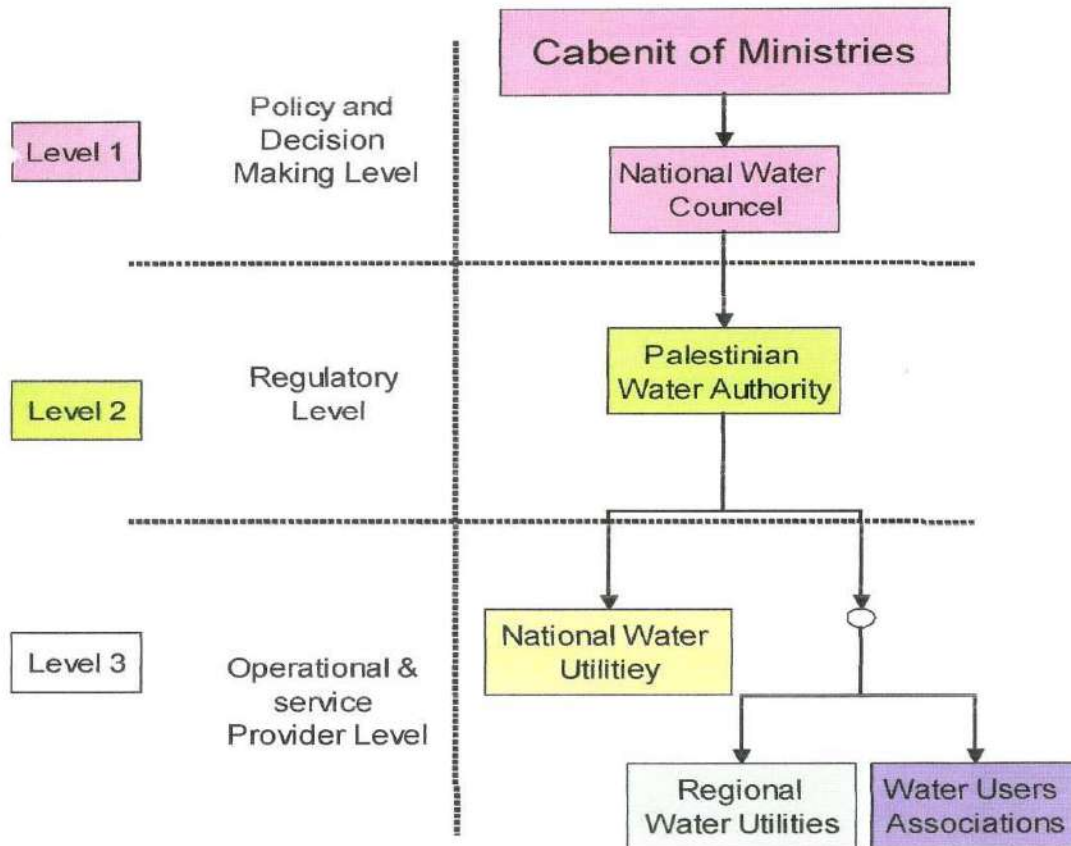
interests. As a result, the Palestinians have developed a distrustful, often non friendly relationship with public authorities. Respect for public goods and public management decisions represented acceptance of our agreement with the Israeli occupation.(Rabi,2009).

The lack of investments in improving infrastructure (physical water losses reach 50% in some areas),(PWA,2011), the scattered nature of the water supply and management utilities with the absence of adequate rules and regulations and absence of stakeholder participation has resulted in the deterioration of the entire water system.

In reality, the change in the political process in the early nineties was not merely an opportunity for greater water use, but rather a challenge to form new, responsive public institutions to govern water sector properly. It is for that the Palestinian Water Authority (PWA) was established in 1995 and was assigned the task of formulating and implementing a comprehensive water strategy and water law, which would entail setting up adequate rules and regulations including proper water pricing policy for the West Bank and Gaza. Due to the fact that Palestinians have not gained yet the full control over their water resources and the issue has been left to the final status negotiation, PWA faced with many constraints to implement the Water Law. Accordingly, no final regulation on water pricing policy has been formulated as of yet. The existing pricing

schemes are those ones prior to the establishment of

## Water Sector Structural Framework



## Chapter Two

### 2. LITERATURE REVIEW

#### 2.1 THE INSTITUTIONAL FRAMEWORK FOR WATER SECTOR MANAGEMENT

The water and wastewater sector in Palestine is one of the most important strategic sectors that were underdeveloped over the past years due to exogenous and endogenous factors. The present situation of the water sector with regard to the position and

performance of institutions responsible for management and operation of the public services is a direct result of many years of occupation and incoherent institutional framework.(Jarrar ,2010).

Generally, the water sector facing o lot of challenges, which are mainly political, financial, social, institutional and technical. These challenges are further compounded by the existence of a multitude of governmental and nongovernmental institutions involved in the sector, leading to institutional fragmentation and lack of coordination.(Samhan,2008).

Despite the fact that the legal and institutional frameworks for the sustainable management of water have been expressed in the Palestinian development plans and have been under focus in the policies and strategies of the ministry of agriculture and the Palestinian water authority, the enforcement of such issues is still lacking. This situation is clearly evident in the case of water institutions in the West Bank, there are several institutional options available, different from each other in legal basis, financial management, administrative and technical capacity. (Klawitter. and Barghouti, 2009).

The Palestinian water sector strategy calls for adequate institutional capability to manage resources and infrastructure and to regulate water sector activities. This necessarily implies substantial capacity building actions in the area of water management, operation and maintenance, and development of service utilities. So in order to improve the institutional arrangements rules and roles should be in place. The expected behavior by various stakeholders should be reflected in well defined rights and responsibilities, as well as in policies, laws and administrative structures and procedures. The stakeholders should be structured through effective organizational and procedural arrangement so that each stakeholder is aware of his own rights and responsibilities, which if dealt with in the appropriate manner would result in an increase in the efficiency of the institutions and consequently the services provided by the water sector. (Jarrar, 2010).

Institutional development is an integral part of a development process which is multidimensional and encompasses social, economic financial, political, institutional, technological, cultural and ecological aspects. Water sector institutions are both the result and the means of such processes which inform institutional change and development and relation to water. This is especially true for Palestine, a state under construction and under an enormous pressure for money often rival and political actors. (ARIJ, 2009).

Number of laws, policies, agreements, strategies, and ministerial decisions are governing water sector in the West Bank. The primary legal instrument for management of water is the water law number three of 2002 which sets out the overall framework of water sector governance. Environmental oversight of the sector is addressed through the environment law number 1 of 1999. The role of local government units in the sector is set out in the local government law number 1 of 1997 and in the Statute for Joint Service Councils adopted in 2006 under authority of section 15 of the local government law. The framework for cooperation in the field of water between Palestine and Israel is established in Oslo II article 40 also called the interim agreement. (Hickman, 2009).

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. The primary legal instruments for management of water is the water law (no3 of 2002), Which aims to sustainable development and management for the existing water resources, to increase capacity, to improve quality by preservation and protection against pollution and depletion. Also define the role and responsibilities of Palestinian water authority and the national water council, but fail to offer any guidance for other institutions and define the overall sector architecture under which the PWA & NWC have to operate.(Jarrar,2010).

## **2.2 THE WATER SITUATION IN THE POPULATED AREAS IN THE WEST BANK**

The populated areas that are served totally or partially with water network in the West Bank is about 395 area, while 95 area were not served with any network, so for about

90% of the west bank population are served with a water network. The water supplied quantity for the West Bank is about 100.9 million cube meter, while the consumed water quantity is about 63.7 million cube meter, which mean that the supplied water per person per day is about 121.5 liter, and the consumed water per person per day is about 76.7 liter. And the lost average is about 36.8%. (PWA,2010).

