



BMBF IWRM Programme

Funding no FKZ 02 WM1079

SMART-IWRM

DELIVERABLE 709

Social acceptance of IWRM alternatives in West Bank

Abdel Rahman Tamimi (PHG)

Ayman Rrabi (PHG)

Muath Abu Saada (PHG)

Subha Ghannam (PHG)

Palestinian Hydrology Group

September , 2012



Funded by

Federal Ministry
of Education
and Research

Project Coordination:

Main Coordinator:

Prof. Dr. Nico Goldscheider

Karlsruhe Institute of Technology

Adenauerring 20b

76131 Karlsruhe

Germany

Phone: +49 (0) 721 6084546

+49 (0)721 608 - 47610

+49 (0)721 606 279

Web: www.agw.kit.edu

Assistant Coordinator

Dr. Jochen Klinger

Karlsruhe Institute of Technology

Adenauerring 20b

76131 Karlsruhe

Germany

+49 (0)721 608 - 47610

E-Mail:

jochen.klinger@kit.edu

Contents

DEFINITIONS.....	7
Chapter one: Integrated water resources management And Drivers for social acceptance.....	8
1. Concept of Integrated Water Resources Management. (IWRM).....	8
The 5 Th World Water Forum 2009, March.....	9
2. Future Challenges of IWRM.....	9
3. Value of Water	10
4. Water Policy and Reform.....	11
5. Good Governance.....	12
6. The main drivers for social acceptance	12
6.1. Water and Poverty	12
6.2.. Water Pricing and Tariff Structure.....	13
6.3. Willingness to Pay.....	14
7. Arguments against Relying upon Willingness to Pay.....	14
8. Affordability.....	16
Chapter two :Literature review and theoretical framwork.....	17
1. Literature review	17
2. Social acceptance of WWR: Influencing factors and theoretical perspectives	18
3. Economic viability	22
4.. Economic and socio-cultural contexts.....	23
5. Local knowledge and experiences associated with WWR.....	26
Chapter three :Jericho case study	28
1. Physical Characteristics (location, surface area, land use, topography)	28
2. Hydrology and Climate	29
3. Population and Socio- Economic Conditions.....	31
Employment.....	31
Water	31
Economic Activity	32
4. Water resources	36
conventional Water Resources (Surface and Groundwater).....	36
Non-Conventional Resources (Runoff, Treated Effluent ...).....	37
6. Supply –Demand	38
_Water Demand Projection scenarios.....	38
Agricultural Demand	40
7. Methodology	44
Reviewing Previous Work	44

Data Collection and Storage.....	44
Stakeholder Meetings and Consultation.....	45
Field Surveys.....	45
Household survey	46
Agricultural survey	47
Data collection tools.....	47
Sample design	48
Data collection and analysis.....	49
Obstacles and constraints	50
8. Water Tariff and Fee Collection.....	51_Toc360091064
9. Income levels and Affordability:.....	52
10. Willingness to Pay.....	54
11. Commercial Tariff structure:.....	56
12. Agricultural Tariff System:	57
13. The Existing Agricultural Tariff System:.....	57
14. Farmers' Socio-economic Background (Survey Findings):	59
15. Willingness to Pay:.....	60
16. Main Weaknesses of the Current tariff	61
17. Income levels and Affordability:.....	63
18. Willingness to Pay.....	65
19. The Degree of Satisfaction with Municipal Water Services:	66
20. Proposed Domestic Water Tariff for Jericho	67
21. Farmers' Socio-economic Background (Survey Findings):	77
22. Social acceptance of different IWRM options.....	83
Chapter 4: Conclusions and recommendations.....	85

List of Tables

Table 1. Long term monthly averages of climate parameters of Jericho.....	30
Table 2: No. of entries and departures through king Hussein Bridge.....	33
Table 3: Average water use.....	35
Table 4: water distribution for the domestic network under Do Nothing Scenario.....	39
Table 5: water distribution for the agricultural network under Do Nothing Scenario.....	40
Table 6: Supply/Demand for Ein As -Sultan spring under Do Nothing Scenario	42
Table 7: Supply - demand for irrigable lands east of Jericho city under Do Nothing Scenario.....	43
Table 8: IWRM Applications.....	44
Table 9: Sample design for agricultural survey	49
Table 10: Current tariff structure	51
Table 11: Number of customers per block.....	52
Table 12: Income Level and affordability	53
Table 13: Public water use	54
Table 14: Willingness to pay	55
Table 15: Current bill payment rates and frequency.....	55
Table 16: Commercial water users and their price block rates	57
Table 17: Types and characteristics of water shares.....	58
Table 18: Farmers income levels	59
Table 19: Family size and farming contribution in farmer's income	60
Table 20: Farmers perception on water price	60
Table 21: Farmer's willingness to pay	61
Table 22: Affordability of users to pay for water	63
Table 23: Public water use categories and quantities	64
Table 24: Willingness to pay for water service	65
Table 25: Current rates of bill payment	66
Table 26: Total cost of supplying domestic water to the city of Jericho	70
Table 27: Proposed Tariff for Jericho City	70
Table 28: The current commercial water tariff	73
Table 29: Proposed Commercial and Industrial water tariff.....	74
Table 30: Existing agricultural water tariff.....	76
Table 31: Average Monthly income of farmers.....	78
Table 32: Income level of full time farmers	78
Table 33: Farmer's perception on water prices	79
Table 34: Farmer's conditional willingness to pay more	79
Table 35: Production cost of agricultural water.....	80
Table 36. % of people perception towards different treatments approaches	82

List of figures

Figure 1 : Agro Industrial Park	34
Figure 3: Surface catchment areas and runoff	38
Figure 4: Supply - demand quantities for the domestic network under Do Nothing Scenario.....	40
Figure 5: Supply - demand quantities for agricultural network under Do Nothing Scenario.....	41
Figure 6: Spring utilization under Do Nothing Scenario	42
Figure 7: Supply - demand for Ein As- Sultan spring under Do Nothing Scenario	43
Figure 8: Geo - database structure	45

Figure 9: Neighborhoods used for sample design.....	47
Figure 10: Agricultural network lines used for sample design	48
Figure 11: Degree of customer satisfaction	56
Figure 12: Interviewed farmer's main source of income	59
Figure 13: Degree of satisfaction with water quality	67
Figure 14: Amounts paid according to water quantities used.....	71
Figure 15: also shows the average price per cubic meters used for both domestic, commercial and industrial.....	71
Figure 16: Cost Recovery and Social equity resulted from the proposed tariff.....	72
Figure 17: Farmers main source of income	77
Figure 18: Level of drivers for social acceptance	82
Figure 19: willingness to pay the real cost.....	83
Figure 20. %of interviewed farmers willingness to pay for different options	84

DEFINITIONS

Economic efficiency: Water resources are used in the most efficient way at the lowest possible social cost, from financial, resource, and environmental perspectives.

Cost-recovery: Tariffs produce revenue sufficient to meet the financial needs of the utility, including operations, maintenance, and administration of the water utility;

Equity & Equality: Equity usually means that everyone gets what's right for them, while equality implies that everyone gets the same thing.

Simplicity and understandability: tariffs have to avoid unnecessary complexity and be clear to utilities, water users and decision-makers.

Operation, Maintenance and Administration Cost. (O.M&A): Cost of sales, sales expense, and administrative fees less depreciation

Conventional water resources: Surface and groundwater resources

Donum/ Dunam: $1000\text{m}^2 = 0.1 \text{ ha}$

Fresh water: Water that can be used for household consumption

Investment cost per water unit: ($\text{US\$}/\text{m}^3/\text{unit}$) Total investment cost relative to the total annual production

New and additional water: Additional water resources from outside of the region

Net Water Gap: The differences between the volume of water that is produced from existing conventional water resources and the need for new and additional water resources

Unaccounted for water: The differences between the volumes of water delivered into a distribution system and the volume of water billed/recorded

Water security: $\geq 1,700 \text{ m}^3$ per capita per year of renewable water¹

Water stress: $\geq 1,000$ and $< 1,700 \text{ m}^3$ per capita per year of renewable water.²

Water scarcity: ≥ 500 and $< 1,000 \text{ m}^3$ per capita per year of renewable water.³

Water absolute scarcity: $< 500 \text{ m}^3$ per capita per year of renewable water.⁴

¹ Source: adapted from World Bank (2007a).

² ibid

³ ibid

⁴ ibid

Chapter one: Integrated water resources management And Drivers for social acceptance

1. Concept of Integrated Water Resources Management. (IWRM)

The concept of the integrated water resources management has been around for nearly 60 years. It was rediscovered in the 1990s in order to try to give specific references. While at a first glance, the concept of IWRM looks very attractive, a deeper analysis brings out many problems both in concept and implementation (Biswas, 2004). Each country however, has created its own model which takes into consideration all socio-economic, political and environmental dimensions. The IWRM concept should be a continuous process and a part of the general policies trends in each country.

The Technical Advisory Committee of the Global Water Partnership defined Integrated Water Resources Management (IWRM) “as a process, which promotes the coordinated development and management of water, land and related resources in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems,” and emphasized that water should be managed in a basin-wide context, under the principles of good governance and public participation (GWP, 2000; GWP, 2003).

IWRM is not a new idea. In a number of countries, water management has been institutionalized in an advanced and integrated way over centuries. Embid writes that Spain was probably the first country to organize water management on the basis of river basins, as it adopted the system of “confederaciones hidrográficas” in 1926. (Embid, 2003). Over the last several decades, there have been serious attempts to implement IWRM in different global regions. In the 1940s, an early version of IWRM occurred when the Tennessee Valley Authority began to develop the water resources for that region (Barkin and King, 1986). Several international events recommended or mentioned IWRM as the most acceptable approach in order to achieve a holistic management of water resources.

At the United Nations Conference on Water in the Mar del Plata (1977), IWRM was the recommended approach to incorporate multiple competing uses of water resources. Although in the 1980s water disappeared, for the most part, from the political agenda; the situation changed in the 1990s thanks to the efforts of a number of conferences and international organizations. Efforts such as the International Conference on Water and Environment (1992), Second World Water Forum (2000), International Conference on Freshwater (2001), World Summit on Sustainable Development (2002) and Third World Water Forum (2003) collectively led to breakthroughs that thrust IWRM onto the political agenda. The most important international events where IWRM was mentioned are as following:

Dublin 1992: International Conference on Water and Environment

In January 1992 International Conference on Water and Environment Issues for the 21st Century, held in Dublin, Ireland. Current thinking on the crucial issues in water resources is heavily influenced by the Dublin Principles, which are (ICWE, 1992)⁵:

- Fresh water is a finite, vulnerable and essential resource, which should be managed in an integrated manner ;
- Water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels ;

⁵ Statement of International Conference on Water and Environment(1992)

- Women play a central role in the provision, management and safeguarding of water ; and
- Water has an economic value and should be recognized as an economic good, taking into account affordability and equity criteria.

The Hague 2000: Second World Water Forum & Ministerial Conference.

The key issue raised in the Second World Water Forum related to IWRM is the importance of efficient management through public participation, recognizing the right to access and to make water ‘everybody’s businesses. (WWC, 2000)

Johannesburg 2002: The World Summit on Sustainable Development (WSSD)

In the end of August -September 2002, The World Summit on Sustainable Development was held in Johannesburg, South Africa. The summit endorsed several concepts of IWRM through integration the policies and strategies, the concept of Public Private Partnership (PPP) and the stake holders’ active participation. (WSSD, 2002).

The Third World Water Forum - Kyoto 2003

. The ministerial declaration vowed support to enable developing countries to achieve the UN Millennium Development Goals, and for developing IWRM and water efficiency plans in all river basins worldwide by 2005, the target set at the World Summit on Sustainable Development (TWWF, 2003).

The 4th world water forum 2006 ,March

the ministerial declaration reaffirms the past forums and focused on IWRM Concept in the following article

“Reaffirm our commitment to achieve the internationally agreed goals on

Integrated water resources management (IWRM), access to safe drinking water and basic sanitation, agreed upon in Agenda 21, the Millennium Declaration and the Johannesburg Plan of Implementation (JPOI). We reiterate the continued and urgent need to achieve these goals and to keep track of progress towards their implementation, including the goal to reduce by half, by the year 2015, the proportion of people unable to reach or afford safe drinking water.”⁶

The 5th World Water Forum 2009, March

The main issue raised in this forum was how the acceptance of the privatization as a management style will protect the rights of the consumers and deals with affordability problem, this hot issue shifted the attention to the importance of stakeholders’ participation and listening to the voice of poor and civil society.

2. Future Challenges of IWRM

The international community now recognizes IWRM as the most efficient and effective water resources management mechanism to enhance **economic well-being, social-equity, and environmental sustainability**. But current IWRM principles are often overlooked due the reality on the ground. The integration of different sectors related to water management is a difficult and challenging task. In addition, the problems and solutions associated with IWRM implementation in different regions are not universal. Overly general or universal policies and guidelines for implementing IWRM may become counterproductive. Integrated water resources management (IWRM) is nowadays regarded as the vehicle that makes the "integrated

⁶ Article 2 of the ministerial declaration of 4th world water forum

view" of sustainable development operational for the management of water resources, since the interests of people, society, economy, and environment are seen as an interconnected whole (and where tradeoffs concerning all interests need to be taken into account). The holistic approach adopted in IWRM implies that information is needed on the state economy, society, and water resources. The most widely adopted indicator framework is the Drivers-Pressure-State-Impact-Response (DPSIR) Framework developed by the Organization of Economic Cooperation and Development (OECD) in 2003. According to the DPSIR, social and economic changes, such as population growth, agricultural policies, food demand and uncertainties potentially cause different kinds of pressures on the environment. The DPSIR Approach is widely used in order to understand what kind of policies should be implemented in order to achieve IWRM. This approach heavily depends on the major functions of indicators and the trends of the indicator overtime. However one of the shortcomings of this approach is that the accuracy of the indicators affects the overall conclusions.

The UN–Economic and Social Commission for West Asia (UN-ESCWA) has two sets of indicators for the water sector, the first one related directly to water aspects (environmental sustainability and water supply data), while the second is related to socioeconomic aspects (equity, affordability...etc). The main targets of the two sets are: an enabling environment (policies and regulation); institutional roles (performance indicators of utilities) and management instruments (economic, social instruments). Many academic studies query how to achieve the optimal benefits of IWRM and how to use it to achieve a combination of **social, economic, and environmental results**. What kind of policies should be taken by decision makers to achieve an efficient system that takes into consideration the socioeconomic uncertainties of each country?

3. Value of Water

Many past failures in water resources management are attributable to the fact that water has been – and is still – viewed as a free good(based on religion or culture), or at least that the full value of water has not been recognized. In a situation of competition for scarce water resources such a notion may lead to water being allocated to low-value uses and provides no incentives to treat water as a limited asset. In order to extract the maximum benefits from the available water resources there is a need to change perceptions about water values and to recognize the opportunity costs involved in current locative patterns.

Value and charges

Concern has been voiced over the social consequences of “the economic good” concept: (While the Dublin principles refer to water as an economic good, water is referred to as an economic and social good in Chapter 18 of Agenda 21) . The concept of water as an economic good (cost-benefit based management) will impact the sustainable livelihood of the poor people since their affordability to secure water for drinking and food production very low, the social fairness requires associating this concept with basic human and water rights, and this should be reflected at policy and management levels. To avoid confusion over this concept there is a need to distinguish clearly between valuing and charging for water. The value of water in alternative uses is important for the rational allocation of water as a scarce resource (using the “opportunity cost” concept), whether by regulatory or economic means.

Charging for water is applying an economic instrument to affect behavior towards conservation and efficient water usage, to provide incentives for demand management, ensure cost recovery and to signal consumers' willingness to pay for additional investments in water services.

4. Water Policy and Reform

The objective of a water policy is to serve as a set of standards for judging the effectiveness of institutions for allocating and managing water (Porter, 1996) Seppa'la analyzed the trends in policy development, he mentioned that the early water development tended to be project specific and fragmented with little exchange of information and experiences between countries and among agencies (Seppa'la', 2002). Towards the end of the 20th century, international agencies and countries have begun to have much more interaction and cooperation with regard to development of water policies and strategies. His paper mentioned difficulties in convincing most of the governments to reform their policies because many of them assume that their water policy is appropriate and justified. Seppa'la' in his detailed paper summarized the pre- conditions and key requirement and approaches for success in water policy and its reform implementation are: "the Institutional change and the factors affecting it, Institutional Incentives (staff, organization), integrated, comprehensive and systematic approach, effective stakeholder participation at all levels effective dissemination and development of adequate capacity for implementation at all levels."

However one of the important preconditions is highlighted by Dinar (1998); the importance of integrated and adequate information in order to create effective water resources development and management policy, additionally his emphasis, on the relationship between water sector policy and other sectors. "New policies should develop a water resources, frame work that account for the future needs of all water use sectors, including the environment, it should be recognized that any sector policy affects".(Dinar, 1998)

However the most important driver for any policy reform is the willingness of politicians. Although the literature contains a rich set of studies on the political economy of institutional and policy reforms, generally speaking very few studies exist addressing figuring out the political circles in bringing out of reforms , additional to that the socioeconomic impact of any accepted option of the reform is highly sensitive for them.(Paul,1990;Azis,1997;Bromly 1989;Nelson,1992).Despite all the above mentioned references constrains to adopt a comprehensive implementable water policy reform, there would be widespread consensus on the following principles to govern the formulation of national policy ; Water is a holistic resource, a scarce commodity and an environmental asset. Basic human right, many stakeholders' involvement, and economic efficiency. (DFID, 1997, Molle and Mollinge, 2003.Poverty –Environment Partnership, 2004.Gray at el, 2006)

The best of our knowledge, the literature does not provide information how to measure the political influence and the political risk of policy reform. However no pre-fabricated model for integrated water management or policy reform, the socio economic and political context of each country is determining the guidelines and main components of the water policy. Additionally, it is a pre-condition to have a proper institutions and legal system to formulate and implement the policy reform, additionally ,the literature is lacking the information and tools how to deal with

continuation of reform process during the uncertainties ; politically (instability of government or internal violence ; socioeconomic and financial (in particular in the countries are highly depend on international aid) , also, the literature is very limited in describing how to keep the utilities performances at acceptable level without more burden on the people who suffer from instability , also the literature rarely mentioned the importance of transiently reform in particular in the new born countries where the central government very weak and vulnerable for influence by several political and social powers.

5. Good Governance

Implementing an IWRM process requires implementing three pillars correctly:

1. Moving towards an enabling environment of appropriate policies, strategies and legislation for sustainable water resources management and development.
2. Putting in the place the institutional framework through which the strategies and policies can be implemented
3. Setting up the management instrument required by these institutions to do their job. (Clausen, 2004)
4. Guarantee social acceptance of the approach

6. The main drivers for social acceptance

Water and Poverty

The application of IWRM concept may be harder in developing countries, giving rise to researchers and international organizations linking water and poverty: 'for humanity , the poverty of a large percentage of the world's population is a both a symptom and a cause of the water crises. Giving the poor better access to better managed water can make a big contribution to poverty eradication (Ojen et.al 2005).Among international organizations (IOs), the United Nations Development Program (UNDP) and the World Bank have influenced the poverty research agenda worldwide, through their yearly reports and extensive lobbying (Human Development Reports, 1999-2006, and World Development Reports, 1978-2004). UNICEF has its own research centre which produces a rich literature on the conditions of children (including access to clean water) deprived of care (UNICEF Reports, 1989-2005).

The most notable recent international event to draw attention to these issues was the UN World Summit on Sustainable Development in Johannesburg in 2002. An important outcome of the summit was the reaffirmation of the UN Millennium Development Goals (MDGs), including goal number seven, which is to "Ensure environmental sustainability." Especially relevant to the water sector is target 7c, which aims to reduce the proportion of people without sustainable access to safe drinking water by half by 2015. Equally important and, in many cases dependent on safe access to water, is goal number one: "Eradicate extreme poverty and hunger".

In addition to poverty-related research of international organizations(IOs), national poverty reports or plans of action for poverty reduction are in progress or being

initiated in many countries (For example, in Palestine, three poverty reports have been published)⁷. Also water is seen as one of the most critically-stressed resources, and much attention has focused on global water stress and the water needs of the poorest (Sullivan *at al.* 2003). The awareness of water and poverty-related issues as fundamental to sustainable human development, through the MDGs and national poverty reports, has spurred many researchers to focus on the best approaches and representative indicators in order to formulate policies to achieve such goals as poverty reduction and integrated water resource management. An important issue has been the relationship between poverty as a socioeconomic term and water scarcity as a water management term. The past decade has seen much progress in the conceptualization of the link between poverty and water. This progress has also been given impetus by the development in the global water sector itself, which has mostly agreed that water, in addition to being an environmental resource, is an economic and social good, as well as a basic human right. (UNESCO, 2003). At the conceptual level, the link between water and poverty still needs to be further refined. Characterizing poverty through water needs further work on development of a conceptual link and analytical framework of water to poverty to include different relevant facts.