<b>Governorate</b>	<b>Number of areas</b>	<b>Number of areas with services</b>	<b>Number of areas without services</b>	<b>Quantity Supplied kml/c/d</b>	<b>Consumed Quantities l/c/d</b>	<b>lost%</b>
<b>Tulkarem</b>	35	24	11	185.8	114.2	38.5
<b>Qalqilia</b>	32	22	10	186.2	151.8	18.5
<b>Jenin</b>	71	55	16	76.4	52.6	31.2
<b>Nablus</b>	61	42	19	106.1	77.1	27.3
<b>Toubas</b>	18	6	12	94.2	55.7	40.9
<b>Salfit</b>	19	17	2	94	80.1	14.8
<b>Jericho</b>	12	11	1	259.5	217.9	16.0
<b>Ramallah</b>	74	72	2	179.5	132.9	26.6
<b>Jerusalem</b>	28	27	1	125.9	70.8	44.6
<b>Bethlehem</b>	44	39	5	110.4	71.7	35.1
<b>Hebron</b>	85	42	43	79.2	56.9	28.2

### **2.3 THE PRICING MECHANISMS IN THE POPULATED AREAS IN THE WEST BANK**

The current pricing mechanisms is substantially differ from one locality to another. The average price is estimated at \$0.6 However, it may reach nearly \$3 in some localities where no proper water supply system exist. Water obtained by tankers costs generally double or even triple the normal price a regular customer may pay for running water system. Simultaneously the quality is much lower. In addition, the price of tinkered water increased by several magnitude during the past three years as a result of the current Israeli restrictions, closure and curfews. In some areas the price of one cube meters may



reach \$5. Despite that people are still willing to pay such high price of water.(Rabi, 2009).

After analyzing the tariff structure in several municipalities and villages clusters of the west bank. Currently there are 17 different tariff system that are applied in different areas of the West Bank, and the basis for calculating water prices varies from one area to the next. The discrepancy in water pricing is huge, both between the west bank and Gaza Strip and within the west bank itself. There is no differentiation in price between different water uses (domestic, irrigation, industrial), and the billing cycle and hence the method of calculating minimum water use differs from region to region.(Rabi,2009).

The factors which affect the pricing of water are the source from which it is drawn(springs, wells, imported from mekorot bulk system), the age and the status of the production, transfer and distribution facilities (well stations, booster pumps, carriers, networks) which affects the maintenance costs. And the energy source used to power these facilities, which affect running costs. Where aging equipment is used, it frequently breaks down and thus incurs high maintenance costs. However , in some cases where modern equipment is used, spare parts are not available locally and foreign expertise may be required to repair system which causes delays in repair and high costs. The cost could be reduced by reducing the water losses, including technical and administrative losses.(Rabi, 2009).

Willingness to use, is a relatively new concept which can be defined as the maximum amount of desire one can willingly express for a certain commodity or service. Many technical, institutional, financial and legal factors determine the willingness to use. Affordability is a function both of the price of water service and the ability of water users to pay for this service. Thus drinking water can be made more affordable by reducing the cost of service, increasing the ability of users to pay or both. Affordability combined with willingness to use leads to willingness to pay.(Islam et al,1994).

Low reliability, poor service, institutional obstacles, managerial problems and lack of awareness are among the compelling causes for low willingness to use. When this is combined with high costs for services, low willingness to pay is inevitable. This in turn

results in poor service quality. For that efforts should be taken to improve willingness to pay, use by some socio cultural activities.(Islam et al,1994).

There are four major types of the water pricing policy as follows

1-Peak pricing system: means that prices of the service vary in accordance to the level of use they experience at different times, determined by seasonal use. For example, water use higher in summer than in wintertime, water utilities would expected to set rate charges higher in summer season than the winter.(cloin,1998).

2-Flat rates system: means single rate for all users. Everyone pays the same amount per cubic meter of water, regardless of income level or the quantity of water consumed. but this system violate the principals of equity and punishing the low income households, that they will pay higher portion of their income for water. On the other hand this system will also create no incentives for higher income level households to conserve water.(cloin,1998)

3-The lifeline rate structure: under this system a specified amount of water known as the lifeline, which is equal to the quantity necessary to meet basic needs, is supplied at a rate set below marginal cost. At any quantity consumed beyond this lifestyle amount, a higher rate will take effect. This system is push for equity water distribution, and make low income families gain access to water for domestic use.(cloin,1998)

4-Increasing Block Tariffs: Under this structure, the water utility charges the consumer a unit price for the first number of specified units abstracted. This initial amount is what comprises the first block which is considered as a lifestyle quantity and is provided at a price below the marginal cost. The second block starts where the price of water increases, this price stays to a given level of consumption. Following that level, the third block starts and the price increase again. This structure promote equity through the use of water from rich to poor, and promote the conservation of water.(cloin,1998)

The type of water pricing structure exists in the west bank vary from the flat rate water to the increased block tariff water pricing in the best cases.(Rabi, 2009).

The design of the tariff structure and the prices charged shall be prepared by the water utilities to fulfill the following policy objectives:

- i) Cost Recovery: The tariff structure and prices set shall ensure cost recovery for the individual utilities whereby revenues exceed costs. The water utilities shall increase revenue collection in the following stages until full cost recovery is achieved:
  - a- Revenues cover Operation and Maintenance (O&M) costs;
  - b- Revenues cover O&M costs, plus depreciation based on re-valued assets;
  - c- Revenues cover O&M costs, plus depreciation based on re-valued assets, plus interest charges on loans (if any).
- ii) Social Equity: The tariff structure shall set an affordable price for the basic consumption needs of low-income households.
- iii) Economic Efficiency: The tariff structure shall set an economic price for the higher consumption levels to encourage conservation and signal future prices to the consumers.(PWA,2011)

User categories shall include domestic, public, commercial and industrial connections. The costs of providing water supplies shall be allocated between the different user groups and between different levels of consumption. Prices charged to consumers shall increase with increasing levels of consumption. The costs of wastewater services shall be allocated between the different user groups based on the volume of water consumed. Fees charged will follow a progressive scale depending on the volume consumed and discharged. A wastewater surcharge fee shall be added for heavy polluters.(PWA,2011)

The tariff structure for the water utility shall be based on the Tariff Design Model prepared by the PWA or another similar model approved by the PWA. The tariff

design for the period given in the Tariff Adjustment Application under consideration shall show the following steps:

- i) Calculation of the revenues required to achieve the appropriate level of Cost Recovery as approved by the PWA;
- ii) Assessment of the affordable price for low income groups and the future economic cost of water and wastewater per cubic meter;
- iii) Design of the tariff structure to implement policy objectives and establish unit prices for the different user categories and consumption levels. (PWA,2011)

Cost recovery shall be enhanced by systematic efforts to reduce service costs through greater management and technical efficiencies; reducing water losses in the system; reducing illegal Connections; and by increasing revenues through improved collection efficiency. Measurable progress in the improvement of technical and financial performance of the water utilities shall be considered by the PWA before a tariff application is approved. (PWA,2011).

The Palestinian governorates of the West Bank (WB) are still suffering from a severe shortage in supplied water services. This shortage is estimated by 41 million cubic meters. Efforts and sufficient funds should be allocated for development of the water sector to ensure sufficient, reliable and safe water supply services to the Palestinian population in all of the Palestinian governorates (PWA, 2010).

Moreover, the Palestinians abstract 20 percent of the estimated potential water resources' underlying the WB, Israel abstracts the balance and over-draws on its agreed quantum by more than 50 percent. Also, Palestinian per capita access to water resources in the WB is a quarter of Israeli access and is decreasing. Therefore, some communities in the WB are restoring to unlicensed drilling to obtain drinking water (The World Bank, 2009).

Over the past decade, the annually growth rate of population in the West Bank (WB) has been more than 3 percent per annum, in parallel with the increase of building expansion,

economic activities and human needs (PCBS, 2007). The increasing uses of the fixed water resources in response to rising demand are not only reducing water quantity, but also jeopardize water quality (Hamoda, 2004).

Therefore, the crisis of water scarcity is considered only one in the WB, poor quality of water supply and the absence of proper assessment make a profound impact on the Palestinian economy (Bellisari,1994). Also, Palestinians in the WB are charged three times more per unit of domestic water than are Israelis, stated in terms of relative GNP per capita, Palestinians pay a minimum of fifteen times more than Israeli consumers (Elmusa, 1997).

According to the abovementioned, Palestine finds itself in a unique situation as a result of these conditions, as well as the Israeli control on the most available resources of waters in the WB. The impact of the Israeli settlements and settlers on the Palestinian land and water resources is a decisive element in a broad relationship of inequality and dependency established and promoted by the occupation over the last quarter century (Aronson, 1998).

## **Chapter three**

### **3. METHODOLOGY**

#### **3.1 INTRODUCTION**

After reviewing the existing literature concerning the different economic theories, pricing policy structures, social aspects, willingness to pay, institutional framework and the water situation in the West Bank, special establishes that if people are not able to communicate about their decisions they usually have a worse outcome as when they were able to talk with each other

about it. The bidding game is a tried and tested method to determine the willingness to pay for water. This is based upon the premise that the water supply is regular, clean and potable. The game allows the users to imagine that they are bidding for water in accordance with their current income levels.