6.2... Water Pricing and Tariff Structure

It becomes clear that efficient water management and policy reform are required for the integration of socioeconomic indicators and understanding the entire social process. (Sohail and Cavill 2001). Taking into consideration the specific conditions of the country, in particular the nature of its economy and social structure will help in minimize the negative impact of desired reform process. Saleth and Dinar (2000) see these reforms as having common patterns and clear trends, suggesting that reforms are enacted due to both endogenous factors (scarcity, performance detritions, and financial non-viability) as well as exogenous factors (political reform, macroeconomic crises, etc.). Despite efforts at institutional reform, there is still a lot of room for improvement. Many researchers, (Homer-Dixon, 1996. Allan and Karsheanas, 1995) present economic tools as part of policies that can be taken to achieve the following objectives: management efficiency, social fairness, and improvement of performance indicators of utilities. The major debate on which application works best continues to focus on water pricing and tariff structures.

In practice, water policy and tariff structure may be designed to meet many objectives, including political ones (Dinar and Subramanian, 1998). After reviewing water experiences across 22 countries in various sectors and over time, experience shows that countries have different reasons for charging for water, including cost recovery, redistribution of income, improvement of water allocation, and water conservation. The willingness of countries to undertake water pricing reforms and successfully implement them cannot be solely explained by their water scarcity levels or by the size of their budget deficit, since high income countries have been relatively more open to reforming water pricing policies (Dinar *et al* 1998). An important

⁷ The ministry of planning and national poverty reduction committee published three reports between 2002-2005 , All reports done by stakeholders consultations and field surveys

question in the field is which pricing and tariff structure should be applied under diverse socioeconomic and political conditions.

6.3. Willingness to Pay

Willingness to pay is a dynamic parameter resulting from the combination of affordability and willingness to use. The latter 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. It is a function of many technical, institutional, financial, and legal factors. It may also include factors such as the scarcity and value of the resource. Meanwhile, affordability is the expression of ability to pay for a service or commodity and is a function of the price of the service or commodity and the income of the user. It has been stated that the cost of water supply should not exceed 5% of family income (Katko, 1990.Awad,2009) However, this rule of thumb is questionable; in fact, the ability to pay criterion can at best be only a broad guideline and represents an external assessment (WHO, 1989). Accordingly, determining willingness to pay by users is not an easy process, simply because some users may value a service more than others and therefore, they may be willing to pay a higher price than others. However, careful measurements of willingness to pay will provide an insight into public opinion regarding the value of water and will allow for the inclusion of public concerns regarding water prices into any future water pricing policy.

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. This vicious circle should be broken with an affordable amount of money. For that, efforts should be taken to improve willingness to pay/ use by some socio-cultural activities. (Islam and Vincent, 1999).Three sets of characteristics jointly influence a household's willingness to pay for improved water supply (World Bank Water Demand Research Team, 1993):

- Socioeconomic and demographic characteristics: education, occupation, size and composition of family, income, expenditure and assets;
- The nature of existing (traditional) water systems versus those of improved supply systems on offer: cost (both financial and time required to collect water), quality and reliability of supply;
- Household attitudes toward government water policies and their sense of entitlement to government services.

7. Arguments against Relying upon Willingness to Pay

Meier (1983) writes that there are a number of arguments against relying entirely upon the willingness of consumers to pay as a criterion for supplying them with water. These include consideration of external benefits, the extent of consumer knowledge, and the ability to pay. Given the difficulties described, there are particular doubts as to the practical relevance of the concept of ability to pay in arriving at a judgment about willingness to do so. There is much evidence that even where consumers are wealthy, they often refuse to pay or otherwise cause difficulties for a water authority which is attempting to introduce or increase water charges. This leads us to suggest that the only way in practice to address this issue is, rather than to conduct elaborate, assumptive socioeconomic surveys, to “test the market” by the

gradual introduction of new tariff policies, and then to observe consumer reaction before deciding to increase those charges or to expand capacity. (Meier, 1983)

Webb and Iskandarani (1998) share the opinion that household response to a new, possibly 'improved' water supply is not due to one set of determinants alone, but to their joint effect. This suggests a need for careful consideration of the potential correspondence between public sector concerns for an appropriate water supply policy and local peoples' wishes as reflected in their willingness-to-pay. It has been suggested that households usually pay, or are willing to pay, 3 to 5 percent of their income for an improved water supply (World Bank Water Demand Research Team, 1993). Yet since income is not the only or even principal determinant of water demand, the share of income that a household is willing to pay varies widely according to local context. Furthermore, the reliability of water supply, one of the elements influencing people's willingness to pay for improved water supply service, should not be underestimated. Unreliable service can discourage people from having their household connected to a piped water system. At the same time, one should keep in mind that the willingness to pay may differ from the ability to pay. It cannot always be assumed that individuals who are willing to pay for a basic service will be able to do so (Webb and Iskandarani, 1998).

Meier mentions also the following: "Experience suggests that in the public utilities field in general, the only way in which the minimum economic worth of investments can be determined is by giving consumers themselves the chance to let authorities know how much they value the service". (Meier, 1983, PHG, 2003). However the method to estimate the willingness to pay is also controversial. Pearce (1998) stated that "The aim of the Contingent Valuation Method (CVM) is to elicit valuations- or "bids" – which are close to those that, would be revealed if an actual market existed. The hypothetical market- the questioner, questionnaire and respondent – must therefore be as close as possible to a real market. The respondent must, for example, be familiar with the good in question. If the good is improved scenic visibility, this might be achieved by showing the respondent photographs of the view with and without particular levels of pollution. The respondent must also be familiar with the hypothetical means of payment vehicle. The questioner suggests the first bid (the "starting – point bid (price) ") and the respondent agrees or denies that he/ she would be willing to pay it. An iterative procedure follows: the starting – point price is increased to see if the respondent would still be willing to pay it. And so on until the respondent declares he/ she is not willing to pay the extra increment in the bid. The last accepted bid, then, is the maximum willingness to pay (MWTP). The process works in reverse if the aim is to elicit willingness to accept (WTA) bids are systematically lowered until the respondent's minimum WTA is reached. A very large part of the literature on CVM is taken up with discussion about the "accuracy" of CVM. Accuracy is not easy to define. But since the basic aim of CVM is to elicit "real" values. A very large part of the literature on CVM is taken up with discussion about the accuracy of CVM. Accuracy is not easy to define. But since the basic aim of CVM is to elicit "real" values. (Pearce, 1998). A bid will be accurate if it coincides (within reason) with one that would result if an actual market existed. Merit (2005) in his critical review of the willingness to pay concepts uses in the 11 studies from Caribbean Africa, and Asia concludes as: "The importance to understand of the existing local market for the services mentioned the water demand school, particularly Dale Whittington, have made a great contribution to our comprehension of these hydro social processes from the point of abstraction to the

moment of water purchase by the household. This now needs to be complemented by an attempt to grasp how much water is used by the family by whom and to what purpose without this baseline behavioral ground work, projects are exposed to a greater risk of failure". (Merit, 2005)

Also merit added our understanding of future household Behavior requires semi structural interviews primarily with families female adults. (Merit, 2005)

8. Affordability

A critical distinction when considering affordability is the difference between willingness-to-pay and ability-to-pay. Willingness-to-pay reflects consumer preference about purchasing a quantity of goods or services relative to prices. As prices rise, particularly for essential goods and services, consumers may demonstrate a reluctance or unwillingness to pay (EPA, 1997). Ability-to-pay raises another host of issues. Ability-to-pay focuses not on whether consumers will pay for water service, but whether consumers can pay for water service. Ability-to-pay is primarily a function of income related to the cost of living, which in turn is primarily a function of employment. Income (weighted by the cost of living) and employment measures often are used in estimating a community's socioeconomic conditions and the related ability of consumers to support utility costs (EPA, 1997). The affordability assessment framework recognizes the flow of resources that affect water systems and the different resources available to different types of water systems. The framework can be used not only to understand affordability issues but also to explore options for addressing affordability concerns.

Chapter two: Literature review and theoretical framework

1. Literature review

Integrated management of water resources: role of water reuse the development and implementation of wastewater reuse practices around the world have shown that reclaimed water is a proven, reliable alternative resource, which can be sold as a new product: *recycled water*. More importantly, water reuse can bring in a whole new, Holistic approach to water management: *integrated resource management with water reuse*, including wastewater management. This approach addresses both ends of the process: water demand and supply, and wastewater disposal and environmental protection.

These two aspects of water management are regarded as complementary, interacting strands for progress towards more sustainable development. The notion of sustainable development encompasses several requirements including economic development on the basis of existing natural resources, but without damage to the natural environment. Figure 1 Renewable water resource exploitation rates in some European and Mediterranean countries, in comparison with the USA and South Africa

It is an approach that favors the creation of closed, decentralized loops using alternative solutions suited to local constraints, and responding to present and future needs. Reusing wastewater with the use of appropriate treatment technologies shortens the natural water cycle. To develop an integrated water management strategy in countries where water is short

one must analyze all aspects of the following alternative solutions: (1) developing any undeveloped water resource, including desalination of brackish or sea water, (2) wastewater treatment and reuse, (3) inter-basin transfer, (4) more efficient irrigation systems, (5) minimizing water leakage, (6) application of adequate charges for water, and (7) importing

Water from neighboring countries. Improving the efficiency of water use and reducing waste and losses in distribution systems are the most affordable ways to address the problem of water scarcity; but pricing reforms, improved wastewater treatment technologies and wastewater reuse are becoming essential. For almost all arid and semi-arid regions in the Mediterranean countries, where current fresh water reserves are at a critical limit, recycled wastewater is already the only affordable water management policies in high-density urban areas in the United States, Japan and the UAE. Indirect potable water production from wastewater is carried out on a large scale in the United States and becomes an important issue in Europe. The only existing example of direct potable water production is the Windhoek plant in Namibia: 25% recycled water, diluted with natural resource water. No negative impact of this type of water on human health has ever been reported. Aquifer recharge for indirect potable reuse is considered one of the most promising avenues for augmenting water supply with treated wastewater in dry regions, especially if advanced reclamation treatments become cheaper. (V. Lazarova *et al.* 2001)

The literature examines theories and concepts relevant to the current study. It situates the assumptions of the study in related theoretical frameworks within social and psychological literature on social acceptance of WWR. In addition, it provides a

platform for identifying and defining the study indicators in the light of relevant international, regional, and local literature.

Several literatures address the dilemma of social acceptance of WWR. In particular, it furnishes a literature review of factors influencing public acceptance of potable and non-potable WWR applications, including agricultural WWR. Since the majority of this literature focuses on acceptance of potable WWR applications, and only few studies explore factors influencing acceptance of WWR for agricultural irrigation, this chapter starts by examining themes emerging from the former to identify the types of factors likely to influence social acceptance of agricultural WWR. Afterward, it draws on research more specific to acceptance of agricultural WWR, mainly farmers' acceptance of using RW for irrigation and consumers' acceptance of buying crops irrigated with RW.

2. Social acceptance of WWR: Influencing factors and theoretical perspectives

During the late 1980s to mid 1990s, a number of high profile indirect potable reuse projects in the USA and Australia encountered strong public opposition and resistance that led to postponing and even halting these projects after long planning and high expenditures (Beck, 2009; Hartley, 2006; Marks, 2004a; Po, Kaercher, & Nancarrow, 2003; Russell & Lux, 2006).⁸ Phrases like “Toilet to tap”, “Sewage Beverage”, and “Citizens against Drinking Sewage” were commonly raised in the public dialogue (Beck, 2009; Hartley, 2006). Since then, public acceptance has been often viewed as a major “obstacle” and a main “ingredient” of success of any WWR project irrespective of economic, environmental, and engineering considerations (Beck, 2009; Friedler, Lahav, Jizhaki, & Lahav, 2006; Hurlimann, Meyer, & Dolnicar, 2009; Po et al., 2003).

As a result, the social dilemma of WWR received a growing interest amongst researchers and decision makers and presided at the heart of the international debates. In lieu of purely technical and economic questions, the scope of WWR research has broadened to incorporate social inquiries (Marks, 2004a; Russell & Hampton, 2006), mainly about factors responsible for “unfavorable” public attitudes towards WWR (Beck, 2009). The topic of “factors affecting public acceptance of reuse” topped research priorities of water industry stakeholders (Russell & Lux, 2006; Stenekes, Colebatch, Waite, & Ashbolt, 2006). Yet, literature addressing it is limited (Marks, 2004b, Po et al., 2003). On top of that, literature shows contradictions and lack of consensus on what influences perceptions and attitudes towards particular WWR schemes (Mooney & Stenekes, 2008; Po et al., 2003; Russell & Lux, 2006). Therefore, public responses to water reuse are still not well understood (Russell, Lux, & Hampton, 2009).

⁸ Despite a number of successful WWR projects implemented across the world (e.g., Singapore, Namibia, the United States, Australia, Berlin, and several European countries), proposals of specific WWR schemes are often strongly resisted by the community (Mooney & Steinke's, 2008; Po et al., 2003). In particular, potable reuse projects are consistently opposed by the public, with very few exceptions, such as Singapore NE Water Project and Windhoek Scheme in Namibia (Russell & Lux, 2006). In contrast, successful reuse projects were mostly for non-potable purposes (Russell & Lux, 2006).

William Bruvold was the forerunner who led the way to early research into public views and acceptance of WWR in the USA from the 1960s to 1980s (Marks, 2004a; Po et al., 2003; Russell & Lux, 2006). His focus was mainly on associations between socio-demographic characteristics and acceptance levels (Bruvold, 1985; Bruvold & Crook, 1981; Po et al., 2003). Subsequent studies were conducted in the United Kingdom (UK), other European countries, Australia, and the Middle East (Russell & Lux, 2006). Yet, most of research on factors influencing acceptance of WWR has focused on potable WWR (Russell & Lux, 2006). In addition, the scope was limited at finding ways to persuade the public and enhance their acceptance, such as using applied behavioral methods (e.g., offering incentives), social marketing⁹, and providing information/education, rather than identifying the basis of opposition and solving the “problem” of the public (Beck, 2009; Po et al., 2003; Russell & Lux, 2006).

In view of that, much of the available research has focused quite narrowly on individual attitudes and adopted the approach of measuring and predicting factors affecting them (Mooney & Stenekes, 2008; Russell & Hampton, 2006). The premise has been that the “public” is an impediment to “rational” water planning and obtaining “support” will overcome the problem (Mooney & Stenekes, 2008; Russell & Hampton, 2006; Stenekes et al., 2006). Consequently, surveys and quantitative analyses dominated the methodological approaches of most studies on social acceptance of WWR in the previous four decades though open-ended questions were sometimes included for qualitative exploration of public views (Russell & Lux, 2006). Despite their useful insights, surveys and quantitative work were criticized for their limited value in explaining public responses to WWR (Friedler et al., 2006; Marks, 2004a; Russell & Hampton, 2006; Russell & Lux, 2006, 2009) due to reasons including

- difficulty in generalizing quantitative results across different contexts (space and time);
- skepticism about the validity of some claims even for the population sampled; and
- limitation in capturing complex processes of social interaction (Bickerstaff, 2004);
- the premise of the quantitative approach that assumes measurable and stable “attitudes” rather than dynamic ones that could be far more context-dependent; affected by local and national factors (Marks, 2004a; Mooney & Stenekes, 2008; Russell & Hampton, 2006; Russell & Lux, 2009).

In contrast, Marks (2004a) appreciated the role of peoples’ cultural, political, and environmental values, attitudes and behaviors, besides their demographic characteristics, in shaping their stands towards potable WWR. Concurrently, Russell and Hampton (2006) argued that “responses may be far more context-dependent, far more influenced by contingent political and cultural factors and local experience, and, perhaps, paradoxically, based on deep but usually unarticulated values” (pp. 217-218). Along a similar vein, Mooney & Stenekes (2008) reported on a broader number of contextual variables that influences individuals’ perceptions and attitudes towards agricultural WWR schemes. They provided evidences on a more viable approach of

⁹ “The premise [of social marketing] is simply to “sell” ideas, attitudes and behaviors using the same types of marketing strategies that are used to sell products” (Redwood, 2004, p.45).

analyzing historical, socio-cultural, and institutional contexts that formulate perceptions and attitudes of individual end-users. In particular, they emphasized on the significant role of institutional structure (organizational framework and legal context) in the initiation, success, and sustainability of agricultural WWR schemes

According to Khan and Gerrard (2006), issues that could influence community response to WWR are likely to be associated with public health, environmental health, economy and finance, available technology and emotional factors. Drawing on Hartley's (2003) report for Water Environment Research Foundation (WERF), in which he reviewed a wide range of research on public responses to WWR from the late 1970s to early 2000, the author concluded on ten factors that contributed to the degree of public acceptance of WWR in the USA. He found that acceptance is likely to be higher when:

- degree of human contact is minimal;
- protection of public health is clear;
- protection of the environment is a clear benefit of the reuse;
- promotion of water conservation is a clear benefit of the reuse;
- cost of treatment and distribution technologies and systems is reasonable;
- perception of wastewater as the source of reclaimed water is minimal;
- awareness of water supply problems in the community is high;
- role of reclaimed water in overall water supply scheme is clear;
- perception of the quality of reclaimed water is high; and
- Confidence in local management of public utilities and technologies is high.

In the light of international literature, this section furnishes a review of a wide range of factors likely to influence public acceptance¹⁰ of potable and non-potable WWR applications, including agricultural WWR. In some cases, existing understandings of these factors are explored based on studies of specific WWR projects and public acceptance or refusal of WWR applications associated with these projects. This section also discusses different theoretical approaches into explaining public responses to WWR including the psychological approach, the psychometric approach, and the cultural approach.

In undertaking this literature review of factors influencing public acceptance of potable and non-potable WWR, different themes emerged. These themes include “proximity” factor and the issue of “salience”, socio-demographics, the “yuck factor”, perceived health risk, the issue of trust, perceived fairness, quality of RW, “individual's sustainability ethic” (including economic viability, attitudes towards the environment, social sustainability-related concerns), and contextual case-specific

¹⁰ In this chapter, the term “acceptance” of WWR refers neither to positive nor negative stands towards WWR unless otherwise specified using the term “support”, “opposition”, “rejection”, or equivalent. On a different note, the majority of studies examining factors influencing social acceptance of WWR did not make a distinction between the terms of “perceptions”, “attitudes”, “acceptance”, “responses”, “views”, or “opinions” when referring to the dependent variable. Therefore, these terms are used in this chapter in accordance to what was used in the context of the reviewed

factors. This section discusses each of the above themes with a main concentration on contextual case-specific factors. These factors refer to factors, conditions, or contexts that should be examined on a case-by-case basis due to considerable variations in contexts across place and time. They are discussed within five main themes including site-specific conditions, economic and socio-cultural contexts, local knowledge and experiences associated with WWR, institutional and political contexts, and public consultation and participation in WWR projects. While this section elaborates on each of the above themes as a dispersed theme, a one should keep in mind that these themes are not completely disconnected, but rather they are highly interlinked and overlapped.

B. M. Haddad (2004) suggested that the “Law of Contagion¹¹” and the “Law of Similarity” have a combined influence on psychological repugnance to treated WW. The “Law of Contagion” suggests that “once in contact always in contact” (Miller, 1997, p. 6). In the context of treated WW, this means that once water has been in contact with contaminants, people might find it psychologically difficult to accept that this water has been purified (Khan & Gerrard, 2006) or to come in contact with what was once sewage (Russell & Lux, 2009). Put differently, treated WW can still be perceived to be disgusting regardless of being treated to highest standards (Po et al., 2003) that could result in equal or better quality than that of traditional sources (Khan & Gerrard, 2006; Schmidt, 2008). Regarding the “Law of Similarity”, it holds that “similarities in appearance mean deeper similarities in substance” (Miller, 1997, p. 6) or “appearance equals reality” (B. M. Haddad, 2004, p. 3); which means that something is perceived to be what it looks like (B. M. Haddad, 2004, p. 3).¹²

In a review, conducted by Po et al. (2003), of international and Australian literature on factors influencing public perceptions of water reuse, the authors pointed out different factors that could create psychological mental barriers to public acceptance of WWR. These include:

- The mental imagery associated with raw sewage from which RW is originated.
- the use history of RW or “source” factor (i.e., in some cases, individuals prefer using RW sourced from their own WW rather than the general public or secondary sources¹³),
- Type of water to be reused (i.e., water subjected to reuse processes rather than natural processes. For example, WW or grey water versus storm water),
- perceived quality and safety of RW (i.e., perceived “filthiness” and “dirtiness” of RW and fears of contagions or personal contamination from using it),
- perceived degree of control over the quality of RW (i.e., perceived application of water quality and safety guidelines, testing and monitoring compliance with standards, regulating and supervising health-related aspects of WWR by responsible authorities, etc. (Khan & Gerrard, 2006)), and
- Terminology used to describe RW (i.e., terminology that focuses on the original source or history of RW, such as “treated wastewater”, rather than on its quality

¹¹ The concept of “contagion” was suggested by Rozin, Millman, & Nemeroff (1986).

¹² For instance, a container contains drinking water marked as “wastewater” will not be consumed.

¹³ A survey study conducted in the UK by Jeffrey and Jefferson (2001) revealed a similar finding on “source” factor.

as end-product, such as “recycled water” or “re-purified water” (Po et al., 2005; Simpson & Stratton, 2011)).

In some case studies, participants explicitly expressed their psychological barriers and feelings of disgust from using RW, particularly for potable purposes. Participants in group discussions conducted by Alexander et al. (2008) to explore perceptions of indirect potable reuse in Queensland, Australia expressed stigmas that reflected a general feeling of unease towards the concept of reusing wastewater, such as “*toilet water*” (p. 13) and “*drinking your own sewage*”(p.13). Likewise, participants in a focus group discussion carried out by Melbourne Water (as cited in Po et al., 2003) expressed their mental imaginary associated with raw sewage. For instance, one of them expressed: “*I guess it is a mental image. Brown solids to clear liquids*” (p. 10).

In Jordan, Carr et al. (2011) investigated farmers` perceptions of the quality of RW they use for irrigation whether directly or indirectly after blending it with freshwater. Results from 56 semi-structured interviews revealed specific features of water quality that concerned the farmers. These features included the effect of RW on soil salinity, potential introduction of parasites, such as nematodes, to their lands, potential damage and clogging of the irrigation systems, and religious considerations and social concerns related to the quality issue, such as marketing crops of RW. Yet, the study showed that farmers` perceived quality did not reflect the actual quality of RW delivered to their farms, and that additional factors interfered with their perception. These factors included farmers` actual and perceived capacity to control and actively choose where and when to apply RW, their capacity to influence the quality of RW delivered to their farms, and their ability to manage the agricultural challenges associated with using RW, such as salinity, damage of irrigation system, and marketing of its produce.

3. Economic viability

Economic viability was the most important component of sustainability prioritized by 41% of growers participated in Kraack`s (2000) study explained in [Section 2.2.7](#). Growers viewed their farms as being a business operation; and economic aspects as being closely connected to on-farm management practices of land and water. Many growers expressed the increased pressure to expand their farms and production levels continuously in order to remain economically viable. Yet, most of them did not view economic viability as the sole consideration of sustainability. (madbouh, unpublished)

In the context of WWR, findings of studies on public acceptance of WWR concur with Kraack`s results. The former showed that individuals` economic concerns related to the price of RW and cost benefit achieved by using it played important role in influencing their acceptance of WWR (Hatton MacDonald & Dyack, 2004; Po et al., 2003), particularly for non-potable reuse applications (Hurlimann, McKay, & Geursen, 2005; Marks, Cromer, Fallowfield, & Oemcke, 2003). Po et al. (2003) pointed out that people generally expected to pay lower prices for RW than for potable water since they perceived RW of lower quality and due to restrictions imposed on their use of this resource. For instance, Marks et al. (2003) conducted a study on benefits and costs of using RW for non-potable applications, including garden watering, irrigation and toilet flushing, in four residential areas in USA and

Australia. They found that the lower price of RW compared to potable water was an attractive incentives for respondents to use RW and that all of them (n=80) were more concerned about the personal cost benefit achieved by using this source rather than water conservation and environmental benefits. In view of that, inquiring about people's willingness to pay (WTP) for RW and factors influencing their WTP is important to facilitate the adoption of RW (Hurlimann, 2008).

Similarly, farmers' economic concerns, mainly those related to the price of RW provided for irrigation and public acceptance of buying crops irrigated with RW, are main determinants of their acceptance of using this resource (Abu-Madi, Braadbaart, Al-Sa'ed, & Alaerts, 2003; Menegaki, Hanley, & Tsagarakis, 2007; Tsagarakis & Georgantzis, 2003). In Jordan and Tunisia, Abu-Madi (2004) found that availability of, or accessibility to, fresh water at low prices and concerns about marketing crops irrigated with RW were among the main reasons behind farmers' reluctance or hesitation to use RW for irrigation. In addition, the author revealed that water prices (including price of RW) and economic profits could change attitudes of 89% and 96% of farmers in Jordan (n=46) and Tunisia (n=50), respectively, towards using RW for irrigation. (Madbough , 2011)

4.. Economic and socio-cultural contexts

Besides the biophysical characteristics of the place, local economic and socio-cultural contexts influencing individuals' values, interests, and practices play an important role in shaping individuals' perceptions of WWR as well as the process of their participation in making decisions related to WWR (Hartley, 2003, 2006; Mooney & Stenekes, 2008; Russell & Lux, 2006, 2009). Yet, few studies focused on examining and understanding this role. This section explains the role of local contextual factors as drivers of, or barriers to, public or farmers' acceptance of WWR. It starts by explaining the influence of contextual economic factors including socio-economic profile of local communities (such as occupation, major source of household income, and employment), prices of fresh water from local sources in the area, and prices of fertilizers used by local farmers. Next, it explains influences of contextual socio-cultural factors including influence of social and cultural norms and ethnic and religious views on water and wastewater; and influence of community structure and networks (i.e., the dynamics within the community) including relations of power within the community, historical construct of power dynamics, and key community figures

Socio-economic profile of local communities, such as occupation, major source of household income, employment, and others, play important role in influencing community and farmers' perceptions of WWR. For instance, in areas where families derive most of their income from activities dependent on irrigation (agriculture), sustainability of farming income can be one of the main drivers for these families to use RW in horticulture irrigation, particularly in cases of water scarcity, as the case of growers using RW from VPS (Keremane & McKay, 2007). Additionally, creating new jobs opportunities for community members is another enhancer for community perceptions of WWR. For instance, horticultural industry is a labour intensive industry and expanding it through providing reliable supply of RW from VPS resulted in creating more job opportunities for communities in the region (Keremane & McKay, 2007).

Local economic factors, such as those related to prices of fresh water from local sources in the area and prices of fertilizers used by farmers, can also have crucial influence on farmers' perceptions of using RW for irrigation. While expensive fresh water in Bottelary River area enhanced some farmers to use cheaper RW (Rui, 2005), availability of fresh water at low prices acts as a barrier to farmers' use of RW in Jordan and Tunisia, as mentioned in the previous section. Additionally, high cost of fertilizers could be a driver for farmers, particularly in developing countries, to use RW and benefit from the nutrients it contains (Abu-Zeid, 1998). Finally, the issue of "high price of mains water" was rated by 32% of Virginian irrigators (n=128) as the most important reason that prompted development of VPS (Keremane & McKay, 2006).

Besides the economic context, socio-cultural context—in which the local community exists, and views on WWR are developed—can fundamentally interfere in shaping community responses to WWR. Nevertheless, research on acceptance of WWR has often ignored this sphere. This ignorance has not allowed for deep-seated interpretations of public responses to WWR, adding to the variability in socio-cultural context across place and time, which does not guarantee that public approval and interpretations of their responses in one context would apply elsewhere. Therefore, research on acceptance of WWR should not only incorporate socio-cultural aspects but also analyze them on a case-by-case basis.

Local customs or cultural belief systems influencing water use in the area, including religious doctrines or traditions and ethnic views related to water and wastewater, may form the basis of people's stance on WWR (Mooney & Stenekes, 2008; Russell & Lux, 2006, 2009). For instance, recycling is a concept highly recognized by Maori people in New Zealand since an integrated holistic approach to water management is required in maori culture, which entails increasing water use efficiency and recycling, and reducing, recycling or eliminating wastewater flow (Morgan, 2006). Therefore, Maori people have been strong proponents of water recycling in New Zealand (Morgan, 2006). In view of that, the role of indigenous perspectives in decision making and sustainability of infrastructure solutions related to water recycling should be acknowledged.

Religious doctrines or traditions, particularly those in which ritual cleansing with water is part of daily spiritual practice, and sacred things is supposed to be protected from defilement, can lead to strong objections to reuse (Russell & Lux, 2006). "Although ritual cleansing is performed with "pure" water, followers may raise concerns about possible contact with "impure" or contaminated water or wearing clothes washed in recycled water, and what such contact means for their state of cleanliness" (Russell & Lux, 2006, p. 14).

Given the importance of cleanliness in Islam (Faruqui, 2001), this issue should be given a particular consideration when introducing WWR to Islamic communities where RW is sometimes viewed as religiously "impure" or "unclean", and thus using it is "haraam" (i.e., unlawful according to Islam) (Al-Kharouf, Al-Khatib, & Shaheen, 2008; Faruqui, 2001). For instance, Abderrahman (2000) mentioned that RW was disposed of without reuse in Saudi Arabia due to unclear Islamic viewpoint on the "purity" of RW after removal of "impurities" by proper treatment. Yet, WWR

expanded greatly in Saudi Arabia and was enhanced by the public when the Council of Leading Islamic Scholars (CLIS) issued an Islamic ruling (Fatwa) on WWR in 1978 (Abderrahman, 2000). The Fatwa makes the use of RW permissible for all purposes (including drinking) provided that WW is treated to the required level of purity for its intended use and does not result in any adverse public health effect (Abderrahman, 2000; Al-Mogrin, as cited in Bazza, 2003; Faruqui, 2001). Nevertheless, in case studies where this Fatwa was not realized by some Islamic communities, opposition to WWR was sometimes based on religious grounds as these communities viewed RW as “unclean and/or impure” from the Islamic point of view (Al-Kharouf et al., 2008).

Therefore, it is wise to consult local religious and cultural leaders over specific proposals regardless of the size of community in question since beliefs and precepts of the community can still have considerable influence on constraining WWR projects (Russell & Lux, 2006). Yet, focusing on cultural norms and religious traditions should be accompanied with focus on routines and everyday practices around water and wastewater (Russell & Lux, 2009).

In addition to the cultural and religious influences, normative influences (i.e., one is influenced or pressured by what other people think and do) are important determinants of individuals' responses to WWR. Dolnicar and Hurlimann (2009) conducted sixty-six qualitative interviews with residents in eight Australian locations and found that friends and relatives were most influential in raising doubts and preventing respondents from drinking RW while scientists and experts were most influential in their decisions to drink RW.

At a different note, community structure and networks, including relations of power within the community, historical construct of power dynamics, key community figures and reference groups, formal and informal institutional arrangements, and legal context managing water use and practices in the area¹⁴, are important levels of analysis to understand community responses to WWR (Kraack, 2000; Mooney & Stenekes, 2008). In a review of research on adoption of rural innovations (including WWR) and conservation practices by rural landholders¹⁵, Pannell et al. (2006) revealed several social aspects influencing landholders' adoption decisions of an innovation. Among these aspects are existence and strength of landholders' social networks and local organizations, history of respectful relationships between landholders and advocates for the innovation including scientists, extension agents, other landholders, and private companies, and ethnic and cultural divisions within landholders' population. Moreover, Kraack (2000) showed how power relations among growers themselves and between growers and the wider community including cane sugar industry affected on-farm decisions, including those related to water management.

Understanding power dynamics, including power of access to resources and information, is important to identify groups in power and key community figures who have the ability to “define” the status of their communities, and thus play a major role in encouraging or inhibiting the adoption of an innovation by other community

¹⁴ Formal institutional arrangements and legal context will be explained in [Section 2.2.8.4](#).

¹⁵ The authors used the term “landholders” rather than “farmers” as many rural landholders are not farmers and differences in the adoption of conservation behaviours between both groups exist.

members (Kraack, 2000). Strategic actions of these figures were found to be influential in enabling innovative WWR schemes in the past and encouraging community involvement in the decision-making process (Mooney & Stenekes, 2008; Stenekes et al., 2006). For instance, in Shoalhaven case study in Australia, the role of a “visionary farmer” in adopting RW was critical to garner support from other farmers for the WWR project implemented in the area (Mooney & Stenekes, 2008). Likewise, the role of innovator and adopter groups of farmers in Coal River case study in Australia was pivotal to the wider acceptance of farming community to use RW (Mooney & Stenekes, 2008).

Kraack (2000) revealed several aspects that affect growers’ status of power in their communities. These aspects included growers’ identity - defined by gender, ethnicity, age, family connections, farm size, and ownership of lands - and their personal history including educational level, localism, and personal relationships with high status members in the community. For instance, growers perceived other growers of better finance as being their leaders in the community whose advice is given weight in their decision-making process.

In conclusion, social acceptance of WWR is not based on simple linear factors but incorporate a wide range of complex and interwoven series of contextual social issues ranging from the community to family and personal contexts.

5. Local knowledge and experiences associated with WWR

A number of early and recent studies on social acceptance of WWR have recognized the role of knowledge locals have about WWR and their experiences associated with RW in shaping their responses to WWR projects.¹⁶ This section explains first the role of “knowledge” factor, whether prior knowledge locals have before the conduct of a research or the knowledge they acquire instantly by providing them with information about WWR throughout the conduct of a research. Second, this section explains the role of “experience” factor.

Findings on correlation between individuals’ prior knowledge about WWR, mainly in terms of treatment process, safety, and benefits, and their acceptance of using RW are inconsistent. Yet, several studies reported positive correlation between the two variables (Baumann, 1983; Bruvold & Crook, 1981; Dolnicar et al., 2011; Hurlimann & McKay, 2004; Jeffrey & Jefferson, 2003; Roseth, 2008; Tsagarakis & Georgantzis, 2003). For instance, a review, conducted by Baumann (1983), of studies carried out in USA between 1960s and early 1970s revealed significant positive influence of “knowledge” on shaping responses to WWR that overcame influences of psychological barriers. The author commented:

What the public thinks and feels about using recycled renovated wastewater appears to depend primarily upon what they know about it and their general educational level rather than on unconscious fears of contamination or general beliefs concerning nature, technology, aesthetics, authority, progress or density. (pp. 82-83)

¹⁶ Since locals’ knowledge and experiences associated with WWR are part of the local context of any community and vary from one community to another, this factor is classified as contextual case-specific factor.

In concord, Australian studies conducted by Hurlimann and McKay (as cited in Russell & Lux, 2006) in Mawson Lakes before and after providing RW for residential applications concluded that an individual's acceptance of using RW increases as knowledge of the system develops. The authors found that those who felt uninformed were more likely to be concerned about potential health risks and future costs associated with the scheme in the area and to have greater expectations about future difficulties facing the scheme.

On the other hand, Marks (2004a) carried out a review of a number of potable reuse studies in the USA, Australia, and the UK, and concluded that no trend emerged for prior knowledge of reuse. Additionally, Marks et al. (2006a) conducted a telephone national survey (n= 2504) to examine Australian acceptance of water recycling from alternative water supplies including RW. The authors found that the majority of participants were willing to use a range of alternative sources of water despite lack of familiarity with the concept of water recycling. They reported that 72.7% of the respondents were willing to use RW of drinking water quality for all household needs while only about one third of the national sample were exposed to the idea of water recycling.

- The literature is lacking a full description on how to deal with political concerns of the decision makers during the process of the policy formulation towards water tariff or other policies.
- Based on the work done on literature review, the author defined the importance of the local conditions to be fully into consideration to formulate water tariff and to suggest the needed reform plans to make this structure workable in order to achieve the predefined objectives.
- Most of the literature considered the water tariff as a static structure, however in order to be efficient the structure should be a dynamic process, without losing the focus and the objectives and flexible enough to deal with uncertainties such as a rapid changes and reforms of institutional arrangements done by political level.
- Despite the fact that water is a necessity for life under all political and socioeconomic conditions, the literature gave very little information and experience on how the decision makers should act under abnormal conditions (civil war, occupation, long term emergencies). Also, the experience of developing countries in water pricing showed the importance of dealing with social and political issues. However the literature rarely mentioned how to deal with this issue during policy formulation and reform process.
- Despite this fact, the literature explained several experience of developing countries for IWRM application, however all these experiences showed that the application should not be as prefabricated model, in other word each country has to choose its own model and the model has to be as part of the entire country socioeconomic model.
- The literature gave several criteria about the methods to define the Basic Human Needs (BHN) for water, however the discussion on the relationship between BHN and the ongoing water scarcity and the deterioration of water services was very shallow.
- The literature explained the importance of the stakeholders involvement in the process of water management but the experiences have been mentioned how

to deal with various interest and the process to facilitate the dialogue among different stakeholders so limited.

Chapter three :Jericho case study

1. Physical Characteristics (location, surface area, land use, topography)

Jericho city (the town of moon, the city of palms or Antony s gift to Cleopatra) which is one of the oldest cities of the world, ten thousand years before the Christ) is located

in the southern part of the Jordan Rift Valley which is extending From Africa in the south to Turkey in the North joining the crossroads of the east-west corridor and north-south corridor. The excavations have proven that the primitive man turned to be a settled one and moved from a hunter to a farmer.

It is 35 km east of Jerusalem and about 14 km northwest of the Dead Sea and 8 km west of the Jordan River and extends over 37,481 dunums. The city has been and will continue to be developed as a regional center for trade, tourism, and agriculture as well as environmental management particularly due to its unique historical, religious and cultural characteristics. Today Jericho City is the only international gateway for Palestinians residing in the West Bank to the outside world.

Due to its suitable climate, relatively abundant water resources and high land fertility the City is well known for its agricultural activities with an estimated 40% of its total land area being used for such purposes giving the City an advantage when compared to other candidates for agri-business plans in the near future.

A large sector of the residents in the Jericho relies on tourism as an essential source of income, as Jericho enjoys great touristic constituents. The large number of historical, ancient, religions and natural sites and the medicinal tourist areas as well as its wonderful weather, it's fantastic nature, its quality services and the colorful recreation means made Jericho focus of attraction as far as internal and external investors are concerned. The town attracted the largest local and international tourism companies to establish five star hotels as well as other touristic utilities. In 1996, investors found Jericho a suitable place to invest in. The size of new investments in tourism sector since 1997 up till 2000 exceeded 180 million US dollars. New hotels were founded to cope with the ever increasing numbers of tourists coming to Jericho and one of the unique salt lakes, the Dead Sea, in the World. Furthermore, it has a rich diversity in terms of flora and fauna and combines both northern and southern type of diversity. It also includes the caves where the oldest evidence of the written bible was found.

2. Hydrology and Climate

In general, Jericho belongs to the tropical zone. The climate is characterized by a long hot and dry summer, and short warm with little rainy winter. Temperature average of the air is ranging between 13.2 and 30 c in January, and August respectively. The mean maximum temperature ranges from 19.1 (January) to 37.6°C (August), while the mean minimum temperature is ranging between 7.4 c° and 22.4 c° for the same months. Figure 4 presents the minimum, maximum and average monthly temperatures in Jericho area.

The mean annual of relative humidity reaches about 52 %, The minimum value of relative humidity is 38% which occurs in May and June during the Khamaseen weather, while the maximum relative humidity of 70% is usually registered in January and December.

Rainfall in Jericho area usually begins in October and continues through May. About 60% of the annual rainfall precipitated in that period between December and February, while 28% of annual rainfall occurs in November and March. Rain in the rest of the year is rare. The annual average of rainfall reaches 166 mm, while the maximum monthly rainfall recorded in February of about 112 mm.

Due to high temperatures, intensive sunshine and low humidity in the summer months, evaporation has a high magnitude. The potential evapotranspiration (PET) amounts range between more than 194 mm in July to 52 mm in January (Figure 4)

Table 1. Long term monthly averages of climate parameters of Jericho

Element	Month											
	Jan	Feb	Mar	Apr	Ma y	Jun	Jul	Au g	Sep	Oct	No v	Dec
Mean Max. Temp (c°)	19.1	20.9	24.3	29.3	33.7	36.7	37.8	37.6	36.1	32.3	26.4	20.4
Mean Min. Temp (c°)	7.4	8.3	10.5	14.2	17.6	20.4	22.1	22.4	21.2	17.9	12.9	9.0
Absolute Max. Temp (c°)	25.0	27.6	33.8	41.4	46.4	45.0	44.0	45.6	43.4	40.6	34.8	28.8
Absolute Min. Temp (c°)	0.2	-0.4	2.8	2.4	10.4	15.4	18.0	19.0	13.2	11.4	4.2	2.1
Mean Temp (c°)	13.2	14.6	17.4	21.7	25.6	28.5	29.9	30.0	28.6	25.1	19.6	14.7
Mean Wind Speed (Km/h)	8.9	10.4	13.1	16.2	15.8	15.3	16.0	14.8	12.5	9.4	7.9	7.6
Pressure (mbar)	1048	1046	1044	1041	1040	1037	1034	1035	1039	1042	1046	1048
Mean Sunshine (hr/d)	5.5	5.9	7.7	9.3	9.4	11.8	11.7	11.6	10.5	8.7	6.5	5.6
Mean RH (%)	70	65	57	45	38	38	40	44	47	51	60	70
Total Rainfall (mm) *	36	31	25	10	2	0	0	0	0	7	22	33
Total Evaporatio n (mm) *	78	76	128	189	261	289	298	267	227	135	94	59
Total PET (mm) *	52	56	85	121	163	181	194	188	166	140	91	58
Max Monthly Rainfall (mm)	62	112	41	20	22	7	0	0	7	71	81	104

1.1.1

3. Population and Socio- Economic Conditions

According to the Palestinian Central Bureau of Statistics (PCBS), the population of Jericho City today is estimated to be 19,696. Known as the city with the lowest population density, Jericho is inhabited by 69 persons/km² (JICA, 2006) which implies a potential for future expansion.