The main concepts established were to define the best methods of reflecting the willingness to pay while assessing the various factors influencing it., to assess the level of awareness that people have. Furthermore, the relation between the water price and the quantity used as well as how a sound pricing policy might influence the rationing of water use was also studied.

The methodology of the research will depend on two main issues:

- 1- Questionnaire: I will formulate a questionnaire about water tariff and distribute it over the relevant parties at the water sector organizations.
- 2- Based on the literature review I will make a feasibility study about the brackish water desalination based on the available data.

### **3.2 STUDY TOOLS**

These concepts were reflected in a form of questionnaire. which target Ramallah and Albireh population as a study area, and the service provider Jerusalem water undertaking which serve this area with water . The questionnaire target the households, so it distributed in the Arabic language, then it translated to English

### **3.3 STUDY SAMPLE**

The questionnaire targeted the households in Ramallah and AlBireh, and the camps that exist in these two cities and the villages around them, which served by the Jerusalem water under taking, so the sample will be random sample.

### **3.4 STATISTICAL WAY**

Following to the completion of the survey, questionnaires will be analyzed using one of the specialized statistical packages (SPSS), and results generated.

The results obtained on willingness to pay and affordability, public perception, the type and

efficiency of water pricing schemes in conjunction with the information collected through the meetings together with the findings of the theoretical background of economic theories and the actual socio-economic conditions in the West Bank were then used to propose a draft water pricing mechanism to be considered in PALESTIN.

## Chapter Four

### 4.RESULTS & FINDINGS

#### 4.1 INTRODUCTION

This chapter presents the results that have been reached from this study, which aimed to introduce the direction toward water tariff and pricing policy in Palestine, and check if this role differ by all the independent variables.

#### 4.2 THE RESULTS OF THE STUDY QUESTIONS AND DISCUSSION

To answer the main question of the study, which reflect the research problem,( What are the population directions toward water tariff and pricing policy in Palestine?), to answer this main question, and make the results presentation easier, a group of sub questions in the questionnaire paragraphs have been analyzed, and these schedules clear that:

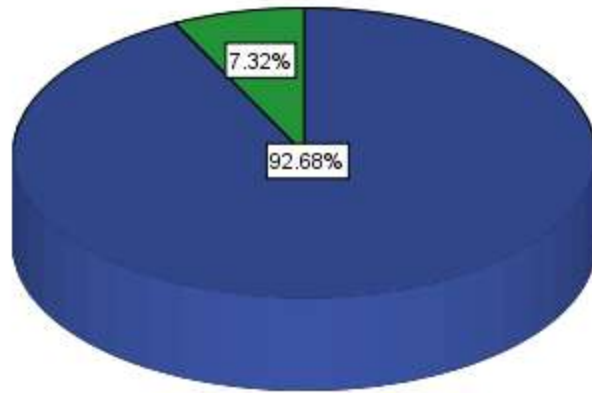
Schedule (4.1) shows that 92.7% have water net in their village, while 7.3% do not have.

#### **Schedule (4.1): Is there a water net in the village**

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Yes	38	92.7	92.7	92.7
No	3	7.3	7.3	7.3
Total	41	100.0	100.0	100.0



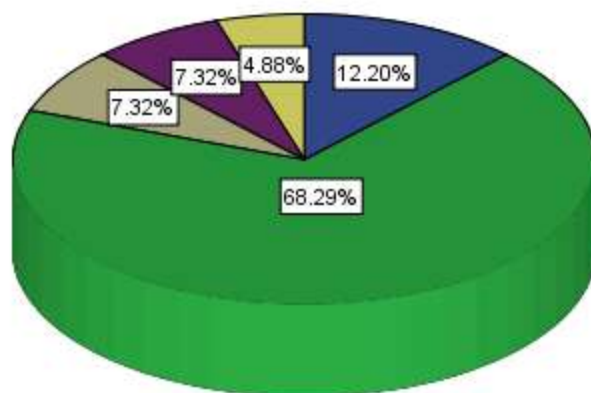
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According to the results of schedule (4.2) 71.8% of their water source is the Water Department in the West Bank (Mekorot) , 12.8 is water aquifer, 7.7% spring and 7.7% other source

**Schedule (4.2): What is the main water sources for the net in your village?**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Water Aquifer	5	12.2	12.8	12.8
	Water Department in WB (Mekorot)	28	68.3	71.8	84.6
	Spring	3	7.3	7.7	92.3
	Other Source	3	7.3	7.7	100.0
	Total	39	95.1	100.0	
Missing	99.00	2	4.9		
	Total	41	100.0		



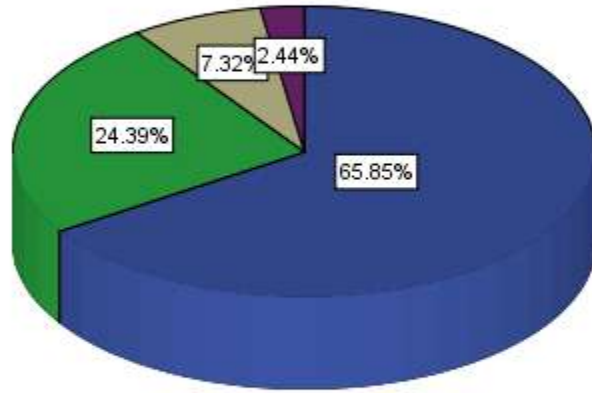
Schedule (4.3) shows that 67.5% get water supply from water department, 25% from municipality, and 7.5% from rural council

**Schedule (4.3) From where you get the water supply?**

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Water Department	27	65.9	67.5	67.5
Municipality	10	24.4	25.0	92.5
Rural Council	3	7.3	7.5	100.0

	<b>Total</b>	<b>40</b>	<b>97.6</b>	<b>100.0</b>	
<b>Missing</b>	<b>99.00</b>	<b>1</b>	<b>2.4</b>		
	<b>Total</b>	<b>41</b>	<b>100.0</b>		

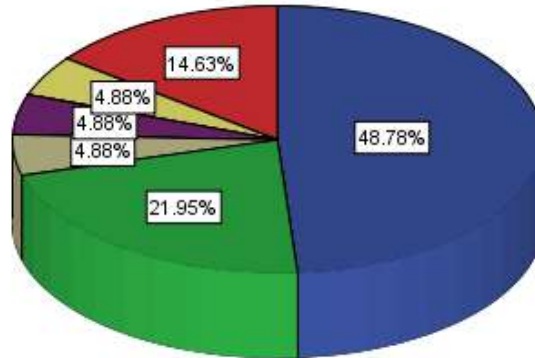
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From Schedule (4.4), we see that 57.1% consume 20-30 m<sup>3</sup> monthly from water, 25.7% consume 30-40 m<sup>3</sup>, 5.7% consume 40-50 m<sup>3</sup>, and 5.7% also consume 50-60 m<sup>3</sup> and more.

**Schedule (4.4): What is the monthly water consuming average according to the bill?**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	20-30 m <sup>3</sup>	20	48.8	57.1	57.1
	30-40 m <sup>3</sup>	9	22.0	25.7	82.9
	40-50 m <sup>3</sup>	2	4.9	5.7	88.6
	50-60 m <sup>3</sup>	2	4.9	5.7	94.3
	More	2	4.9	5.7	100.0
	Total	35	85.4	100.0	
Missing	99.00	6	14.6		
	Total	41	100.0		

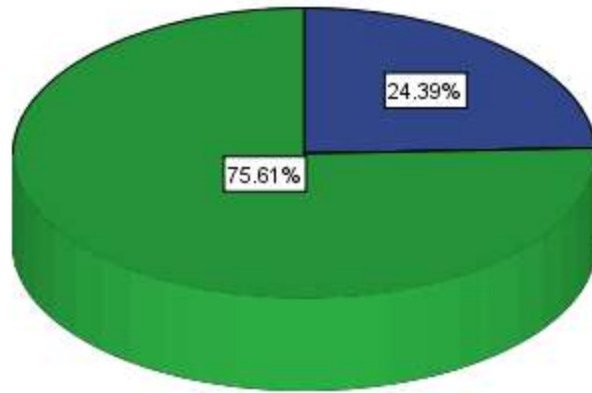


It is clear from schedule (4.5) that 75.6% does not use water for non house uses, and 24.4% use it.