Employment

Most of the population in Jericho City relies upon agriculture and the service sector as their main source of livelihood. Many of the residents in the Jericho Governorate also rely on tourism as an important source of income. It has a 9% average unemployment rate.

Based on the results of the household survey more than half of the sampled households rely on the private sector as their main income source. Around 40% of the respondents earn between 1000 and 2000 NIS, that is \$US 2/capita/day. The breadwinners in these households are prevalently males, around 95%, at an average age of 50 years old and have a secondary education or

Water

Supplied from Ein al Sultan spring almost all of the households in Jericho City are connected to a water network. The results from the household survey give a general overview of the water services from a household perspective. More than 85% of the respondents complain of seasonal water cutoffs mainly during the summer during the night.

This problem is further complicated by the lack of storage facilities in a considerable number of households as 11.5% of the responding households do not have any storage facilities and those who do can store an average of 2 m³ or two small plastic roof tanks common to the area. Despite the seasonal cutoffs, which when compared to other areas in the West Bank are very minor, 80% of the respondents believe that the water supply is sufficient enough to fulfill their needs. However, residents in some neighborhoods complained more than others such as those in Ein al Sultan and Al Jami where 50% said that the water is not enough.

Households pay an average 173 NIS/cycle in the summer and 116 NIS/cycle; meaning that households are paying an average of 7% of their income for water supply.

In order to grasp a clear understainging of water use trends the households were asked if they own certain devices or facilities that maybe related to water consumption, see Table 12. Of the most interesting results is that 67% of the respondents own at least one wet cooling system used extensively in the summer regardless of their high water consumption rates or their negative health impacts. Of the households surveyed 2.6% own swimming pools with an average volume of 40 m³, changing the water 1.17 times/year. Related to

water practices about 64% irrigate their home gardens with an average area of 500 m² (half a dunum), 75% of which rely on the domestic network for their supply. The produce is used for personnel consumption. About 84% do not reuse water for irrigating their home gardens while 63% are willing to reuse treated wastewater for irrigating their gardens. An average 72% do not use water saving devices in their homes such as pressurized taps.

Economic Activity

Commerce

Situated on one of the main commercial routes and being the main urban center in the Governorate gave Jericho a significant commercial role throughout history. However, the difficult circumstances that Palestinians experience under occupation have very much paralyzed any significant economic activities. Following the Oslo Agreement a number of small workshops and businesses were established in the City including sewing and food factories in addition to a water bottling company, cement storage facilities imported from Jordan and a steel factory. Commercial activities today in the City are limited to small privately owned businesses. But what distinguishes Jericho is the variety of agricultural products cultivated in the area housing the central fruit and vegetable market. Today, commercial facilities in Jericho extend over 336 dunums although the lack of industrial zones far away from residential areas is a challenge as result of the complicated geo-political context since most of the proposed industrial areas are to the north and are all classified as Area C under Israeli control. Challenges to the sector also include the lack of financial resources and infrastructure.

Future plans envision the City to be a trilateral free market area for Jordan- Israel- Palestine as it is the eastern gate of Palestine. A planned Agro-industrial Park will put its priority on business dealing with high value added fresh fruits and vegetables, and food processing industry. Export promotion of priority industries will be the important mission of the Agro-industrial Park development (JICA, 2009).

Tourism

Jericho, the oldest and lowest city in the world, is considered as the main resort in the West Bank due to its unique weather and beautiful settings in addition to its numerous recreational parks, touristic and historical sites. It contains around 80 religious, touristic and ancient ruined sites, including Hisham Palace, Old Jericho (Tel Sultan), and Mount of Temptation.

In 2008, the city hosted some 500,000 tourists, an increase of over 100,000 from 2007. According to the Palestinian Ministry of Tourism, the number of visitors has risen dramatically over the last year due to patches and updates that were completed for the most important attraction locations. The number of local visitors and residents in the city increased from about 80 thousand visitors during the month of February, 2009 (32 thousand overnights) to more than 150 thousand visitors during the same period of this year (55 thousand overnights), which means an increase of 90.3%.

There are 6 hotels in the City with a total of 335 rooms. According to PCBS the room occupancy rate in 2008 was 28% with around 700 guests per month and a 2.2 night stay per guest.

A phenomenon that is unique to Jericho is known as internal tourism. Jerusalemites are very frequent visitors to Jericho, “temporary residents”, that tend to spend the weekends for every month in the City especially during the winter and are well known to be large water consumers since many of them are said to own swimming pools. The results of the household survey show that almost 9% of the sample are temporary residents that spend an average of 6 days per month.

Also known as the only international gateway more than one million Palestinian was reported to have passed through Jericho while entering or departing the West Bank last year. A 32% increase in the number of entries and departures through the Jericho between 2006 and 2009

Table 2: No. of entries and departures through king Hussein Bridge

Year	No. of enteries and departures
2006	706,005
2007	865,461
2008	942,300
2009	1,035,500

However, there remains a great potential for an increase in touristic activity. The city will be developed as a major tourism center, attracting more international tourists, as well as local visitors. Resort tourism developments in the Dead Sea area will be proposed to stimulate tourism in the longer term. The area around the Dead Sea bordering with Jordan and Israel would be proposed for a border free eco tourism zone utilizing existing natural resources and geographical features (JICA, 2006).

Industry

Industrial activities in Jericho City are also very limited. One of the main water consuming industries is the Sultan Water Bottling Factory in addition to the Iron Factory, Ketf Al Wad Brick Factory, the Market Brick Factory and Ar Rowad Meat Factory.

Since the Jericho governorate is the largest in the area of all Palestinian governorates in the West Bank, and due to the abundance of suitable lands it's nominated for the establishment of an industrial zone (Agro Industrial Park) the center of which is expected to be the City due to its strategic location and proximity to borders.

The Agro Industrial Park is expected to be constructed over three phases and will occupy 1115 dunums and will include nearly 123 food processing factories in addition to other businesses and logistic support businesses as shown in Figure 6 & 7.

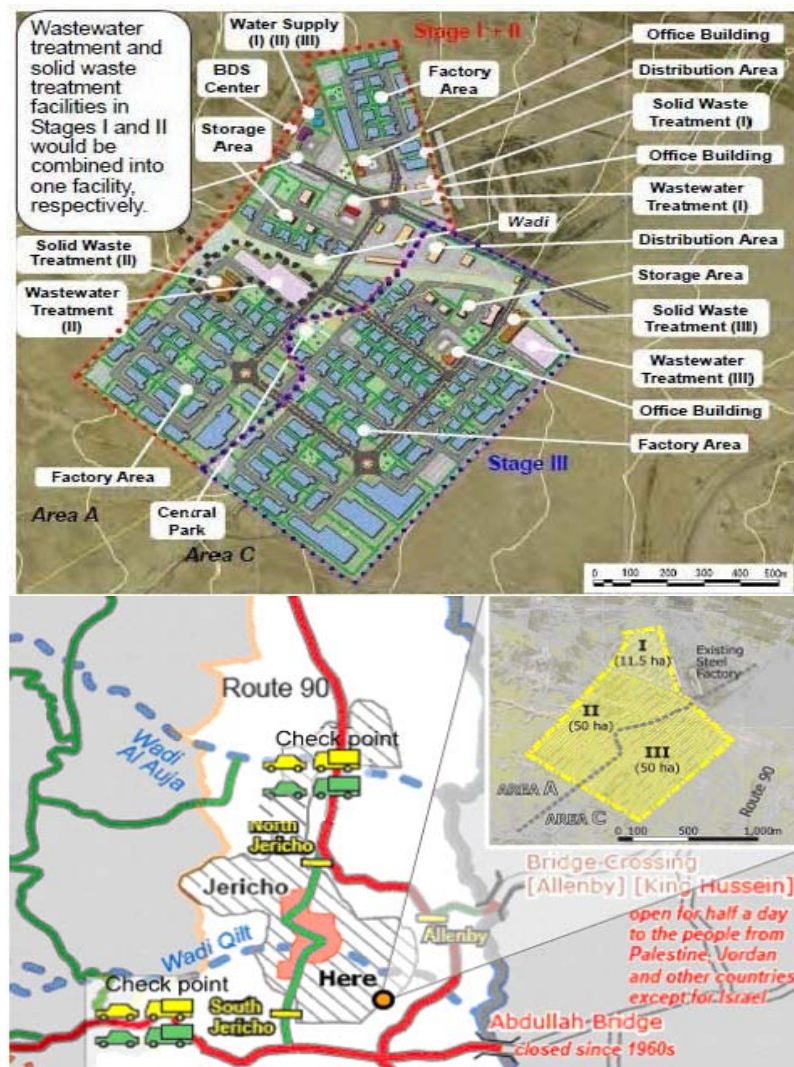
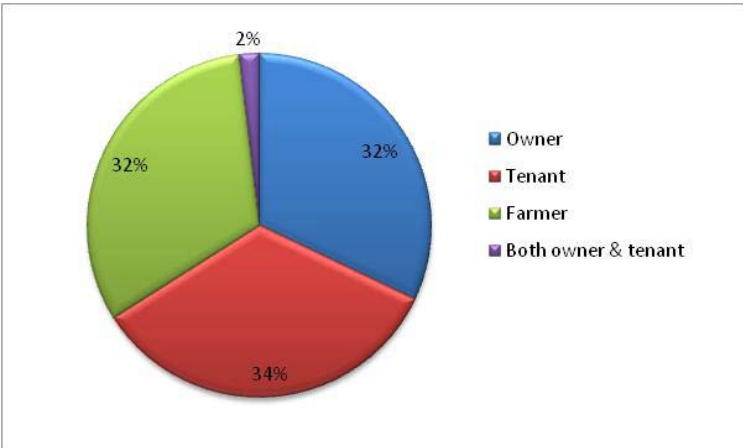


Figure 1 : Agro Industrial Park

.Agriculture

Agriculture plays a significant role in the economical lives of the people in Jericho. The essential combination of a warm climate and abundance of water gives the area a perfect agricultural environment. Most of the planted area depends on irrigation rather than rainfall. The irrigation is organized in small to medium land slots around the major irrigation network lines that are fed by Ein Al Sultan spring. Furthermore, some private farms possess their own wells, so they are independent from public supply and can sell some of their irrigation loads to other farmers. Irrigation in the area is mostly drip irrigation (82%). Surface irrigation represents only 1.4% and sprinkler 2%, however 14.6% are using mixed methods. In future plans the City is expected to be a vital agribusiness and export terminal and has a large potential for agricultural expansion under efficient water management schemes.

In the agricultural survey 32.1% of the respondents were land owners, 34% tenants, 32.1% farmers and 1.9% both owners and tenants all being permanent residents of Jericho City, as depicted in



In the socio-economic context of these farmers 61.5% of the respondents depend on agriculture as their main income source. Around 73.5% of the respondents earn between 1000 and 3000 NIS, that is \$US 2 /capita/day managing households of 8 members.

On the farm level the results show that an average of 3.6 people work in the farms of the respondents. About 98% of the farmers use the irrigation network of which 66% use hydrometers and 32% use water meters while the remaining respondents use groundwater wells. The respondents receive an average of 2 days of supply per week. Forty nine out of the 54 respondents use drip systems for irrigation. About 70% of the sampled say that the water is sufficient only for irrigating a percentage of their land (82%) on a seasonal basis, 97% in the winter and 59% in the summer. Only 34% use storage facilities, mostly agricultural pools with an average capacity of 765 m³. Distributed among months the water is mostly used during the period between April and August ..

Table 3: Average water use

[Table content is obscured by a black box]

In terms of prices 56% of basateen share owners do not know how the fees are determined while 72% of muftalah share owners do not know how the fees are determined.

Some of the most interesting results from the survey were the perspectives of the surveyed farmers in terms of water management as 78.7 % believe that the Municipality has the technical capacity to maintain the irrigation network while 74.5

% believe that the Municipality has the managerial capacity to maintain the irrigation network. In terms of cropping patterns and irrigation methods 69.7% are willing to change crops according to a national strategy and 12.1% are willing to change irrigation methods to decrease losses while 12.1% are willing to do both. An encouraging 71.2% are willing to reuse treated wastewater for agricultural purposes but for specific crops, 21.2% are not and 7.7% do not know a lot about this option.

Some of the main problems mentioned by the surveyed farmers include the insufficient water supply (especially during the summer season), the weak pressure of water supply and the expensive water fees from source (price per m³ & annual taxes). Mainly anticipated to be caused by the lack of timely distribution of water shares on a weekly basis, the lack of compliance between supply and demand throughout the seasons, the increase of water demand due to urban expansion and the mismanagement of the water and lack of follow up.

The farmers mainly suggested the introduction of better management and follow up plans (including water distribution) and new water sources as the best ways to solving these problems.

4. Water resources

conventional Water Resources (Surface and Groundwater)

Water resources in the study area are mainly limited to groundwater that is being exploited through wells and springs. However, the only surface water resource is the Jordan River but Palestinians have no access to its water as of yet. At the same time, flood flows of two main valleys of Wadi Qilt and Wadi Nuwei'meh which are crossing the area are not used. Thus, groundwater forms the main water resource in the area through wells and springs. The main aquifer systems in the area are:

- **The Shallow aquifer (Alluvium and Lisan Formation) of Plio-Pleistocene ages:**

Geologically, the area is mostly covered by Lisan Formation rocks that related to Pleistocene age. Lisan formation in the area is mainly composed of thin laminated marls, and gypsum beds (Table 1). Structurally, the marls are very simple, having some slight north-south trending folds and towards the Jordan river, the center of the basin a slight depositional dip which may have been accentuated by subsidence. Marginally the lithology is gravels and poorly sorted pebble beds, occasionally calcareous with little or no evaporites, sometimes siliceous adjacent to present of former outcrops of Chert, and limestone adjacent to older rocks. In addition, Alluvium deposits occur alongside the Jordan River tributaries. These deposits are mainly unconsolidated, laminated marls, and mud with some siliceous sand.

Alluvium and Lisan formation are considered the main aquifer system in the area where it is tapped by many agricultural wells drilled in the area. Hydrogeological properties of this aquifer differ from one area to another regarding the lithological composition and the thickness of these sediments (Table 15). Recharge of Pleistocene system is mainly originated from the lateral flow from the Mountain Aquifer Systems

that is replenished in the mountain area some 10 to 30 km to the west; and the infiltration of storm water from flooded valleys crossing the aquifer.

The depth of the groundwater level of this aquifer varies from one area to another ranging from 20 m to 80 m below ground level. The seasonal / annual groundwater level fluctuation is a function of recharge - discharge relation. In general, groundwater moves in this system towards the Jordan River and the Dead Sea to the east.

Non-Conventional Resources (Runoff, Treated Effluent ...)

Wastewater

Wastewater quantity and characteristics is currently not known due to the lack of data especially concerning Jericho. Usually the calculated wastewater generated is based on 80% of the water consumption. However the case in Jericho may be different due to the large amounts of water that are used in irrigation purposes for home gardens and yards. Wastewater composition is mainly domestic and usually concentrated due to low water consumption rates.

Jericho has no wastewater collection system instead cesspits are used. When they are full, if ever due to leakage, they are emptied by sewage tankers and the contents are disposed of in a nearby sewage dump or simply into wadis surrounding the area. A cesspit with an average volume of 25 m³ is usually emptied once every 5 to 6 months. Each tank load costs 50 NIS. Currently, four sewage tankers are in use in the city alone. The dumpsite is located about 1.5 km east of the nearest residential area. This was the farthest point that could be reached due to the Israeli restriction on land use in the area.

Obviously, no treatment prior to disposal occurs. One private treatment plant exists belonging to Jericho's Intercontinental Hotel Casino. Before the current Intifada the Municipality discharged all wastewater coming from public facilities and other municipal centers into the small-scale plant. About 250 m³ were dumped weekly. However, this is not the present situation.

Storm Water Runoff

The two major wadis in the study area are those of Al-Qilt and Nuiemeh as shown in (Figure 10) with average total annual flow of 1.47 Mcm and 0.945 Mcm respectively.

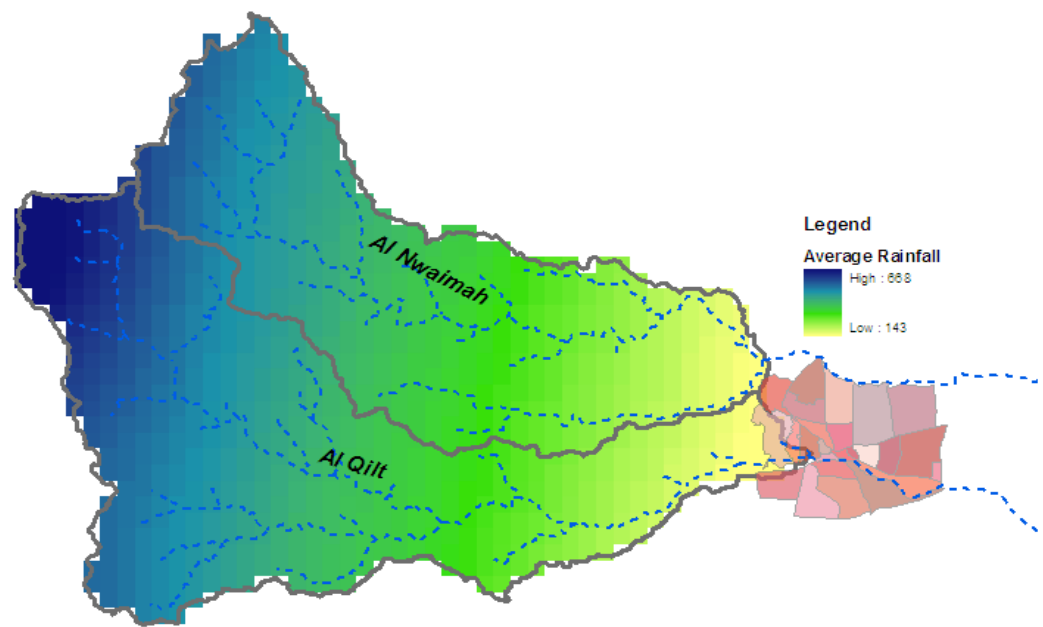


Figure 2: Surface catchment areas and runoff

6. Supply –Demand

Water Demand Projection scenarios

Water situation has been intensified considerably due to the increased demand of various users especially tourists and holiday-makers. Yet, Jericho is the food basket of the West Bank, therefore, agriculture is the main sector that will likely remain in the city to maintain food provision to the rest of the Palestinian Areas. Moreover, according to the argumentation laid out at the Bethlehem Investors' Conference in May 2008, the Middle East Quartet does its best to encourage private investment in Palestine, and a large industrial Estate has been planned in the Jericho area. Under this project, the Municipality of Jericho could become an area with highly concentrated economic activity.

In the light of this situation and rapid increase in population and industrial development, it is likely that Jericho will be faced with several challenges that may affect its unique status. Accordingly, the purpose of developing this water master plan for Jericho city is to manage the existing water resources as well as looking for additional water sources in order to meet the growing domestic, commercial and agricultural needs. Consequently, the master plan will be developed to provide guidance and directions for managing the supply and demand of the Jericho city. It includes different types of actions, starting from development of new water sources which aims to increase the supply, demand management actions to rationalize the demand and infrastructural actions which aims to improve its efficiency and decrease the losses from the system.

Table 4: water distribution for the domestic network under Do Nothing Scenario

		2010	2020	2030	2040	2050
Population (Inhabitant)		19671	25676	33515	43747	57101
Supply Requirement (including loss, reuse and other demand Management)	Domestic Demand (1000 m ³ /yr)	1795	2343	3058	3992	5211
	Domestic Demand (l/c/d)	250	250	250	250	250
	Public Demand (1000 m ³ /yr)	425	555	725	946	1235
	Commercial Demand (1000 m ³ /yr)	138	180	235	307	401
	Aqbat Jaber Camp (1000 m ³ /yr)	46.5				
	Agricultural Demand (1000 m ³ /yr)	164	198	232	265	299
	Agro-Industrial Zone (1000 m ³ /yr)	0	0	0	0	0
	Sum (Mm ³ /yr)	2.57	3.32	4.30	5.56	7.19
Delivered Supply at demand sites	Domestic Demand (1000 m ³ /yr)	1470	1556	1580	1607	1639
	Domestic Demand (l/c/d)	205	166	129	101	79
	Public Demand (1000 m ³ /yr)	355	377	382	389	397
	Commercial Demand (1000 m ³ /yr)	115	123	124	127	129
	Aqbat Jaber Camp (1000 m ³ /yr)	46.5				
	Agricultural Demand (1000 m ³ /yr)	138	136	124	111	97
	Agro-Industrial Zone (1000 m ³ /yr)	0	0	0	0	0
	Sum (Mm ³ /yr)	2.12	2.24	2.26	2.28	2.31
Un-met demand (Mm³/yr)		0.44	1.08	2.04	3.28	4.88

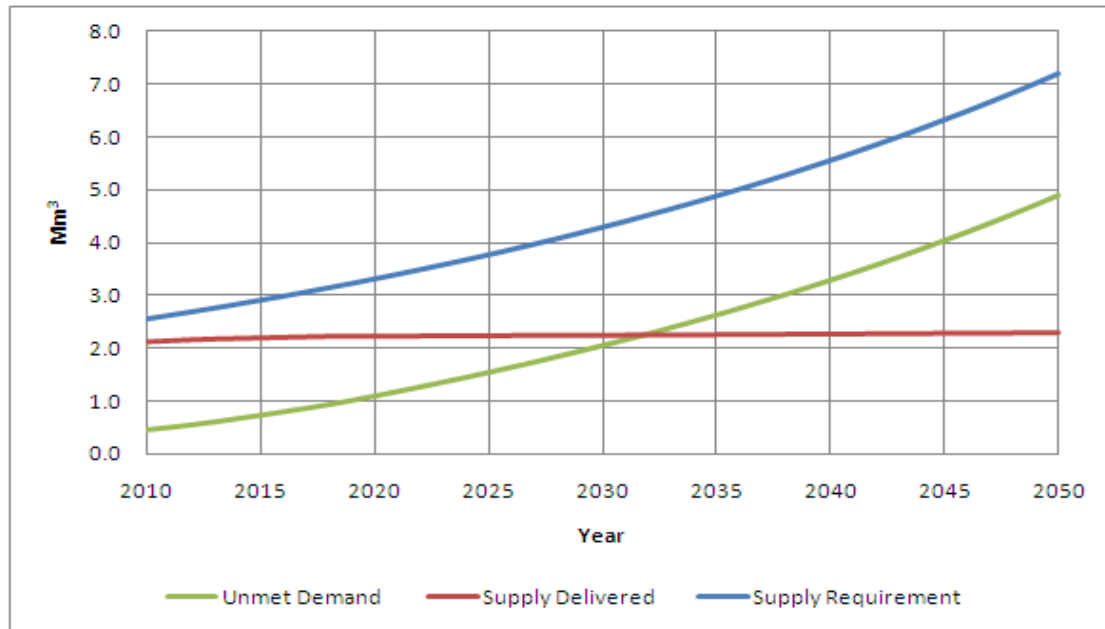


Figure 3: Supply - demand quantities for the domestic network under Do Nothing Scenario

As can be noticed that the gap between the supply and demand for the domestic sector under the do nothing scenario is very high. Total domestic demand will exceed 7 Mm³ by the year 2050 while the supply will remain constant around 2 Mm³/year. Such situation would mean that the entire spring discharge should be allocated to domestic and agriculture would be abandoned completely and probably can rely on alternative sources. Even the total spring discharge will not be sufficient to cover this deficit and new resources must be developed from 2015 onward if the situation continues as is today.

Agricultural Demand

The demands, the available supply and the network losses for the five lines on the agricultural network as well as other related information are summarized in Figure 13 and Figure 14

Table 5: water distribution for the agricultural network under Do Nothing Scenario

		2010	2020	2030	2040	2050
Supply Requirement (including)	Line A (1000 m ³ /yr)	644	619	593	567	542
	Line B (1000 m ³ /yr)	609	596	583	571	558

	Line C (1000 m ³ /yr)	756	747	739	730	721
	Line CD (1000 m ³ /yr)	31	30	29	28	27
	Line D (1000 m ³ /yr)	360	356	351	347	343
	Sum(Mm³/yr)	2.40	2.35	2.30	2.24	2.19
Supply Delivered at Demands sites	Line A (1000 m ³ /yr)	578	572	565	555	540
	Line B (1000 m ³ /yr)	556	553	550	546	541
	Line C (1000 m ³ /yr)	756	747	739	730	721
	Line CD (1000 m ³ /yr)	29	28	28	27	26
	Line D (1000 m ³ /yr)	351	349	347	344	341
	Total supply (Mm³/yr)	2.27	2.25	2.23	2.20	2.17
Un-met demand (Mm³/yr)		0.13	0.10	0.07	0.04	0.02

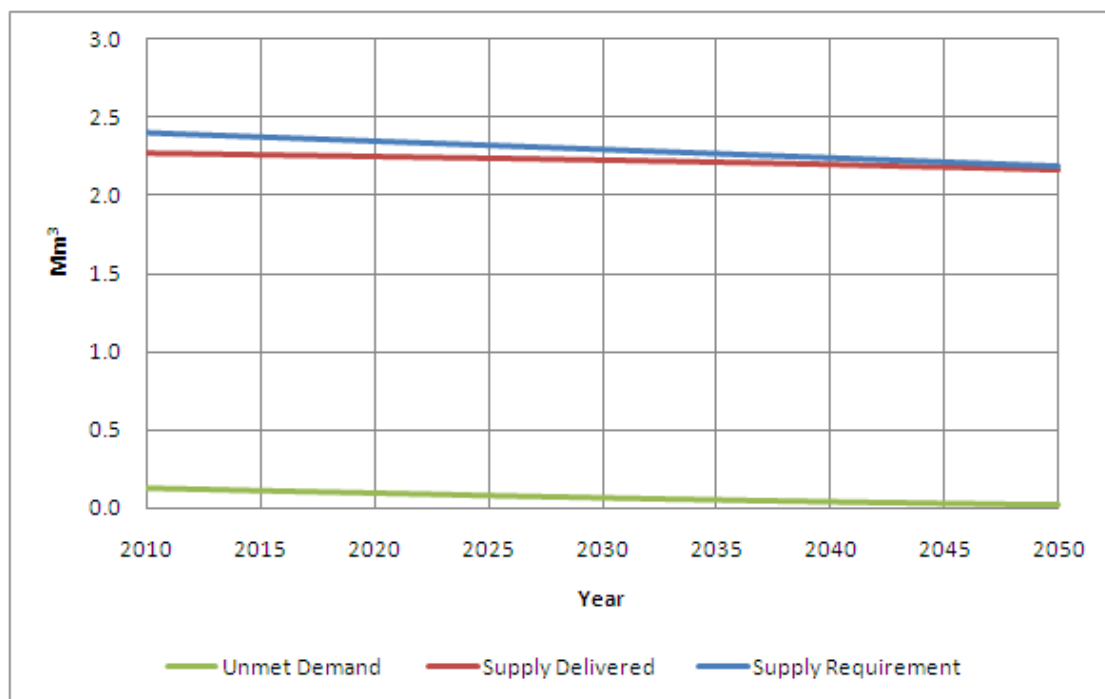


Figure 4: Supply - demand quantities for agricultural network under Do Nothing Scenario

As expected, agriculture will be declining since domestic water use will increase and more urbanization will take place.

Ein As-Sultan Camp: the demand and the supply delivered to Ein As Sultan Camp is considered constant for the entire master plan period. (Supply=Demand= 0.144 Mm³/yr). The total demand/supply on Ein As-Sultan Spring for all demand sites (domestic, agriculture, commercial, public and for the two camps) is shown in Figure 15, 16 and 17.

Table 6: Supply/Demand for Ein As -Sultan spring under Do Nothing Scenario

	2010	2020	2030	2040	2050
Supply Requirement (including loss, reuse and other demand Management) (Mm³/yr)	5.12	5.82	6.74	7.95	9.53
Supply Delivered at Demands sites (Mm³/yr)	4.53	4.63	4.63	4.62	4.62
Supply Delivered at Source (Mm³/yr)	5.67	5.67	5.67	5.67	5.67
Un-met demand (Mm³/yr)	0.59	1.19	2.11	3.33	4.91

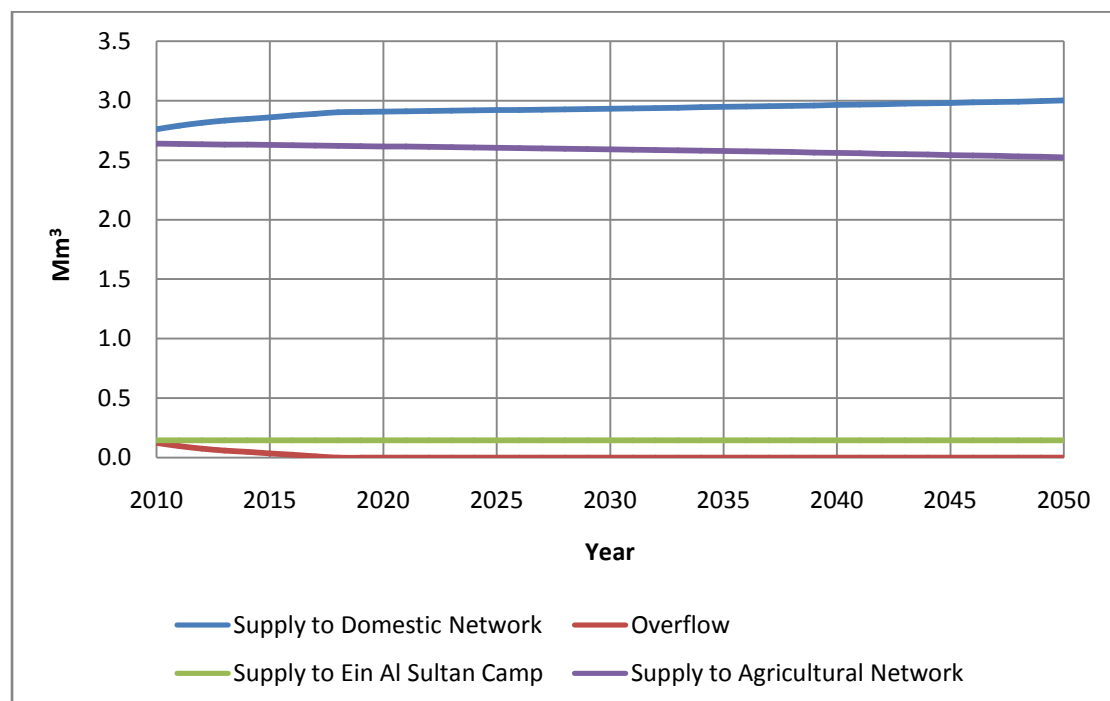


Figure 5: Spring utilization under Do Nothing Scenario

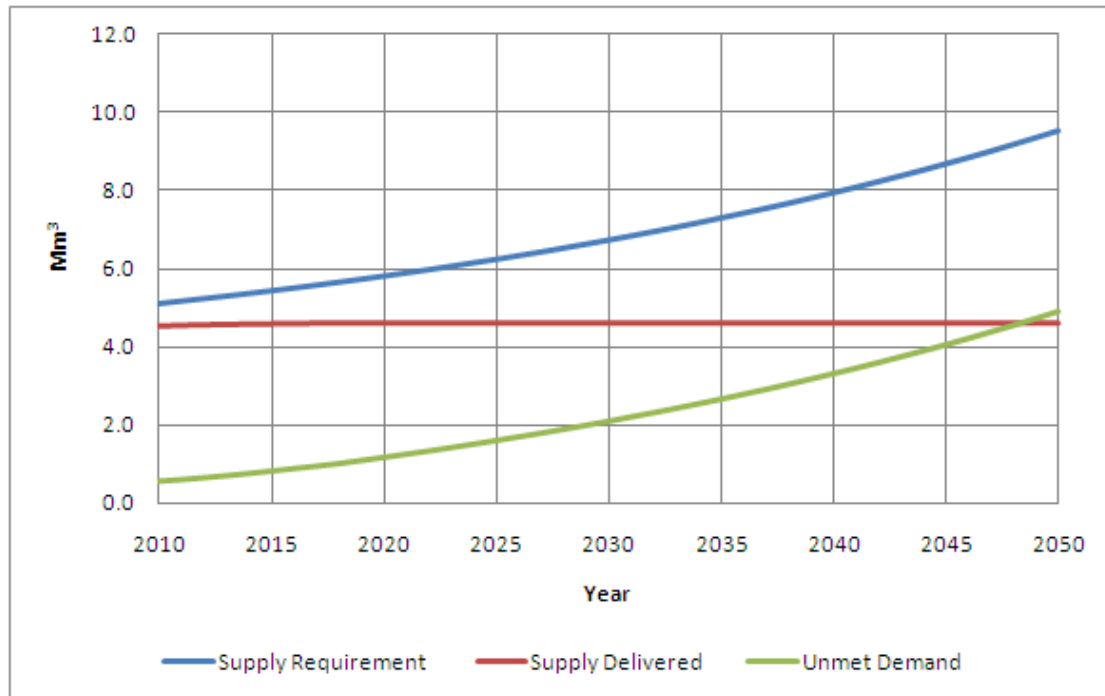


Figure 6: Supply - demand for Ein As- Sultan spring under Do Nothing Scenario

Agricultural Demand (east of Jericho city): the demand and the supply delivered to around 6500 donums under do nothing scenario is shown in Figure 18.

Table 7: Supply - demand for irrigable lands east of Jericho city under Do Nothing Scenario

	2010	2020	2030	2040	2050
Demand (Mm³/yr)	3.62	4.08	4.54	5.00	5.46
Supply Delivered (Mm³/yr)	2.86	1.61	0.90	0.51	0.29
Un-met demand (Mm³/yr)	0.75	2.47	3.63	4.49	5.18
Irrigated areas (Donums)	3451	1940	1090	613	344

Table 8: IWRM Applications

Activity
Execute laws and rules
Finding and development of alternative/ additional water resources
Installing a wastewater network system
Installing wastewater treatment plant
Conducting small-scale rainwater harvesting techniques
Installing brackish water desalination projects
Exploiting surface water sources
Improving utilization of Groundwater Supply
Founding Sanitary Landfill Sites. (In avoidance of soil and groundwater contamination)
Distribution of responsibilities amongst organizations and bodies working in the sector.
Raising public awareness
Establishing a just water system for the allocation and distribution of the available supply according to water laws
Establishing a higher committee or commission to take control over water services in the Valley Area.
Capacity building for technical staff.
Rehabilitation and maintenance of water network system.
The introduction of advanced technology in the sector
Changing cultivation and irrigation trends to reduce agricultural consumption
Establishing a credible tariff system.
Potentially, encouraging the substitution of water based cooling systems (wet conditioners) with gas based ones (dry conditioners).

7. Methodology

Reviewing Previous Work

As Jericho City has been a centre of interest for a number of organizations working in the sector, a number of publications have been produced relevant to our study. These publications have been collected and reviewed at the very beginning of the project. Data related to the socio-economic context and economical activities in the City for this section of the report was collected from different sources and is often referenced within the report.

Data Collection and Storage

PHG has collected relevant data on population from the Central Bureau of Statistics (PCBS). It also collected relevant data on groundwater resources from PWA. Moreover, it compiled several sets of data related to water use, water supply system details, water tariff and water governance from Jericho Municipality. All compiled

data were then entered into a special geo-data base that was developed under this master plan for Jericho city in order to facilitate data management, handling and retrieval. The geo-database includes several types of information related to water management. It includes maps, aerial photos, satellite images related to the area, location of groundwater wells, potential abstraction, location of springs and their potential discharge, the main streams and their potential flow and many other types of data. Figure 1 shows the structure of the geo-database.

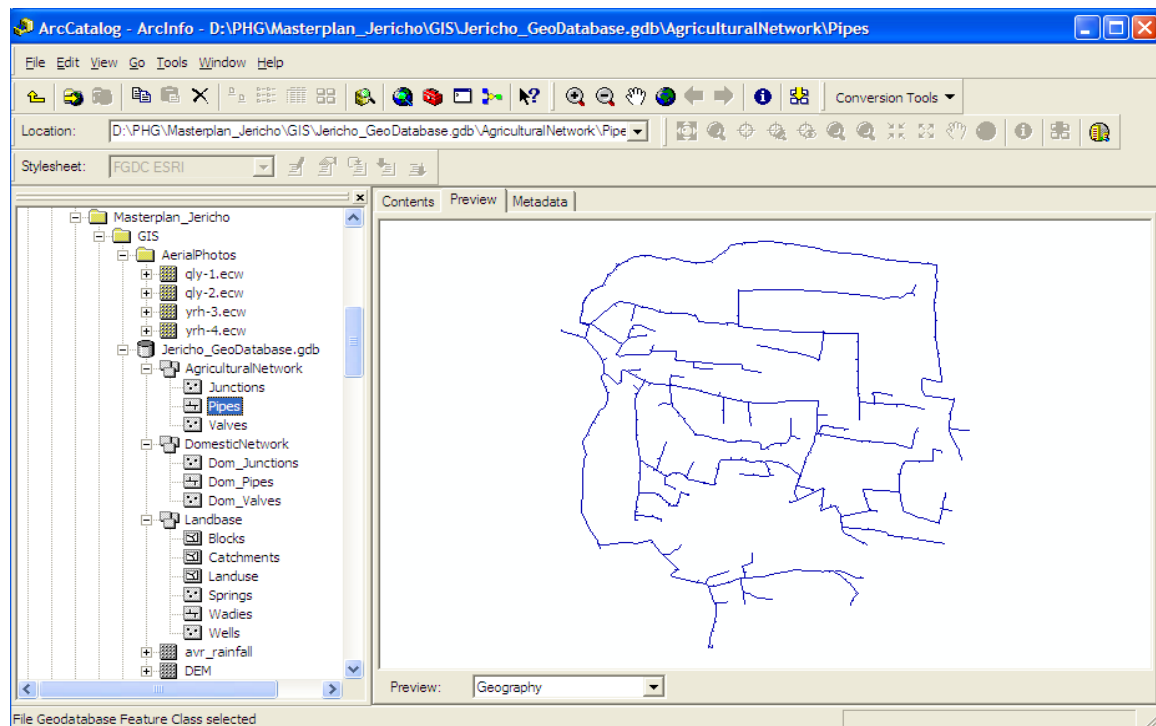


Figure 7: Geo - database structure

Stakeholder Meetings and Consultation

PHG has conducted several meeting with potential stakeholders in Jericho to understand the situation and to assess the roles and relations of those stakeholders in managing water in the area. The following were the main stakeholders that were met: Jericho Municipality, Ein Sultan Irrigation Association, Ministry of Local Governments and the Governor's Office. Moreover, the meetings were necessary to introduce the master plan and to understand better the overall stakeholder engagement in the process.

For example, the meetings and discussions with representatives from Jericho Municipality was conducted for the purpose of attaining a wider and more comprehensive assessment of the general socioeconomic conditions in the targeted area.

Field Surveys

PHG has conducted a field survey to reflect the existing situation and to understand the needs and define gaps in the existing water management pattern. Accordingly, PHG defined three major sectors to be covered in the survey,

namely domestic, agriculture and large consumers. A representative samples were considered from these type as follows:

Household survey

For the purpose of understanding the quality of the services provided and the general perspective of locals on several issues related to water use and practices a household survey was initiated.

A 3-page questionnaire was designed based on a set of predefined indicators related to:

- Socio economic background: it includes aspects about demography (age/sex distribution and permanent & non-permanent residents) and socio economic variables (education, employment status, average monthly income and average monthly expenditures).
- Quantity and quality of water supply: questions about the current water status such as water resources, interruption of water during summer and winter seasons, storage capability, the sufficient quantities from water and satisfaction degree.
- Expenditure on water supply: questions about billing system.
- Water related practices: includes questions related to people daily system life, availability water saving devices and water quantities consumed on home gardening, willingness to pay, the ideal price of water per cubic meter,
- Perspective of problems which most people suffering from, causes and solutions for those problems.

A copy of the questionnaire used is included in Annex.

Sample design

In order to be able to draw conclusions for the actual situation in the City a representative sample was designed to include all 18 neighborhoods used by the Municipality's Water Department for their database system (see Figure 2). The sample was developed to include at least 6% of the customers from each neighborhood to finally total 231 households.