**Schedule (4.5) Do you use water for non house uses**

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid yes	10	24.4	24.4	24.4
no	31	75.6	75.6	100.0
Total	41	100.0	100.0	

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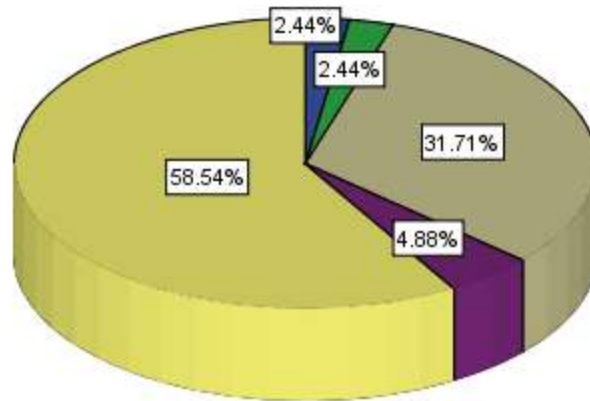


Schedule (4.6) shows that 76.5% use water for the garden, 5.9% use water for agriculture, 5.9% also use it for tourism, and 11.8 use water for something else.

**Schedule (4.6): you use water for**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	agriculture	1	2.4	5.9	5.9
	tourism	1	2.4	5.9	11.8
	garden	13	31.7	76.5	88.2
	else	2	4.9	11.8	100.0
	Total	17	41.5	100.0	
Missing	99.00	24	58.5		
	Total	41	100.0		





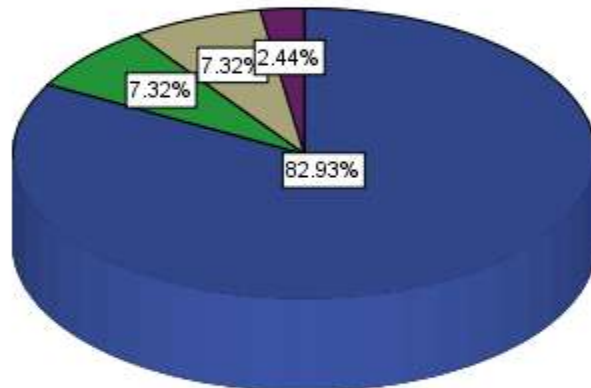
Schedule (4.7) shows that 85% consume water as their needs, 7.5% consume more than their need, and 7.5% consume less than their need.

**Schedule (4.7): is your water consume enough for your house need**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	As need	34	82.9	85.0	85.0
	Less than need	3	7.3	7.5	92.5
	More than need	3	7.3	7.5	100.0
	Total	40	97.6	100.0	
Missing	99.00	1	2.4		

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	As need	34	82.9	85.0	85.0
	Less than need	3	7.3	7.5	92.5
	More than need	3	7.3	7.5	100.0
	Total	40	97.6	100.0	
Missing	99.00	1	2.4		
	Total	41	100.0		

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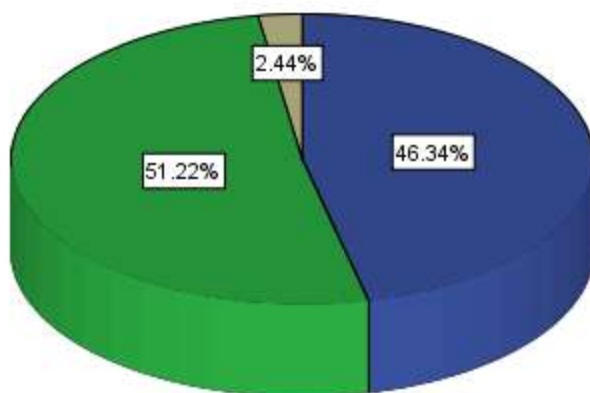


The results of schedule (4.8) shows that 52.5% have some means for saving water, and 47.5% do not have.

**Is their any means in your house for saving water?**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	19	46.3	47.5	47.5
	no	21	51.2	52.5	100.0
	Total	40	97.6	100.0	
Missing	99.00	1	2.4		
	Total	41	100.0		

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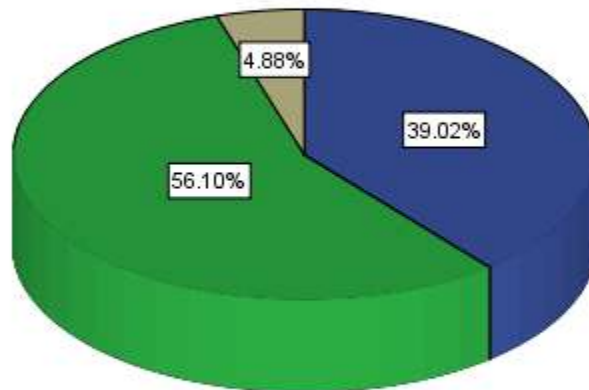


The results in schedule (4.9) shows that 59% do not have any problems in water supply. While 41% have problems.

**Schedule (4.9): Are their any problems facing you in water supply**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	16	39.0	41.0	41.0
	no	23	56.1	59.0	100.0
	Total	39	95.1	100.0	
Missing	99.00	2	4.9		

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	16	39.0	41.0	41.0
	no	23	56.1	59.0	100.0
	Total	39	95.1	100.0	
Missing	99.00	2	4.9		
	Total	41	100.0		

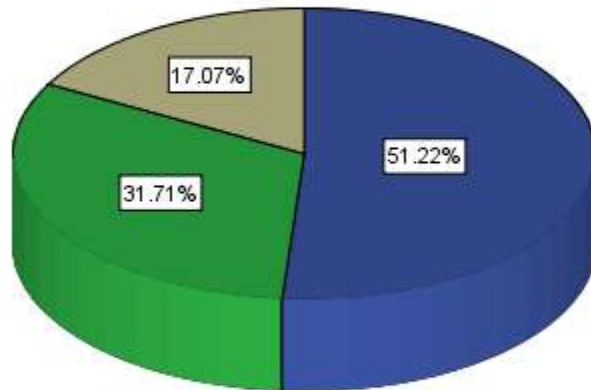


The results in schedule (4.10) points that 51.2% have good satisfaction about water pumping to their house, 31.7% have fair satisfaction, and 17.1% have bad satisfaction.

**Schedule(4.10): What is your satisfaction level about water pumping to your house**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Good	21	51.2	51.2	51.2
	Fair	13	31.7	31.7	82.9
	Bad	7	17.1	17.1	100.0
	Total	41	100.0	100.0	

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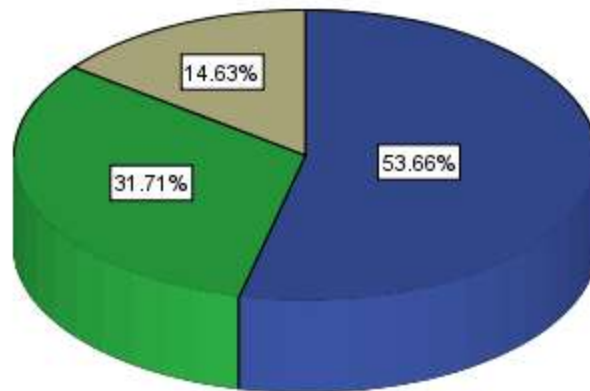


The results in schedule (4.11) points that 53.7% have good satisfaction about water quantity that reach to their house, 31.7% have fair satisfaction, and 14.6% have bad satisfaction.

**What is your satisfaction level about water quantity that reach your house?**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Good	22	53.7	53.7	53.7
	Fair	13	31.7	31.7	85.4
	Bad	6	14.6	14.6	100.0
	Total	41	100.0	100.0	

■ جيد  
■ متوسط  
■ سيء



The results in schedule (4.12) points that 50% have good satisfaction about water pumping period, 32.5% have fair satisfaction, and 17.5% have bad satisfaction.

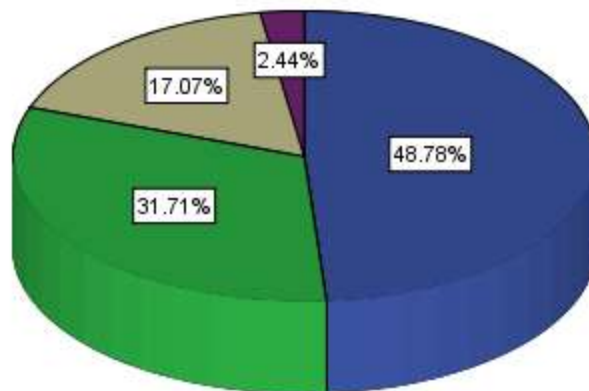
**Schedule (4.12): What is your satisfaction level about water pumping period?**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	good	20	48.8	50.0	50.0
	fair	13	31.7	32.5	82.5
	bad	7	17.1	17.5	100.0
	Total	40	97.6	100.0	



Missing	99.00	1	2.4		
Total		41	100.0		

■ جيد  
■ متوسط  
■ سيء  
■ Missing

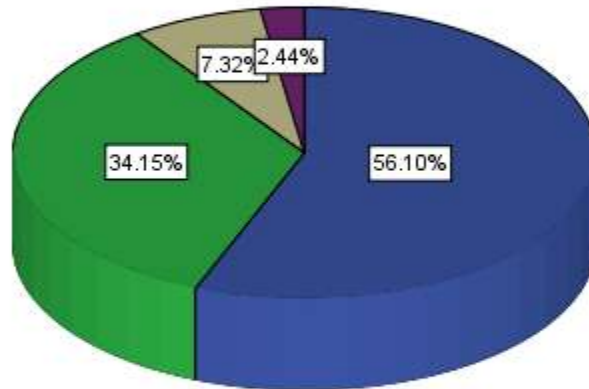


The results in schedule (4.13) points that 57.5% have good satisfaction about water taste, 35% have fair satisfaction, and 7.5% have bad satisfaction.

**Schedule (4.13): what is your satisfaction level about water quality according to the taste?**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	good	23	56.1	57.5	57.5
	fair	14	34.1	35.0	92.5

	bad	3	7.3	7.5	100.0
	Total	40	97.6	100.0	
Missing	99.00	1	2.4		
	Total	41	100.0		

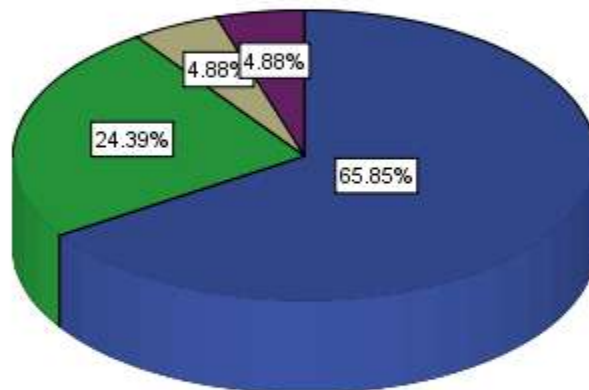


The results in schedule (4.14) points that 69.2% have good satisfaction about water color, 25.6% have fair satisfaction, and 5.15% have bad satisfaction.

**Schedule (4.14): what is your satisfaction level about water quality according to the color?**

	Frequency	Percent	Valid Percent	Cumulative Percent
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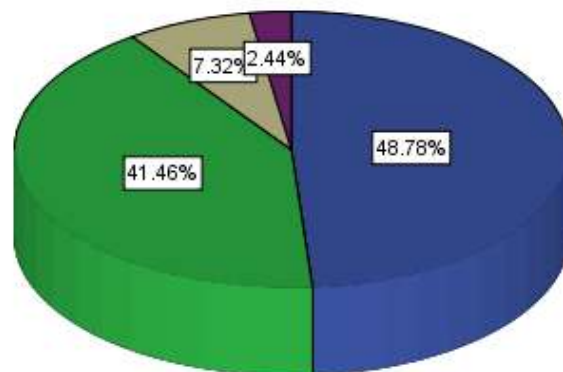
Valid	good	27	65.9	69.2	69.2
	Fair	10	24.4	25.6	94.9
	Bad	2	4.9	5.1	100.0
	Total	39	95.1	100.0	
Missing	99.00	2	4.9		
	Total	41	100.0		



The results in schedule (4.15) points that 50% have good satisfaction about water purity, 42.5% have fair satisfaction, and 7.5% have bad satisfaction.

**Schedule (4.15): what is your satisfaction level about water quality according to the purity?**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	good	20	48.8	50.0	50.0
	fair	17	41.5	42.5	92.5
	bad	3	7.3	7.5	100.0
	Total	40	97.6	100.0	
Missing	99.00	1	2.4		
	Total	41	100.0		

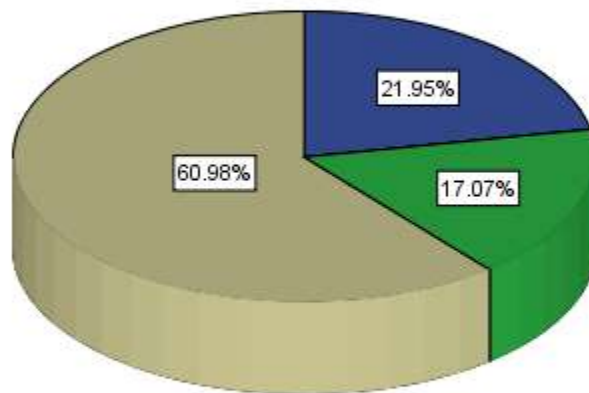


Schedule (4.16) shows that 61% use water filter for drinking and cooking, on the other hand 22% use it sometimes, and 17% do not use filter.

**Schedule (4.16): Do you use water filter for drinking and cooking?**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	always	9	22.0	22.0	22.0
	sometimes	7	17.1	17.0	39.0
	never	25	61.0	61.0	100.0
Total		41	100.0	100.0	

■ نعم دائما  
■ احيانا  
■ لا

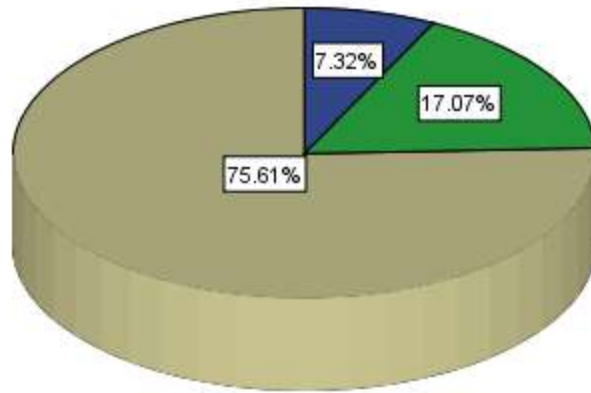


Schedule (4.17) shows that 75.6% do not boil water before drinking, while 17.1% boil it sometimes, and 7.3% always boil the water before drinking it.

**Schedule (4.17): Do you boil the water before drinking it?**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Always	3	7.3	7.3	7.3
	Sometimes	7	17.1	17.1	24.4
	never	31	75.6	75.6	100.0
	Total	41	100.0	100.0	

■ نعم دائما  
■ احيانا  
■ لا

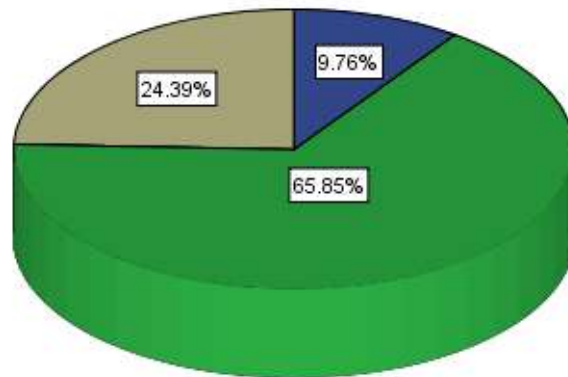


The results in schedule (4.18) shows that 9.8% the water cause disease for their family, while 24.4% sometimes, and 65.9% the water has never cause disease to the family.

**Schedule (4.18): Did the water cause any disease for the family?**

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid always	4	9.8	9.8	9.8
Sometimes	27	65.9	65.9	75.6
never	10	24.4	24.4	100.0
Total	41	100.0	100.0	

نعم دائما  
 احيانا  
 لا الاري



The results of Schedule (4.19) show that 58.5% believe that the municipality should be responsible upon water supply, 26.8% believe the government and 14.6% believe others.