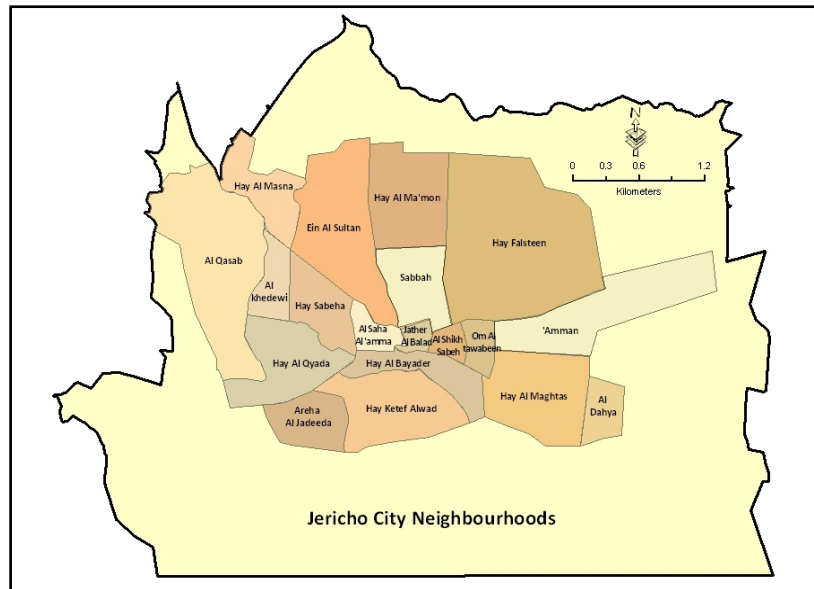


Figure 8: Neighborhoods used for sample design

Data collection and analysis

Before beginning the actual data collection from the field a pilot batch of 10 questionnaires were filled out after which the questionnaire was reviewed and modified based on comments from the field.

A team of 4 well trained employees surveyed the neighborhoods throughout the month of December 2009. The team confined to the number of questionnaires to be filled out in each neighborhood but choose the households randomly. A total of 235 households were surveyed. The data was entered into pre-designed spreadsheets after which it was validating by crosschecking 10% of the questionnaires and removing all out layers. The data was later analyzed using the Statistical Package for Social Sciences (SPSS).

Agricultural survey

In addition to the household survey an agricultural survey was also initiated. The purpose of this survey is to compile data on the actual on farm water use practices and the farmers' perspectives on relevant issues.

Data collection tools

A 5-page questionnaire was designed and prepared based on a set of predefined indicators related to:

- Socio-economic background: it includes aspects about demography (age/sex distribution and permanent & non-permanent farmers), socio economic variables (education, employment status, average monthly income and average monthly expenditures), and the farmer-owner relationship (land owner, tenant, farmer or both owners and tenant).
- Quantities of water consumed for agricultural purposes according to type of water shares (Basateen, Muftalaha) and storage methods.
- Cropping patterns and irrigation systems
- Water management and prices including the farmers' willingness to pay and ability to pay.

- Perspective on problems from farmers' point of view, causes and solutions.

A copy of the questionnaire used is included in Annex 1.

b. Sample design

The sample was designed to cover all the main irrigation lines A, B, C and D and to include both types of connections: hydrometers and water meters (see Figure 3 and Table1). The theoretical sample included 48 farmers distributed along all lines.

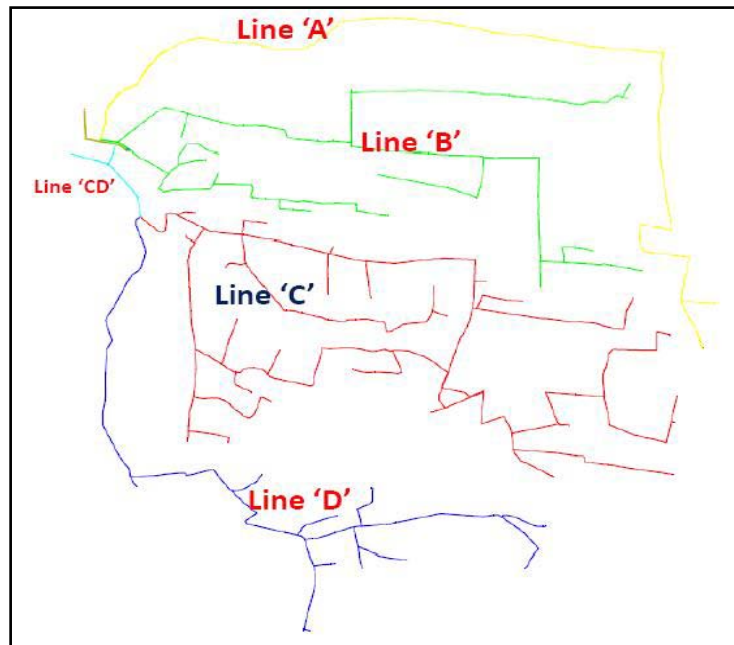
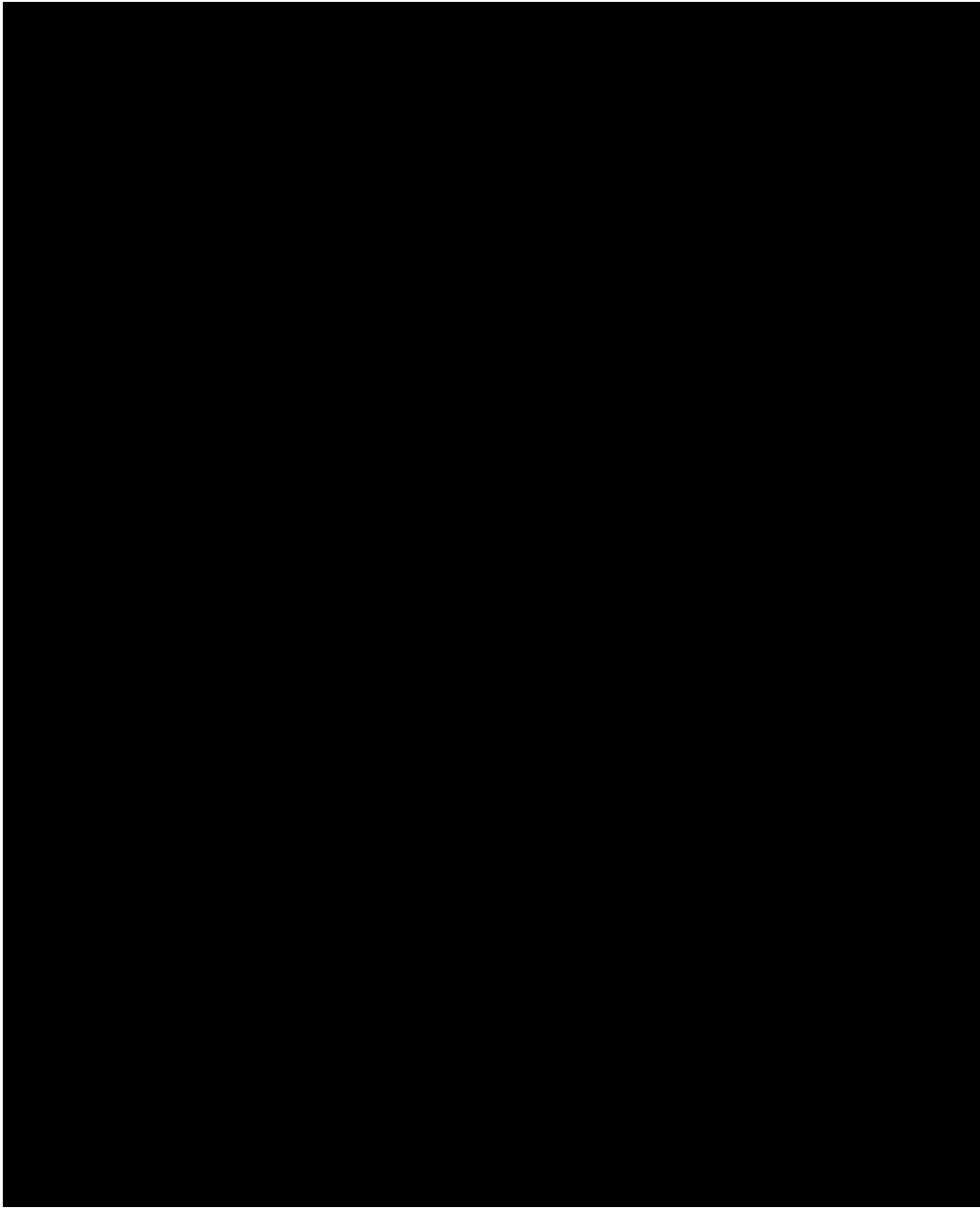


Figure 9: Agricultural network lines used for sample design

Table 9: Sample design for agricultural survey



Data collection and analysis

Before beginning the actual data collection from the field a pilot batch of 10 questionnaires were filled out after which the questionnaire was reviewed and modified based on comments from the field.

A team of 4 well trained employees surveyed the neighborhoods. The team confined to the number of questionnaires to be filled out for each line but choose the farmers randomly. A total of 54 households were surveyed. The data was entered into pre-designed spreadsheets after which it was validating by crosschecking 10% of the questionnaires and removing all out layers. The data was later analyzed using the Statistical Package for Social Sciences (SPSS).

Obstacles and constraints

As in any study, the survey entailed a number of obstacles that challenged the progress of the work. The team tried very much to overcome these obstacles by thoroughly explaining the questions to the households interviewed and crosschecked some of the information providing by asking questions in different manners and by direct observation.

Obstacles of Household Survey:

- Lack of availability of “outsider residents”: These people own houses in Jericho yet were not present for most of the survey timeline. The overwhelming majority of this segment of Jericho’s residents own Villas and have large domestic consumption rates especially throughout the summer season. Thus, the PHG team was not able to acquire a representative sample of Villa dwellers in the different neighborhoods.
- Limited knowledge concerning water issues: Many of the households that were encountered throughout the survey had limited knowledge about water consumption, pricing and other water related information.
- Reduced responsiveness by some people: in some neighborhoods, people were not willing to fully cooperate with the survey team in providing information about their household water practices. This was problematic when the team had to knock on several doors until we were able to conduct an interview.
- Social restrains: The nature of the Palestinian society may be perceived as being somewhat conservative and/or traditional depending of the area and community. In this case, some areas of Jericho were found to be relatively conservative where men would work during daytime while women would work at home. This was problematic because in many cases, women weren’t willing to cooperate since their husbands were not at home, a phenomenon which also required the team to put in an extra effort to attain as many interviews as possible.
- Social events in the community: On some working days, the field team ran into the coincidence that a social event would be taking place in the city and since Jericho is a small city where people are well connected, it would be hard to get a hold of people as these events were happening.

Obstacles of the Agricultural/ Farmer Survey:

1. Municipal lists of famers are overdue:
 - Owner/ beneficiary names may not be updated: This problem was especially exacerbated for the Muftalah water shares due to the frequency of water transactions (renting, purchasing, and tenanting). In addition, since Ein Sultan water shares are historically owned by people as property, many of the shares are registered in the names of their original proprietors and have not been changed according to inheritors. (Note: in many cases inheritance complexities are not resolved amongst the inheritors)
 - The quantities of weekly shares are not updated: the quantities of water shares supplied to farmers may not be updated following a change in its status.

2. Difficulty in finding farmers (Availability): Throughout our survey of farmers, we faced the difficulty of finding farmers on their agricultural lands, which prolonged the process of covering all farmers selected for the survey.
3. Uncertainty in identifying water share type: Due to the multiplicity of types of water shares according to a diverse list of systems, it was difficult to identify the type of share whether owned or rented by farmer and its associated costs. Also, in some cases farmers possessed certain weekly quantities that belonged to a variety of water shares and systems.
4. Municipality accompanier's uncertainty about water branches: This problem stemmed from the complexity and continuous change in the irrigation network system. The municipality representative that accompanied the PHG field team pointed us to farmers according the needed branch line, whom, later on, turned out to belong to different or numerous ones. Consequently, this influenced the progress of our survey since we had interviewed farmers that do not correspond to the sample we had initially selected.
5. Irrigation network system map is not updated

8. Water Tariff and Fee Collection

Domestic Water Tariff System

Over the past decade, population and economic growth have both induced a proliferation of demand on the domestic supply, a phenomenon that has pushed the municipality to provide these extra amounts on the account of spring water initially allocated for agriculture.

Furthermore, this reality has raised concern over the future of water resources in Jericho city urging the municipality to reformulate an effective tariff system that would encourage conservation, while at the same time maintain accessibility of the general population to water at a reasonable and affordable price. However, despite the fact that the current tariff system is a block tariff structure, yet it doesn't address the actual cost and the blocks specified in the structure was not defined to ensure lifeline and secure cross subsidization among the various blocks. The current tariff structure at Jericho Municipality is summarized in Table27.

Table 10: Current tariff structure

Block no.	Consumption Category	Price (NIS/M ³)	Tax (NIS)
1	0 -100 m ³	1 NIS/m ³	10 NIS
2	101 -150 m ³	2 NIS/m ³	
3	151-250 m ³	4 NIS/m ³	
4	> 250 m ³	5 NIS/m ³	

Note₁: An exceptional price is given to Municipality employees who are instead charged 0.5 NIS/m³ under the 1st block.

Note₂: The billing cycle is 2 months, giving 6 cycles annually.

In spite of this fact and exceptional to most other tariff systems in the oPt, the block tariff structure set by Jericho municipality appear to encompass ranges of consumption amounts that are too broad, yet associated with a similar unit price per cubic meter as shown in the table above, this is especially the case with the first block as merely 1.00 NIS/m³ is set for the first 100 cubic meter used, even though almost 78% of registered customers are falling within this block category in the year 2009. Table 28 below shows the detailed number of customers in each of the existing tariff blocks for the year 2009.

Table 11: Number of customers per block

Customer Categories According to Consumption (ANNUAL 2009)				
Block no.	Consumption Range (m ³)	Price (NIS/m ³)	Number of Customers Per Block	Percentage of Customers Per Block (%)
1	0 -100 m ³	1 NIS/m ³	3207	<u>78%</u>
2	101 -150 m ³	2 NIS/m ³	497	12%
3	151-250 m ³	4 NIS/m ³	296	7%
4	> 250 m ³	5 NIS/m ³	133	3%
TOTAL			4133	100%

Moreover, apart from the wide ranges of quantities assigned under each block, the prices correlated with each of the blocks are also believed to have been arbitrarily chosen rather than constructed upon credible social, economic, cost recovery, or environmental criteria. This applies to both domestic and commercial water billing schemes. It is worth mentioning that once municipality superiors were asked about the origins and/or reasons for the current block structure of the tariff system, they either expressed unfamiliarity with the topic or affirmed that it had been decided upon by the municipal board through the self-judgments of its members.

However, since consumption varies widely from customer to another within the same block, a more reliable tariff structure should be constructed. It should be based upon a comprehensive evaluation of the socio-economic circumstances of city residents and the cost recovery objective of the municipality.

9.Income levels and Affordability:

Affordability is an imperative measurement for the formulation of tariff systems as it depicts the extent to which people are able to pay for water services. It differs from *Willingness-to-pay* in the sense that it targets households' actual financial capability to pay for water services. As specified by EPA (1997), "*Affordability* is a function both of the price of water services and the ability of households (and other 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".¹⁷ Furthermore, *Affordability* is mainly a function of income related to cost of living, which in turn is a primary function of employment (EPA, 1997). The findings of our

¹⁷ Palestinian Hydrology Group, "Pricing Policy, Willingness to Pay and Affordability in the West Bank, Palestine", December 2002.

household socio-economic survey regarding income level groupings and the affordability are displayed in the Table 29.

Table 12: Income Level and affordability

Question: How much can you afford for suitable water?							
Income group	Mean Family Size	0 NIS/m ³	0-1 NIS/m ³	1-2 NIS/m ³	2-3 NIS/m ³	> 3 NIS/m ³	Total
< 1000 NIS	5.3	11.8	88.2				100 %
1000 - 2000 NIS	6.5	2.3	95.4	1.1	1.1		100 %
2000 - 3000 NIS	6.1	1.9	94.3	3.8			100 %
3000 - 5000 NIS	6.7	2.3	95.3			2.3	100 %
> 5000 NIS	7.1		95.7	4.3			100 %
Total	6.4*	2.7%	94.6%	1.8%	0.4%	0.4%	100 %

Note: the unit used in all the cells is % with the exception of mean family size (members).

***A weighted Average of family members**

As illustrated in table 29, the overarching majority of residents in Jericho expressed an ability to afford a water price of 1 NIS/m³. These percentages, however, may not be fully representative of the actual affordability of people as they might have underrated their abilities to avoid increased prices.

PHG's survey also reveals that approximately 92% of people who do not pay their water bills on a regular basis refer it to economic reasons (affordability). Over the course of providing financial assistance to low-budget in attaining their basic water requirements, a tariff structure should be devised in a manner that can encompass their special socio-economic standing. Additionally, special assistance programs and other poverty alleviation projects may come relevant in this realm, however and since this vulnerable group constitutes a large portion of the general population, a centralized tariff block structure that can reduce their hardships is much preferred. This may refer to an IBT system that promotes equity through the use of a cross subsidy from the rich to the poor, made achievable once the socio-economic indicators of an area are directly deployed in determining the number and ranges of tariff blocks and the associated prices. For this cause, a balanced exponential pricing structure is envisioned most fit for Jericho city.

A major set-back to the domestic tariff is the excessive consumption by governmental and public facilities reaching approximately 17.5 - 18% of the total domestic supply in 2009. Furthermore, the average consumption rates per connection for non-household connections exceed that of a typical household by 150-1000%. Table 30

shows the consumptions, percentages, and rates for these facilities during the year 2009:

Table 13: Public water use

Facility type	No. of Connections	Total Consump. (2009)	% from total domestic consumption (2009)	Avg. Consump./Connection	Rate of Consump. to average domestic/connect.	Rate of Consump. to average HH. domestic/connect
Parks/Playgrounds	45	29705	1.51	55.0	120.18	213.19
Security Centers	67	143404	7.28	178.4	389.66	691.26
Governmental Centers	63	55304	2.81	73.2	159.81	283.51
Organizations	112	51573	2.62	38.4	83.83	148.72
Municipal facilities	20	63224	3.21	263.4	575.51	1020.95

Some of the problems caused by these high-consuming facilities are: Shortage in supply, water cuts on households (especially during the summer), etc. Thus, the tariff system must elevate prices for such customers in order to rationalize their water use.

10. Willingness to Pay

Willingness-to-Pay is an indicator used widely to project the effectiveness of a tariff system as it depicts the average customer's intuition on prices. This customer psyche towards payment is the product of a sophisticated web of factors and attitudes. Willingness to pay may be perceived as the combination between Affordability and willingness to use.¹⁸

Some of the major factors affecting willingness to pay are as follows: Socio-economic circumstances (such as income, educational attainment levels and awareness, family size, etc.), the quality of services being provided (such as: water availability and quality, reduced water cuts, maintenance efficiency, management effectiveness, etc.), and customer-supplier relations (concerned with: level of trust, bondage and nature of interactions, level of conformity, attitudes, transparency and corruption, etc.). These major factors are extremely intertwined, each having its influence on customer attitudes and standpoints.

The use of willingness to pay as a measure in setting tariff structures is criticized for reliability assurances. Firstly, many of the indicators used in willingness to pay are literally un-measurable and their level of influence may vary according to location,

¹⁸ Palestinian Hydrology Group, "Pricing Policy, Willingness to Pay and Affordability in the West Bank, Palestine", December 2002.

situation, time, etc. Secondly, questionnaires cannot reflect the real situation because results may vary depending on simple interactions such as the way questions are asked, their phrasing and form, the tone used to ask the question and even the seeming interest or benefit an interviewee may sense. Additionally, some people may not answer with honest answers in fear of increased charges. This issue is highly debatable; however this section will display people's answers to our socio-economic survey questionnaires to provide a general idea on the context of pricing in Jericho city as shown in Table 31.