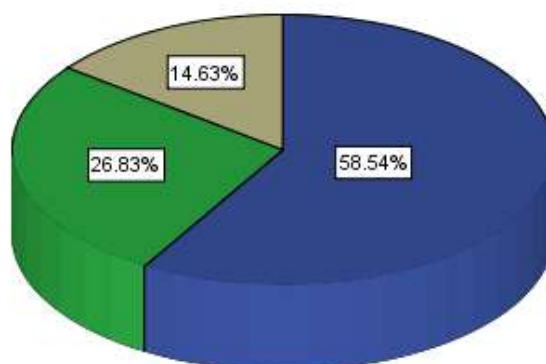
**Schedule (4.19): In your opinion, who must be responsible on water supply?**

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Governorate	24	58.5	58.5	58.5
Government	11	26.8	26.8	85.4



Others	6	14.6	14.6	100.0
Total	41	100.0	100.0	

■ البلدية  
■ الحكومة  
■ غير ذلك



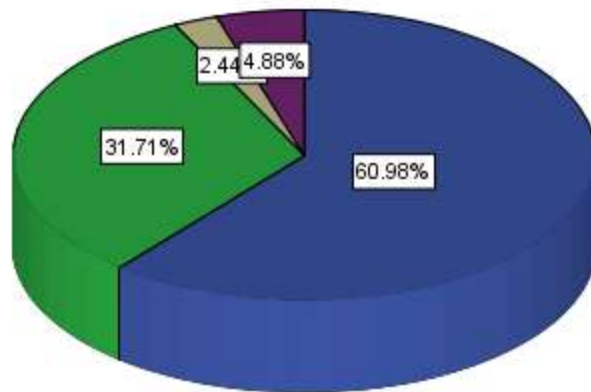
The schedule (4.20) shows that 64.1% are aware of the price of the cubic meter, 33.3% are not aware and 2.6% are not interested to know.

**Schedule (4.20): Do you know the price of the cubic meter that you pay for water**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	25	61.0	64.1	64.1
	No	13	31.7	33.3	97.4

	Not Important	1	2.4	2.6	100.0
	Total	39	95.1	100.0	
Missing	99.00	2	4.9		
	Total	41	100.0		

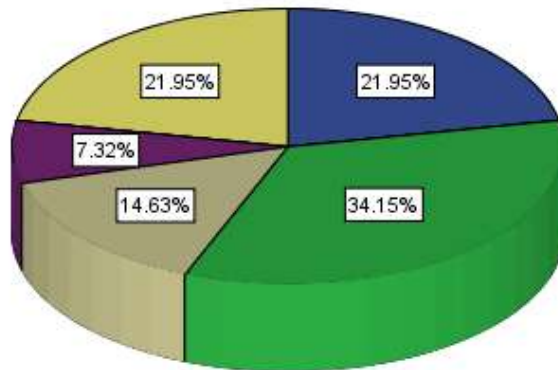
■ نعم  
■ لا  
■ غير مهم  
■ Missing



Schedule (4.21) indicates that 43.8% say that the price of the cubic meter is 4-5 shekels, 28.1% say 3-4 and 9.4% say 6-7 shekels

**Schedule (4.21): what is the price that you pay for one cubic meter of water according to the invoice?**

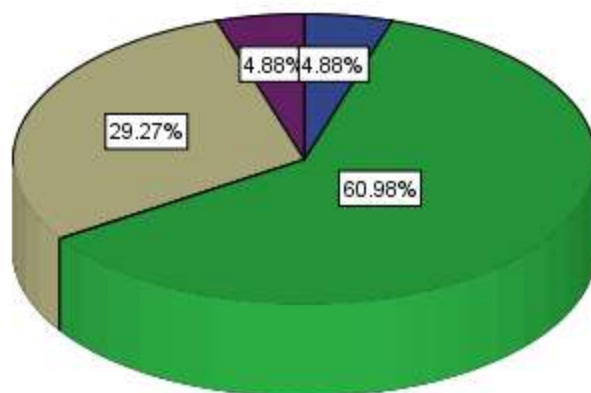
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3-4 NIS	9	22.0	28.1	28.1
	4-5 NIS	14	34.1	43.8	71.9
	5-6 NIS	6	14.6	18.8	90.6
	6-7 NIS	3	7.3	9.4	100.0
	Total	32	78.0	100.0	
Missing	99.00	9	22.0		
	Total	41	100.0		



Schedule (4.22) indicates that 64.1% believe that the amount they pay is appropriate, 30.8% believe it is expensive and 5.1% believe it is cheap.

**Schedule (4.22): Do you believe that the amount that you pay for water is?**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Cheap	2	4.9	5.1	5.1
	Appropriate	25	61.0	64.1	69.2
	Expensive	12	29.3	30.8	100.0
	Total	39	95.1	100.0	
Missing	99.00	2	4.9		
	Total	41	100.0		



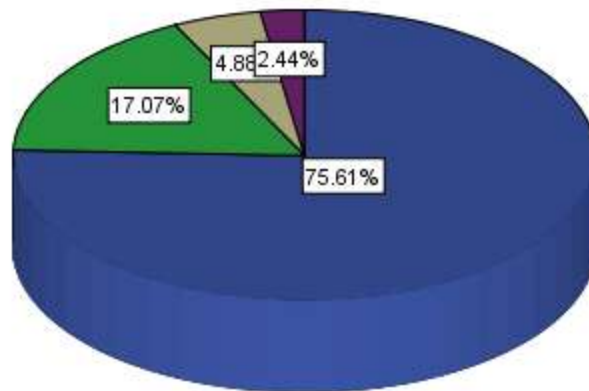
Schedule (4.23) indicates that 75.6% pay the bill on a monthly basis, 17.1% on installments, 4.9 do not pay because they are not able to pay and 2.4% do not want to pay.

**Schedule (4.23): How do you pay the water bill?**

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Pay monthly	31	75.6	75.6	75.6
Installment	7	17.1	17.1	92.7
Do not pay because I cannot	2	4.9	4.9	97.6
I do not pay	1	2.4	2.4	100.0

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Pay monthly	31	75.6	75.6	75.6
Installment	7	17.1	17.1	92.7
Do not pay because I cannot	2	4.9	4.9	97.6
I do not pay	1	2.4	2.4	100.0
Total	41	100.0	100.0	

■ ادفع شهريا  
■ ادفع بالتقسيط  
■ لا ادفع بسبب عدم مقدرتي  
■ لا ادفع المتأخرة

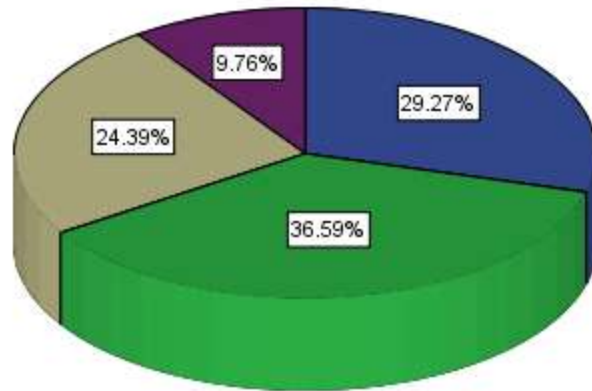


Schedule (4.24) indicates that 36.6% pay to the collector, 29.3% to the municipality, 24.4% to the bank and 8.8 pay in a different way.

**Schedule (4.24): What is the method of paying the water bill?**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Municipality	12	29.3	29.3	29.3
	Collector	15	36.6	36.6	65.9
	Bank	10	24.4	24.4	90.2
	Different way	4	9.8	9.8	100.0
	Total	41	100.0	100.0	

■ البلدية  
■ النجاسي  
■ البنك  
■ غير ذلك

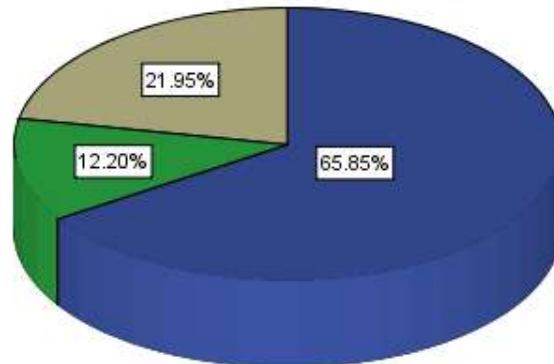


Schedule (4.25) indicates that 65.9% consider that the information in the bill is sufficient, 12.2% consider it not sufficient and 22% do not know.

**Schedule (4.25): Is the information on the water bill sufficient**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	27	65.9	65.9	65.9
	No	5	12.2	12.2	78.0
	Do not know	9	22.0	22.0	100.0
Total		41	100.0	100.0	





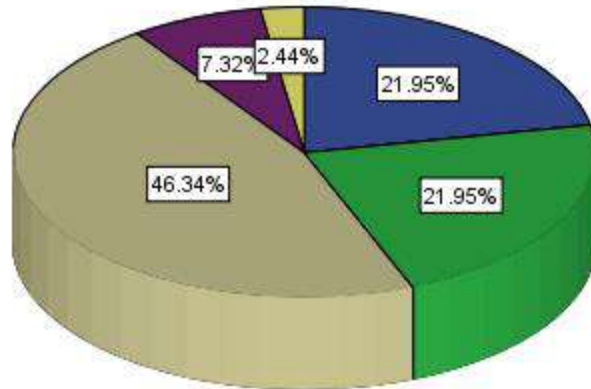
Schedule (4.26) indicates that 47.5% prefer paying the bill at the bank, 22.5% at the municipality, and 22.5 for the collector and 7.5% in a different way.

**Schedule (4.26): What is the method that you prefer to pay the bill?**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Municipality	9	22.0	22.5	22.5
	Collector	9	22.0	22.5	45.0

Bank	19	46.3	47.5	92.5
Else	3	7.3	7.5	100.0
Total	40	97.6	100.0	
Missing	99.00	1	2.4	
Total	41	100.0		

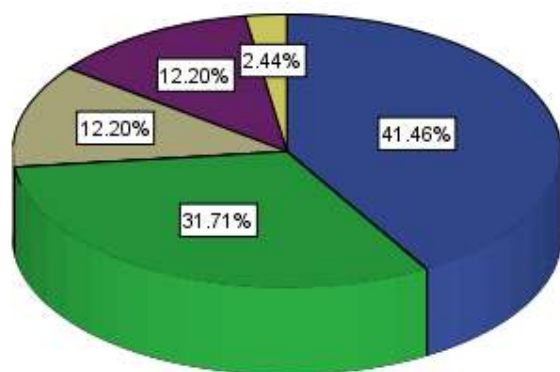
- البلدية
- الجادي
- البنك
- غير ذلك
- Missing



The results in schedule (4.27) indicate s that 42.5% believe that prices they pay for water is appropriate for cost, while 32.5% believe that it is more than the cost, and 12.5% believe that it is less, and 12.5% do not know.

**Schedule (4.27): In your opinion Does the prices that you pay for water cover the costs?**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	appropriate	17	41.5	42.5	42.5
	More than cost	13	31.7	32.5	75.0
	Less than cost	5	12.2	12.5	87.5
	Do not no	5	12.2	12.5	100.0
	Total	40	97.6	100.0	
Missing	99.00	1	2.4		
	Total	41	100.0		



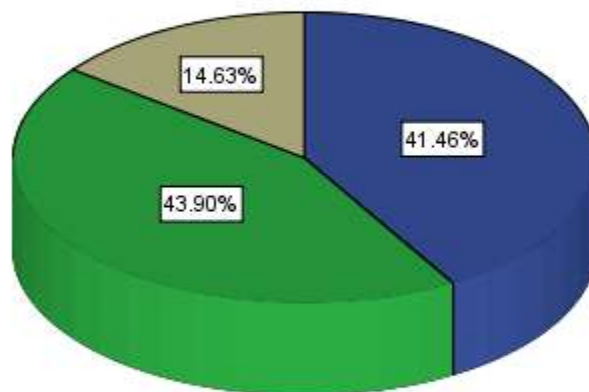
This schedule (4.28) shows that 43.9% are not ready to pay more than what are they paying now for the development and improvement of the quality and the services of water supply, while 41.5% are ready to pay more, and 14.6% want to think about that.

**Schedule (4.28): Are you ready to pay more for the development and improvement of the quality and the services of water?**

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Yes	17	41.5	41.5	41.5
No	18	43.9	43.9	85.4
Do not know	6	14.6	14.6	100.0

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Yes	17	41.5	41.5	41.5
No	18	43.9	43.9	85.4
Do not know	6	14.6	14.6	100.0
Total	41	100.0	100.0	

■ نعم  
■ لا  
■ لا ادري (بتم التفكير)

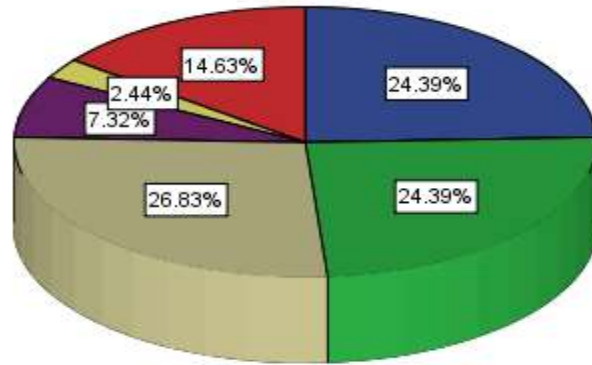


The schedule (4.29) indicates that 28.6% can pay 3-4 nis, 28.6% can pay 4-5 nis, while 31.4% can pay 5-6 nis, and 8.6% can pay 6-7 nis, and the rest can pay more than that.

**Schedule (4.29): What is the price that you can pay for the m3 of water?**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3-4 nis	10	24.4	28.6	28.6
	4-5 nis	10	24.4	28.6	57.1
	5-6 nis	11	26.8	31.4	88.6
	6-7 nis	3	7.3	8.6	97.1
	more	1	2.4	2.9	100.0
	Total	35	85.4	100.0	
Missing	99.00	6	14.6		
	Total	41	100.0		

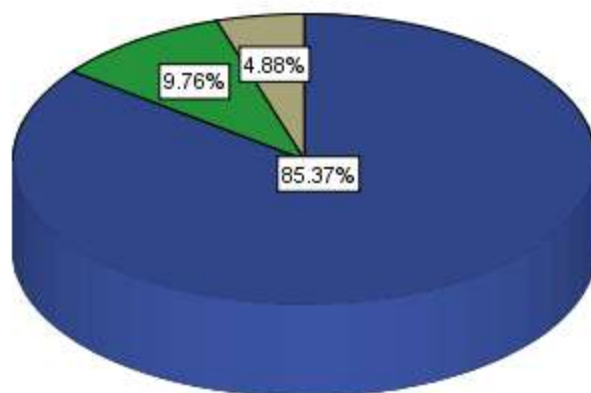
- شیکل 3-4
- شیکل 4-5
- شیکل 5-6
- شیکل 6-7
- اکثر من دلاک
- Missing



The schedule (4.30) shows that 85.4% do not think that another party should pay the bill instead of them, while 9.8% think that.

**Schedule (4.30): Do you think that another party should pay the bill instead of you?**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	35	85.4	89.7	89.7
	yes	4	9.8	10.3	100.0
	Total	39	95.1	100.0	
Missing	99.00	2	4.9		
	Total	41	100.0		



The schedule (4.31) indicates that 41.5% their income is more than 5000 nis, 29.3% between 4000-5000 nis, while 12.2% between 3000-4000 nis every month, and the rest is less than that.

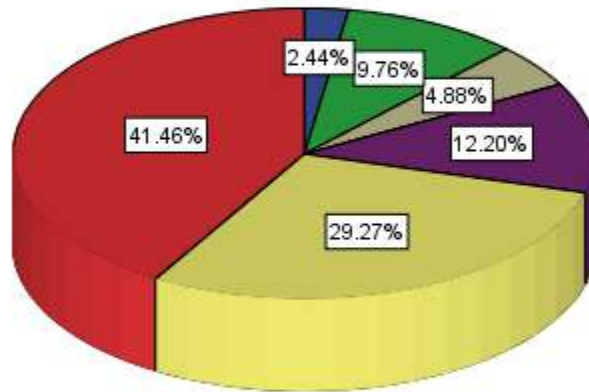
**Schedule (4.31): The family income is between**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 1000 nis/month	1	2.4	2.4	2.4
	1000-2000	4	9.8	9.8	12.2
	2000-3000	2	4.9	4.9	17.1
	3000-4000	5	12.2	12.2	29.3



4000-5000	12	29.3	29.3	58.5
More than 5000	17	41.5	41.5	100.0
Total	41	100.0	100.0	

- اقل من 1000 شيكل / شهر
- من 1000-2000 شيكل / شهر
- من 2000-3000 شيكل / شهر
- من 3000-4000 شيكل / شهر
- من 4000-5000 شيكل / شهر
- اكثر من 5000 شيكل / شهر

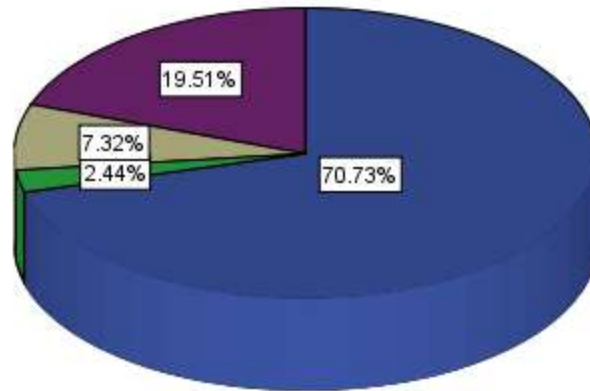


The results in the schedule (4.32) shows that 70.7% believe that the illegal connection with the water net is theft, 19.5% said that it has to be prevented, 7.3% said that it is not accepted, while 2.4% believe that it is not theft.