Table 14: Willingness to pay

Question: How much do you think the most suitable fee for current services?					
Income ranges	0 NIS/m ³	0 -1 NIS/m ³	1 - 2 NIS/m ³	> 3 NIS/m ³	Total
< 1000 NIS		100			100
1000 - 2000 NIS		98.9	1.1		100
2000 - 3000 NIS		96.2	3.8		100
3000 - 5000 NIS	2.3	95.5		2.3	100
> 5000 NIS		95.8	4.2		100
Total	0.44%	97.35%	1.77%	0.44%	100%

Table 31 is an expression of residents' level of willingness to pay under the existing circumstances; in other words it is the general price of water they have set if current services remained the same, which would be expected to increase if quality of service is improved. The current rates of bill payment and its regularity are illustrated in table 32:

Table 15: Current bill payment rates and frequency

Condition	Do you pay your water bills?	Do you pay your water bills <u>regularly</u> ?
Valid	Valid Percent	Valid Percent
Yes	95%	67%
No	5%	33%
Total	100%	100%

The Degree of Satisfaction with Municipal Water Services:

Generally speaking, households expressed much higher satisfaction with supply than farmers receiving water from the agricultural network system, however many did express **dissatisfaction with the municipality's managerial processes and services**. Some examples of the service problems identified by residents were price, water cuts and the associated turbidity following such incidents. It is worth mentioning that survey results revealed that the most prevalent problem for domestic water services was with no question **water cut-offs during the summer season, whereby approximately 80%¹⁹ of survey interviewees experienced this problem**. Figure 21 summarizes the degree of satisfaction with water quality in terms of taste, color, smell and turbidity (pay attention to relatively lower satisfaction with turbidity).

¹⁹ A Valid Percentage: the percentage of people who answered the question.

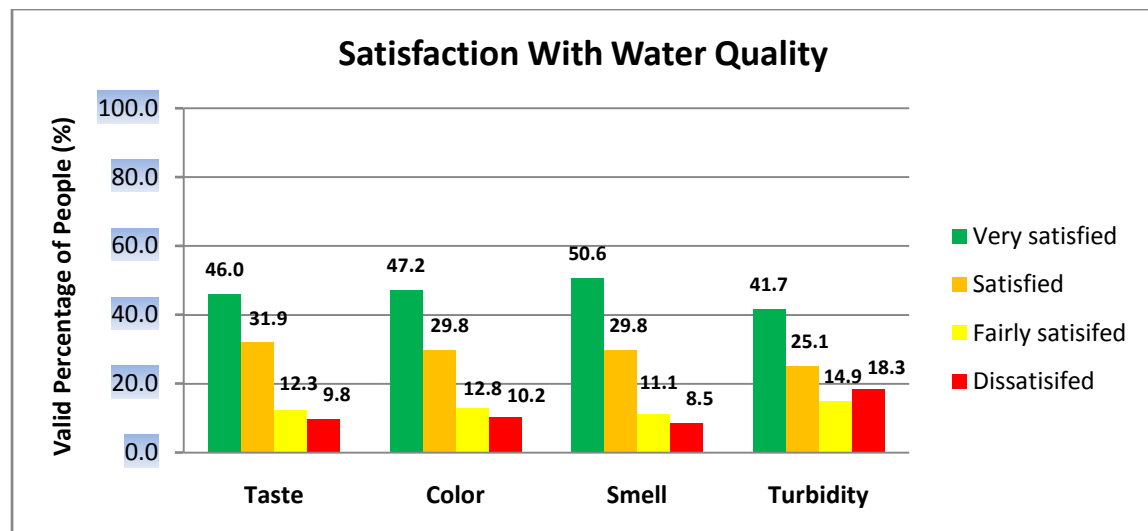


Figure 10: Degree of customer satisfaction

These are rather examples showing the relation between service efficiency and willingness to pay. Since the problems mentioned here were allocated by residents to poor management and lack of follow up by the service provider, municipality superiors are highly advised to take measures in achieving an 'improved water supply' to elevate people's willingness to use, which is logically tailored with a higher willingness to pay.

11. Commercial Tariff structure:

The existing tariff system differentiates commercial water purchases from those for households through a specialized block structure that is generally characterized by higher pricing. This setting is the appropriate approach as commercial users are profit generating establishments and generally consume much higher amounts of water for production purposes.

Taken this understanding, the standard technique in formulating a commercial block structure is basing it upon cost recovery calculations. Additionally, revenue from commercial purchases may be premeditated to subsidize potential net loss from certain blocks in the household structure, a phenomenon that is expected since the household block structure is predominantly constructed upon certain socio-economic factors that especially serve the vulnerable groups.

Table 16: Commercial water users and their price block rates

Category	Consumption Quantity	Fee	Number of Customers (2009)	Tax (Maintenance+ Meter Reading)
1	0 -20 m ³	1 NIS/m ³	275 Customers	10 NIS
2	21 -50 m ³	2 NIS/m ³	69 Customers	10 NIS
3	51-100 m ³	4 NIS/m ³	37 Customers	10 NIS
4	> 101 m ³	5 NIS/m ³	36 Customers	10 NIS
Total # of Commercial Customers			417 Customers	

12. Agricultural Tariff System:

Jericho city has for decades been known for being an agricultural haven for, as agricultural activity took up approximately 22%²⁰ of GDP in Jericho city. This cultivation activity is normally fed by either agricultural wells –which are turning increasingly brackish by the moment- or Ein Sultan Spring the most relied upon water source in the city. The existing tariff system specifically handles the management of Ein Sultan Spring water supply. The Master Plan study revealed despite the fact that there is 3% reduction in allocation amounts annually, still over 95% of farmers in Jericho rely on Ein Sultan for irrigation (PHG, 2009).

The existing tariff system for agricultural water shares is extremely sophisticated and appears to amalgamate laws from previous historical eras, that is: Ottoman, British Mandate, Jordanian, and current. One of the main challenges of managing such a tariff system pertains to the different classifications of Ein Sultan water shares, part of which are privately owned that are sold according to unique standards. Additionally, Ein Sultan Association is a body consisting of representatives of Jericho farmers that have been in dispute with the municipality (the current supplier) over taking charge of managing Ein Sultan agricultural water shares. However, the price per cubic meter for agricultural use was calculated by the Municipality to be 0.36 NIS. Yet, based on the understanding reached between the Municipality and ESIWUA, the later agreed to allocate 60 m³/hr to the municipality to cover the agricultural water pumping cost, as mentioned earlier. Accordingly, the price per cubic meter to become 0.2 NIS instead of 0.36 NIS.

13. The Existing Agricultural Tariff System:

Table 34 here summarizes the different types of water shares, their characteristics, the transaction used for it, and the associated prices. The abbreviations below the table will help in understanding what some symbols stand for.

²⁰ PCBS (agricultural survey 2010)

Table 17: Types and characteristics of water shares²¹

Municipal Agricultural Water Tariff System In Jericho City						
Share Category	Owned Water Shares				Rented Shares	
Type	Type I	Type II a	Type II b	Type III	Type I	Type II
Seller	N/A	N/A	N/A	N/A	Municipality	Share Owner through Municipality
Delivery Period	Year-round	Year-round	Year-round	Year-round	5 Month Cycle	Year-long Transaction
Range of Owned Minutes (Real)	1-11 Minr	12-20 minr	21-30 minr	≥ 31 minr	Depends	Unlimited
Pumpage Fees (NIS/M3)	1.00 NIS/ m ³	0.20 or 0.36	0.20 or 0.36	0.20 or 0.36	1.00 NIS/ m ³	0.20 or 0.36 NIS
Annual Tax (NIS/ Minr)		3 NIS/ Owned minr	3NIS/ Owned minr	3 NIS/ Owned minr		3 NIS/m ³ (billed to original owner)
Quantity Delivered (m3)	Depends on share	19 m ³ (fixed)	39 m ³ (fixed)	Depends on share	Depends on rented amount	Depends on rented amount
Delivering Water Network	Domestic	Agricultural	Agricultural	Agricultural	Agricultural	Agricultural
Fee for Excess Use	3 NIS/ m ³	-	-	-	-	-
Transaction Fees	N/A	N/A	N/A	N/A	None	An approximate 5% of trans.
Price of Water	1.00 NIS/ m ³	N/A	N/A	N/A	1.00 NIS/ m ³	Depends on agreement (normally 150 J.D/

²¹ = An Owned Irrigational Minute (depends on water share type) A Real irrigational minute (1 min, = 60 seconds) OR the an actual minutes of pumpage equivalent to 1.25m³/minute An Owned irrigational hour (depends on the water share type)A Real irrigational hour (1 hr, = 60 minutes)1 min, = 1.25 m³

14. Farmers' Socio-economic Background (Survey Findings):

As mentioned earlier, agriculture is an intrinsic element of Jericho residents' way of life, thus it could either be exercised as a profession or as smaller-scale cultivation around dwellings. For this reason, owners of agricultural water shares in Ein Sultan are not necessarily distributed to full-time farmers. Figure 22 below reveals the distribution of main sources of income for farmers interviewed in our survey. It is worth mentioning that aside from interviewing farmers receiving water through Hydrometers (corresponds with high quantities of water), the survey also included owners of water-meters (lower quantities) who are predominantly non-farmers.

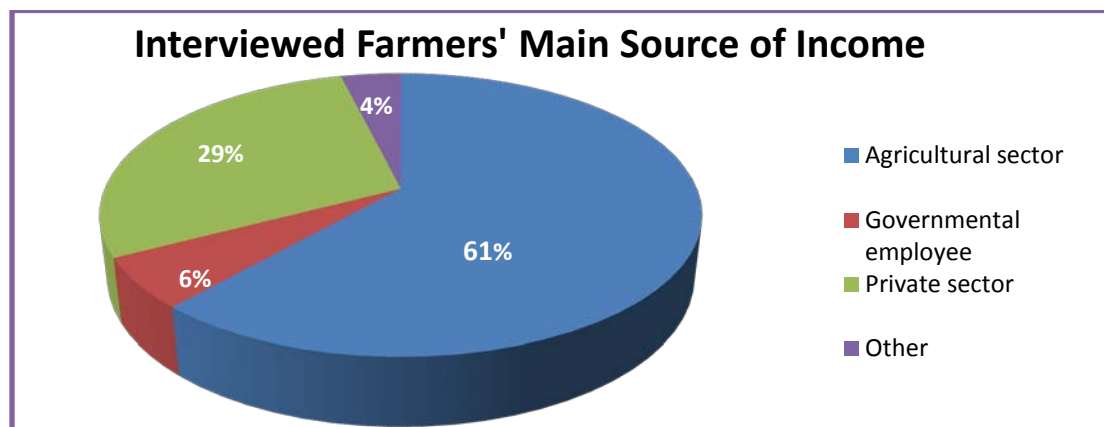


Figure 11: Interviewed farmer's main source of income

Generally speaking, it could be assumed that farmers are for the most part low income citizens, specifically in Jericho, struggling to sell their local harvest in a market flooded with cheaper settlement produce. Table 35 below finds over 85% of our interviewed farmers to receive an *average monthly income*²² underneath the 3000 NIS level.

Table 18: Farmers income levels

Income group	Frequency (No. of Answers)	Valid Percent
< 1000 NIS	6	12.2%
1000 - 2000 NIS	21	42.9%
2000 - 3000 NIS	15	30.6%
3000 - 5000 NIS	4	8.2%
> 5000 NIS	3	6.1%
Total	49	100%

Furthermore, as shown in table 36, most fulltime farmers (as in, agriculture is their main source of income) receive average monthly incomes below 2000 NIS (An approximate 75% of them). Despite this fact, it has been a social phenomenon in Palestine as a whole that farmers have larger families than other citizen; this is mainly

²² Due to the fact that income varies widely for farmer depending on month, crop type, market conditions, etc., the values market here represents rough estimations of our interviewed farmers.

because they have the mentality that children would naturally help in the fields. A further reasoning for high growth rates, as many social scientists choose to endorse, may be linked to the relatively low educational attainment levels. PHG survey results conclude that the weighted average family size for farmers in Jericho is 8.0 members, compared to a 6.4 average for the rest of the population. The following table displays statistic for the issues discussed herein, all in relation to the Income groups identified by the team.

Table 19: Family size and farming contribution in farmer's income

Income Groups	Weighted Avg. Family Size	% of full-time farmers in each income group
< 1000 NIS	8.8	17 %
1000 - 2000 NIS	7.9	<u>59 %</u>
2000 - 3000 NIS	7.2	17 %
3000 - 5000 NIS	9.8	7 %
> 5000 NIS	11.0	0 %
Total	Avg. family size= 8.1	100 %

Consequent to the socio-economic information provided above, it is within our conviction that such indicators should be used to evaluate the affordability levels of farmers. Such an understanding should constitute the foundation for an equitable agricultural tariff system that would insure farmers are able to generate moderately accepted profit rates.

15. Willingness to Pay:

As was elaborated upon in the household tariff system section, people's perspective on pricing and the resulting willingness to pay plays a vital role in both determining the form of a modified tariff system as well as the feasibility for its effective implementation empirically. The latter implies that such a proposed tariff system would hypothetically be widely accepted as it safeguards vulnerable groups and other socio-economic factors. Table 37 shows farmer's perception on water prices.

Table 20: Farmers perception on water price

Question: Water prices are considered (cost of transport & pumping)...		
Status	Frequency	Valid Percent
Too expensive	24	45.3 %
Expensive	16	30.2 %
Fair	13	24.5 %
Total	53	100 %

As is obvious from the survey results, most farmers consider current water prices too expensive for them to be able to make profit from farming. These results, however, may be misleading as it remains unknown to what extent they truly reflect economic hardships. An alternative explanation feeds into the idea of farmers in Jericho still believing that water from Ein Sultan is a commodity that should always be available for free. Some even express their disagreement with the distribution of water through a water network and demanded that the old canal system be restored. Table 38 displays farmers' willingness to pay in a set of different circumstances:

Table 21: Farmer's willingness to pay

Question: Willing to pay...		
Condition→ Action	Frequency (# of answers)	Valid Percent
More in return for an increased supply	4	7.7 %
More in return for the same quantity but more continuous supply	7	13.5 %
More in return for better services	6	11.5 %
Disagree with increasing water prices	35	<u>67.3 %</u>
Total	52	100 %

It appears that the extreme majority of farmers are not willing to accept any increase in water prices regardless of whether services might improve. This rate does not account for farmers who are willing to tolerate the normal costs arising from the existing tariff system. This might be perceived as a disadvantage to any change in the current tariff system, however it cannot be taken for granted – at least with a large degree of confidence- especially once put into the context of how much farmers have suffered from a poorly managed agricultural network system, specifically during the dry summer season. This is to imply that enhancing services to a level that would increase the yield and income of farmers would only naturally be followed by more trust in the providing body and a higher willingness to use and pay. The most pressing issues and problems identified by farmers were: the weak pressure of water supply, insufficient amounts, the expensive water fees per cubic meter (operation and maintenance), the lack of timely distribution of water shares, and mismanagement and lack of follow up measures.

16. Main Weaknesses of the Current tariff

Following to this quick analysis of the existing tariff structure for all sectors in Jericho city and the willingness to pay and affordability, we realized that there are several drawbacks in the current tariff setup that should be addressed when developing the tariff later on in this report under chapter 4. The main points are summarized as follows:

1. Domestic and Commercial Tariff

- **Low Commercial Tax Fees:** Commercial customers- including large consumers- are charged a mere 10 NIS per billing cycle for both meter reading

and maintenance costs. Shockingly, this same fee is analogous with what households pay as well (including low income ones). Thus, we believe that this tax is underrated for the commercial sector and is advised to be boosted for the sake of subsidizing low income families as well as attaining a proficient cost recovery of Maintenance and operation of the water network system (even depreciation and interest rate if possible).

- **Information Inaccuracy:** In 2007, the Jericho municipality switched from using Microsoft Access to Oracle Database software for keeping records of all water transactions, a measure that was believed to improve the accessibility and quality of information. For the most part, this software seems to complement many difficulties that may occur with the attainment of data, a reason why most of the information used for this Master Plan was inquired from this particular program. However, throughout the process of data compilation, the PHG team faced some difficulties in understanding and validating certain data such as the following:
 - Consumption statements provided a column with the number of readings in each neighborhood rather than showing the number of customers. Once the numbers of readings were divided over billing cycles, some of the numbers came out to give increments rather than whole numbers. For instance, the commercial consumption gave out the following actual number of customers in each category: 274.8, 69.3, 37, and 35.5.
 - The neighborhoods identified by the municipality do not fall within a certain zoning arrangement for the city; as a matter of fact, some neighborhoods actually represented a particular road rather than an area. As a response to this inaccuracy problem –especially affecting the technical management of water networks- , the PHG technical team sketched a new zoning map for the municipality to adopt.

2. Agricultural tariff

The following points were identified as major setbacks that need to be considered in improving the tariff system:

- a) **Owned/ TYPE II:** The tariff system for owners of water shares within the range categories of 12-20mins & 21-30mins is unjust as it doesn't distinguish between the different shares; the customers falling within the same range are provided with the same amount of water regardless of actual need or ownership (range 1= 19m³, range 2= 39m³). The fees corresponding to these categories are also extremely problematic and ill-structured because not only might a smaller share owner receive the same amount of water as that of a larger share owner, he/she are required to pay lower annual tax fees for the formal possession of more minutes (in theory). To our knowledge, this system has not been based on any credible criteria.
- b) **Pumpage Fees:** The Municipality of Jericho has not determined a final price for the pumpage of water as it has been going back and forth between 0.20 & 0.36 NIS, a problem that applies to all the different types of

delivered water shares. The current handling by the municipality is to give farmers the opportunity to either pay 0.20 or 0.36 NIS/ m³ on the basis that once a final price is set, either party will owe the other the remainder of the billed amount. Aside from being a tariff concern, this issue is also regarded as a matter of dispute and disagreement among the two major stakeholders.

17. Income levels and Affordability:

Affordability is an imperative measurement for the formulation of tariff systems as it depicts the extent to which people are able to pay for water services. It differs from *Willingness-to-pay* in the sense that it targets households' actual financial capability to pay for water services. As specified by EPA (1997), "*Affordability* is a function both of the price of water services and the ability of households (and other 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".²³ Furthermore, *Affordability* is mainly a function of income related to cost of living, which in turn is a primary function of employment (EPA, 1997). However, for the purposes of this study, the principal focus of affordability will be on the percentages of household Income paid on water per month.

Table (5) shows affordability results obtained from our household socio-economic survey.

Table 22: Affordability of users to pay for water

Question: How much can you afford for suitable water?							
Income group	Mean Family Size	0 NIS/m ³	0-1 NIS/m ³	1-2 NIS/m ³	2-3 NIS/m ³	> 3 NIS/m ³	Total
< 1000 NIS	5.3	11.8	88.2				100 %
1000 - 2000 NIS	6.5	2.3	95.4	1.1	1.1		100 %
2000 - 3000 NIS	6.1	1.9	94.3	3.8			100 %
3000 - 5000 NIS	6.7	2.3	95.3			2.3	100 %
> 5000 NIS	7.1		95.7	4.3			100 %
Total	6.4*	2.7%	94.6%	1.8%	0.4%	0.4%	100 %

Note: the unit used in all the cells is % with the exception of mean family size (members).

***A weighted Average of family members**

²³ Palestinian Hydrology Group, "Pricing Policy, Willingness to Pay and Affordability in the West Bank, Palestine", December 2002.

As illustrated by table 4, the overarching majority of residents in Jericho expressed an ability to afford a water price of 1 NIS/m³. These percentages, however, may not be fully representative of the actual affordability of people as they might have underrated their abilities to avoid increased prices. PHG's survey also reveals that approximately 92% of people who do not pay their water bills on a regular basis refer it to economic reasons (affordability). Over the course of providing financial assistance to low-budget in attaining their basic water needs, a tariff structure should be devised in a manner that can encompass their special socio-economic standing. Additionally, special assistance programs and other poverty alleviation projects may come relevant in this realm, however and since this vulnerable group constitutes a large portion of the general population, a centralized tariff block structure that can reduce their hardships is much preferred. This may refer to an IBT system that promotes equity through the use of a cross subsidy from the rich to the poor, made achievable once the socio-economic indicators of an area are directly deployed in determining the number and ranges of tariff blocks and the associated prices. For this cause, a balanced exponential pricing structure is envisioned most fit for Jericho city. In this regard, there is no doubt that the existing tariff block should be modified to satisfy water conservation, O&M cost recovery, social equity and sustainable management, yet it must also respect Jericho's exclusiveness particularly with high per capita use and low prices²⁴. A major set-back to the domestic tariff is the excessive consumption by governmental and public facilities reaching approximately 18% of the total domestic supply in 2009. Furthermore, the average consumption rates per connection for non-household connections exceed that of a typical household by 150-1000%. Table (6) shows the consumptions, percentages, and rates for these facilities during the year 2009:

Table 23: Public water use categories and quantities

Facility type	No. of Connections	Total Consump. (2009)	% from total domestic consumption (2009)	Avg. Consump./ Connection	Rate of Consump. to average domestic/connection.	Rate of Consump. to average HH. domestic/connection
Parks/ Playgrounds	45	29705	1.51	55.0	120.18	213.19
Security Centers	67	143404	7.28	178.4	389.66	691.26
Governmental Centers	63	55304	2.81	73.2	159.81	283.51
Organizations	112	51573	2.62	38.4	83.83	148.72
Municipal facilities	20	63224	3.21	263.4	575.51	1020.95

²⁴ Once comparing the current water prices set in Jericho city with other Palestinian governorates', it is substantially cheaper.