**Schedule (4.32): What is your opinion in the illegal connection with the water net**

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid theft	29	70.7	70.7	70.7
Not theft	1	2.4	2.4	73.2
Not accepted	3	7.3	7.3	80.5
Must prevented	8	19.5	19.5	100.0
Total	41	100.0	100.0	

■ سرقة  
■ ليس سرقة  
■ غير مقبول  
■ يجب القضاء عليه

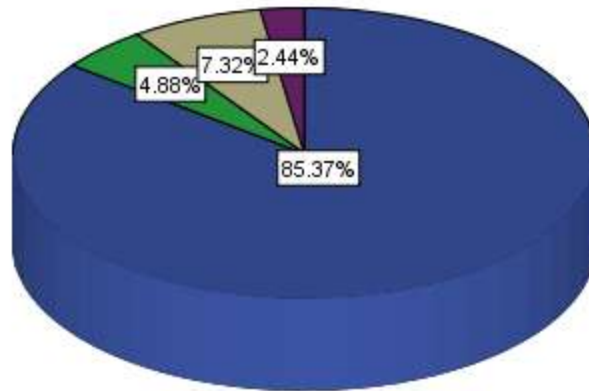


The results of schedule (4.33) indicates that 87.5% said that it is fair to pay the monthly bill, while 7.5% do not know, and 5% said that it is not fair.

**Schedule (4.33): In your opinion is it fair to pay the monthly bill?**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	35	85.4	87.5	87.5
	no	2	4.9	5.0	92.5
	Do not know	3	7.3	7.5	100.0
Total		40	97.6	100.0	

Missing	99.00	1	2.4		
	Total	41	100.0		



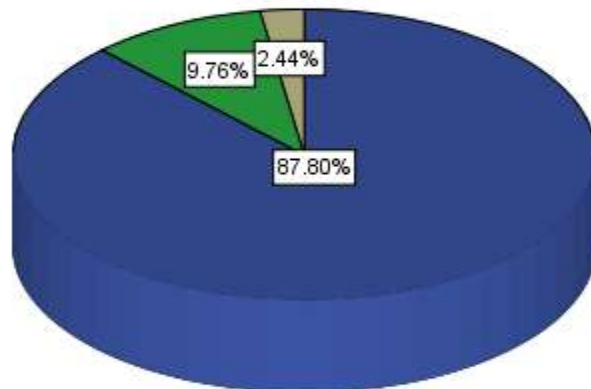
Schedule (4.34) indicates that 87.8% believe there is a real problem because of water in Palestine, 9.8% are moderate and 2.4% believe there is no problem.

**Schedule (4.34): In your opinion is there a real problem because of water in Palestine?**

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Yes, real and serious	36	87.8	87.8	87.8

Moderate	4	9.8	9.8	97.6
No problem	1	2.4	2.4	100.0
Total	41	100.0	100.0	

■ ندم حقيقة وحادة  
■ متوسطة  
■ لا يوجد مشكلة

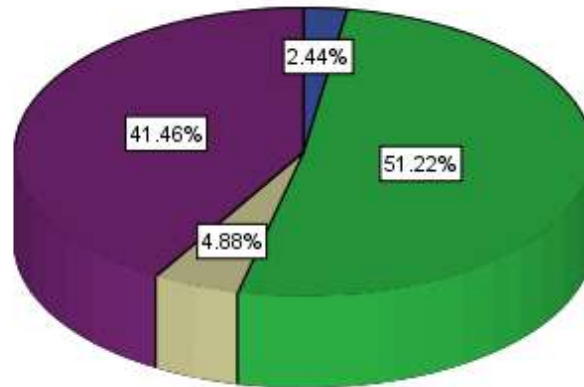


Schedule (4.35) indicates that 51.2% believe that there problem is a result of political reasons, 41.5% believe it as a result of political reasons in addition to the high consumption and scarcity of rain water, 2.4 believe it is as a result of scarcity of rain water and 4.9% believe it is as a result of the high consumption.

**Schedule (4.35): What is the problem in your opinion? One reason or more**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Scarcity of rain	1	2.4	2.4	2.4
	Political reasons	21	51.2	51.2	53.7
	High water consumption	2	4.9	4.9	58.5
	Previous reasons	17	41.5	41.5	100.0
	Total	41	100.0	100.0	

■ قلة الأمطار  
■ اسباب سياسية  
■ استهلاك الماء العالي  
■ الأسباب السابقة



## Chapter 5

### FEASIBILITY STUDY

First of all, here are some figures about water in Palestinian territories

<b>Water access</b>	91%
<b>Sanitation access</b>	89%
<b>Continuity of supply</b>	62.8%

**Average domestic water use (liter/capita/day)** West Bank: 50  
(2005/2009) Gaza strip: 70

**Average urban water tariff (US\$/m3)** 1.20

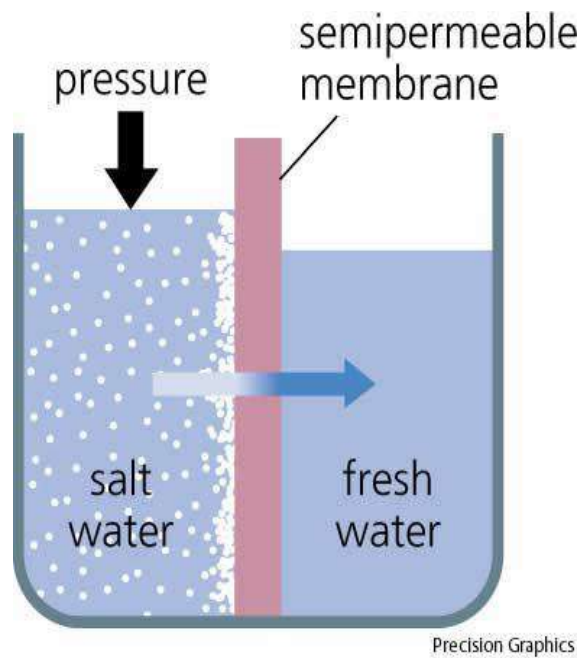
**Share of household metering** n/a

**Share of collected wastewater treated** West Bank: 15%  
Gaza Strip: 62% (2001).

**Non-revenue water** 44%

**Annual investment in water supply and sanitation** n/a

**Sources of investment financing** Mainly from external grants



The picture above clarifies in a simplified way how water is desalinated. The result is fresh water with a high degree of purity.

To find out how much is the cost of water desalinated here is a graph that shows the details of the various costs. These costs were deducted from those incurred by other parties outside the Palestinian territories, mainly Jordan and Israel.



The total water desalination cost		
Cost item	NIS/m2	% of TWP
Base fixed price	1.315	59.2
Base variable price		
- Energy	0.565	25.4
- Membranes	0.120	5.4
- Filters	0.20	0.9
- Chemicals	0.090	4.1
- Post treatment	0.040	1.8
- Others	0.070	3.2
- Subtotal	0.905	40.8
- Base total water Price (TWP)	Base total water price 2.220	100

**Customer tariff (for each period/2 months) for the Jerusalem Water Undertaking:**

**The tariff for the bulk customers: 4.2 shekels for the meter cubed.**

Consumption in meters cubed	Tariff of meter cubed in shekels
Until 10	4.10
11-20	4.60
21-40	4.85
41-100	6.30
More than 100	6.85

The tables above show clearly that there is a significant segment of the Palestinian community is willing to pay more money in order to have access to clean and sustainable drinking water supply. The costs of desalinated water could be covered from the water tariff while the earning profits.

## Chapter six

### CONCLUSIONS AND RECOMMENDATIONS

Based on the questionnaire and the feasibility study here are my conclusions and recommendations:

- ▶ Implementation of autonomous desalination technologies powered by renewable energy at eastern aquifer, River Jordan, Mediterranean sea.
- ▶ Overcome water shortage and increase water supply by desalinating brackish water.
- ▶ Better water quality.
- ▶ Sustainable and reliable water supply.
- ▶ Protecting water resources.
- ▶ Savings in purchased water required to overcome the shortage.
- ▶ Energy savings.

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