Some of the problems caused by these high-consuming facilities are: Shortage in supply, water cuts on households (especially during the summer), etc. Thus, the tariff system must elevate prices for such customers in order to enforce conservation.

18. Willingness to Pay

Willingness-to-Pay is an indicator used widely to project the effectiveness of a tariff system as it depicts the average customer's intuition on prices. This customer psyche towards payment is the product of a sophisticated web of factors and attitudes. Willingness to pay may be perceived as the combination between Affordability and willingness to use.²⁵

Some of the major factors affecting willingness to pay are as follows: Socio-economic circumstances (such as income, educational attainment levels and awareness, family size, etc.), the quality of services being provided (such as: water availability and quality, reduced water cuts, maintenance efficiency, management effectiveness, etc.), and customer-supplier relations (concerned with: level of trust, bondage and nature of interactions, level of conformity, attitudes, transparency and corruption, etc.). These major factors are extremely intertwined, each having its influence on customer attitudes and standpoints.

The use of willingness to pay as a measure in setting tariff structures is criticized for reliability assurances. Firstly, many of the indicators used in willingness to pay are literally un-measurable and their level of influence may vary according to location, situation, time, etc. Secondly, questionnaires cannot reflect the real situation because results may vary depending on simple interactions such as the way questions are asked, their phrasing and form, the tone used to ask the question and even the seeming interest or benefit an interviewee may sense. Additionally, some people may not answer with honest answers in fear of increased charges. This issue is highly debatable; however this section will display people's answers to our socio-economic survey questionnaires to provide a general idea on the context of pricing in Jericho city. Table (24) depicts the results of the WTP.

Table 24: Willingness to pay for water service

Question: How much do you think the most suitable fee for current services?					
Income ranges	0 NIS/m3	0 -1 NIS/m3	1 - 2 NIS/m3	> 3 NIS/m3	Total
< 1000 NIS		100			100
1000 - 2000 NIS		98.9	1.1		100
2000 - 3000 NIS		96.2	3.8		100
3000 - 5000 NIS	2.3	95.5		2.3	100
> 5000 NIS		95.8	4.2		100
Total	0.44%	97.35%	1.77%	0.44%	100%

Table 25 shows the residents' level of willingness to pay under the existing circumstances; in other words it is the general price of water they have set if current

²⁵ Palestinian Hydrology Group, "Pricing Policy, Willingness to Pay and Affordability in the West Bank, Palestine", December 2002.

services remained the same, which would be expected to increase if quality of service is improved. The current rates of bill payment and its regularity are illustrated in table (42) below:

Table 25: Current rates of bill payment

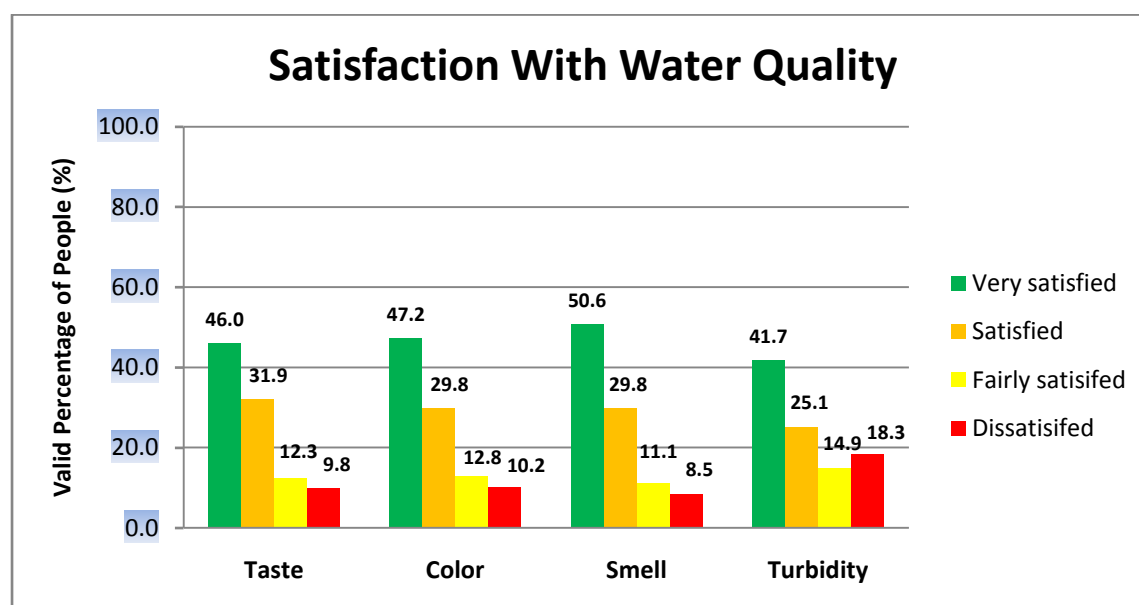
Condition	Do you pay your water bills?	Do you pay your water bills <u>regularly</u> ?
Valid	Valid Percent	Valid Percent
Yes	95%	67%
No	5%	33%
Total	100%	100%

As can be seen from Table 7, almost 95% of people are generally paying for water. However, almost two third of the surveyed people are paying regularly due to various economic, social and service reliability reasons.

19. The Degree of Satisfaction with Municipal Water Services:

Generally speaking, households expressed much higher satisfaction with supply than farmers receiving water from the agricultural network system, however many did express dissatisfaction with the municipality's managerial processes and services. Some examples of the service problems identified by residents were price, water cuts and the associated turbidity following such incidents. It is worth mentioning that survey results revealed that the most prevalent problem for domestic water services was with no question water cut-offs during the summer season, whereby approximately 80%²⁶ of survey interviewees experienced this problem. Figure 13 shows the degree of satisfaction with water quality in terms of taste, color, smell and turbidity (pay attention to relatively lower satisfaction with turbidity).

²⁶ A Valid Percentage: the percentage of people who answered the question.

Figure 12: Degree of satisfaction with water quality

These are rather examples showing the relation between service efficiency and willingness to pay. Since the problems mentioned here were allocated by residents to poor management and lack of follow up by the service provider, municipality superiors are highly advised to take measures in achieving an 'improved water supply' to elevate people's willingness to use, which is logically tailored with a higher willingness to pay.

20. Proposed Domestic Water Tariff for Jericho

Following to this analysis, there is no doubt that the existing tariff structure should be modified to satisfy water conservation, O&M cost recovery, social equity and sustainable management of the only water source in the city (Ein Essultan), yet it must also respect Jericho's exclusiveness particularly with high temperature and historic low prices. In the mean time there is a need to improve the service so that people can feel the difference and the change in water price can be more justifiable for the public so they can endorse and accept it.

The proposed modification for the current IBT structure would be simply to change the block range settings in order to align it with the real domestic water use and to prevent wasteful use of water and encourage water conservation. In the mean time, it would ensure the social equity and cost recovery. It will also be as close as possible to the proposed block ranges by the Palestinian Water Authority.

Having said that, further consideration is being given to the local context of water use in Jericho when determining the blocks and setting the proper price. Such considerations would include an understanding of community lifestyle, water use and practices, availability of water resources and finally levels of acceptance to a change in pricing. From the socio-economic survey results we realized that most people regardless of their monthly income they are not willing to pay more for water. Only a small percentage indicated their willingness to pay more. In the mean time most of the surveyed people indicated low affordability figures. We believe that this is part of the nature of people in general when they can get a service at lower price why they should express their willingness to pay more for the same service they are already getting?

The challenge remains how to design a tariff structure that would be accepted by people and that would charge real cost of produced water while eliminate wasteful use of this precious resource and in the same time it takes the low income groups into consideration.

The current water use in Jericho is rather high compared with other places in the West Bank. If we have a closer look into what are the likely causes for such high water use we can conclude the following:

- **Meteorological Uniqueness:** Jericho governorate is generally considered an arid to semi-arid area, where temperatures rise much higher than any other Palestinian governorate. This is largely due to the geographical location characterized by low elevations reaching 400 meters b.s.l and the high pressure associated with it. These weather conditions have for centuries influenced people's water practices in the area resulting in much higher use rates for hygiene and cooling purposes. For the sake of objectivity, these water practices cannot merely entirely be considered as reckless behavior since the extremely elevated temperatures do in fact require much higher use of water to sustain a healthy life.
- **Availability of Water Resources:** Historically, people have been accustomed to having high accessibility to Ein Sultan Spring freshwater flow. Despite low rainfall amounts of about 170mm annually, Ein Sultan Spring remains a substantial and constantly flowing water source throughout the year. This factor has -for centuries now- encouraged increased agricultural activity in the area as well as the occurrence of many other domestic water practices that don't properly take conservation into consideration.

The two main factors mentioned above have generally outcome the following elevated-use practices:

- 1) **Extensive Use of Wet Cooling Systems** or water based air-conditioning, which is estimated approximately to use up to 0.5 Mcm/Yr.
- 2) **Widespread Agricultural Activity** both as an income generation activity and in gardens on the household level.
- 3) **Increased Domestic Use on the Household level** such as increased amounts for drinking, multiple daily showers, outdoor spraying, etc.
- 4) **The Spread of Swimming Pools** especially those owned by partially residing property owners (mainly from Jerusalem).

All this practices have resulted in a per capita water use of 206 liters/day. However once the average household consumption was calculated excluding non-household facilities connected on the domestic water network, the per capita water use was calculated to actually average 88 L/c/d (assuming that the average family size is 6.5 members/family). This quantity constitutes almost 43% of the water used by households. The remaining 53% is going for air conditioning, irrigating gardens and filling swimming pools in some residential areas.

Therefore, we notice that most of the water is used for purposes other than pure domestic. This is why such unnecessary uses needs to be reduced gradually and make more water available for domestic uses. In the mean time, attention needs to be paid to secure sufficient water quantity for domestic use taking into all the considerations

listed above. Accordingly, the first block will be based on the lifeline quantity that vulnerable groups can afford and that monthly expenditure on water would not exceed 4% from their monthly income (which is slightly below what they are currently paying). According to EPA, the importance of “lifeline” quantities and rates is emphasized as a mitigation strategy for social inequity.

“To alleviate these hardships, communities may offer pricing structures that mitigate impacts on low-income households. The most common example is “lifeline rates” whereby low-income households are charged lower rates on that portion of water consumption considered non-discretionary (the minimum sanitary requirement, e.g., 23 m³ a month) but then higher charges are levied on water consumption beyond that amount”²⁷

This “lifeline” quantity could be used as the cornerstone for setting the first block in a tariff block structure and at a rate reasonably below marginal cost. In common cases, the first block is extended to also benefit middle and upper classes rather than strictly serve the purpose of assisting low-income families.²⁸ PHG’s pricing policy study in 2002 reveals that the first block in Palestine is normally set around 15 m³/ month, which is on average 3 times the “lifeline” proposed by PWA. This of course is also in line with the acceptable practice worldwide to make sure that low income and middle income people are getting their basic water use at affordable prices.

Accordingly, it is more logic to consider the real per capita water used for domestic purposes to define the first block. When the 88 l/c/d rate is used, the monthly water needs of a family of 6 would be nearly 16 m³. Even if we consider the recommended level of WHO of 100 l/c/d the domestic monthly water needs for a family of 6 is nearly 18 m³. Given that family size may vary and that it is not possible for the Municipality to record or keep track for this issue, and taking the climate as well as other specific conditions exist in Jericho, we may propose that the first block should be placed slightly higher than this level and would be **20m³/month**.

Having determined the first block it is necessary to define the price per cubic meter that should be applied and that would be set below the marginal cost to make sure that lower income groups are able to afford paying for water. To calculate such price we tried to collect all relevant data from Jericho Municipality on the likely O&M expenses as well the existing value of water assets and tried to apply the straight line depreciation on these assets to get the annual depreciation that should be considered in the price. However, it was not easy to obtain detailed asset value and we had to estimate the value to our best knowledge. Table 9, shows the total cost of supplying the domestic water quantity to the city of Jericho.

²⁷ <http://www.epa.gov/waterinfrastructure/pricing/FAQ.htm#LowIncome>

²⁸ Palestinian Hydrology Group, “Pricing Policy, Willingness to Pay and Affordability in the West Bank, Palestine”, December 2002.

Table 26: Total cost of supplying domestic water to the city of Jericho

Domestic	Total	%
Total Quantity supplied (m3/year)	2721732	100
Total quantity Billed by Jericho city (m3/year), excluding Ein Essultan Camp	2077823	76.3
Losses (m3/year)	643909	23.7
Water Production Cost Categories	Costs (NIS)	
Salaries	632,791.11	
O&M	1,191,728.13	
Depreciation (Flat rate for 20 years), water supply infrastructure	357,262.13	
Total production cost	2,181,781.37	
Production Cost per m3 including losses	0.8	
Production cost without losses (total production cost / billed quantity)	1.05	
Safety margin 10%	1.15	

As can be noticed, the production cost of one cubic meter under the current available information where part of the asset was not valued and not included in this price, is around 1.05 NIS. When we included most of the assets and depreciated them, we ended up with a figure close to 1.2 NIS / m3. Assuming that we may have over estimate for some assets, we can consider a 10% increase as a safety margin for the first calculated price and set the cost at 1.15 NIS / m3. Now if we apply the same methodology used by PWA to approximate the recommended block range and prices for domestic uses we would then come up with the following:

Table 27: Proposed Tariff for Jericho City

Type of consumption	Tariff blocks (m ³)						
	0 - 20		21 to 30	31 to 50	51 - 70	70 - 100	>100
Domestic	0 - 5	6 to 20					
	Price NIS / m3						
	5	1.1	2.5	3.5	4.5	5.5	6.5
Institutional	20		2.5	3.5	4.5	5.5	6.5
Commercial and tourism	30		3.5	5	6	6.5	7.5
Industrial			3.5	5	6	6.5	7.5

As can be noticed from Table 10 above, the first 5m3 which forms the lifeline proposed by PWA is provided at a very minimum cost. After this limit, the price is provided at nearly the cost of production but slightly less. After the 20m3 limit, we assume that the quantity used is no longer domestic and therefore the prices should

increase exponentially. It can also be noticed that toward the upper limit of water used the price difference between domestic and other commercial or industrial uses is very close. The reason is again the use of such large quantity will generally be either for leisure or for production purposes. Such users are the ones who will pay for the lower water users and compensate the lower prices charged in the first block.

When the price per block is analyzed, we can realize that this proposed ITB pricing structure fulfils the criteria of the increasing trend where the more water is used the higher price is paid as depicted in figure 3.

Figure 13: Amounts paid according to water quantities used

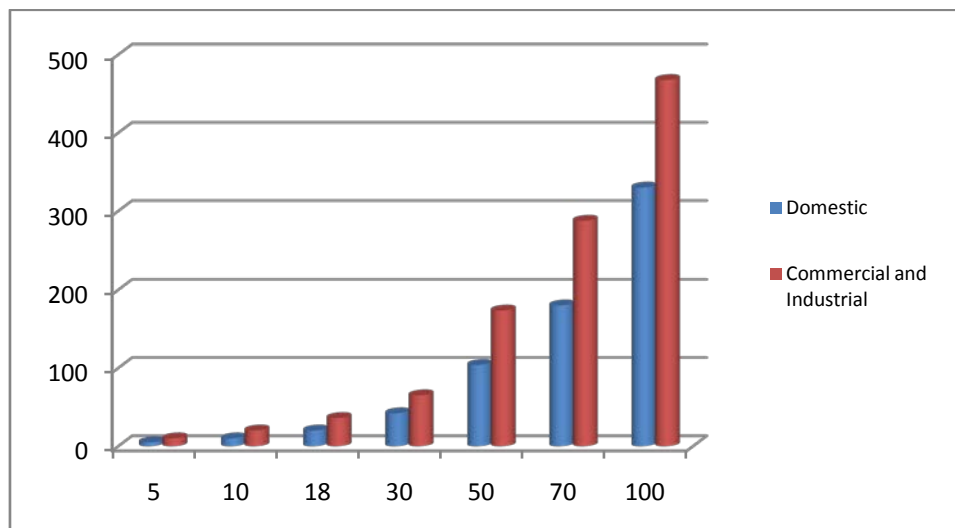
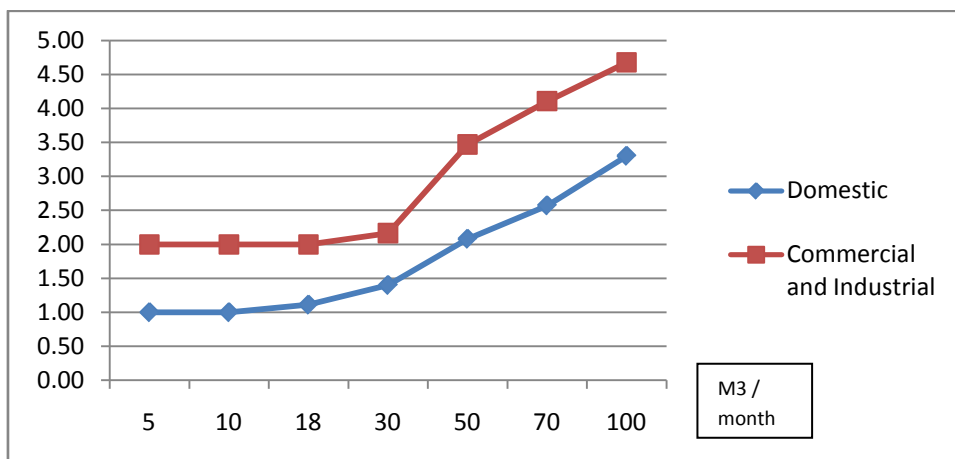


Figure 14: also shows the average price per cubic meters used for both domestic, commercial and industrial



As we can notice from figure 4, that the price difference between domestic, commercial and industrial uses is almost paying double the price per cubic meter used for domestic purposes. This is also in line with the recommended tariff policy by PWA.

In addition, the proposed tariff structure ensures more social equity among various users and assures cost recovery unlike the existing structure as shown in Figure 4.

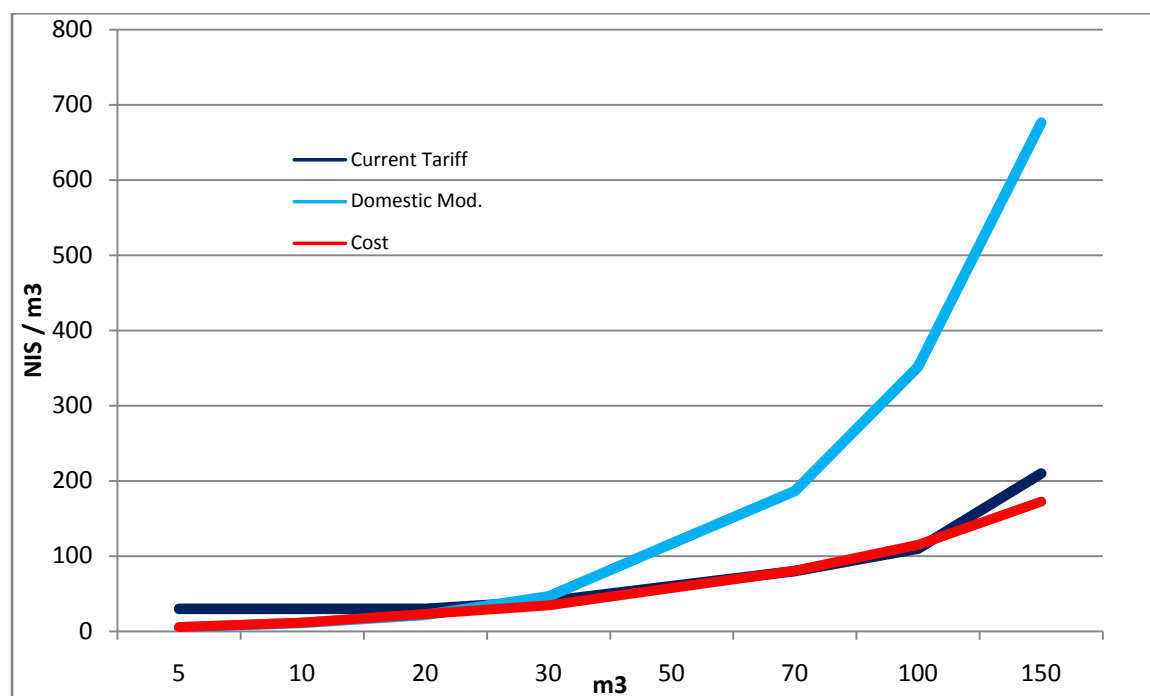


Figure 15: Cost Recovery and Social equity resulted from the proposed tariff

As can be noticed from figure 4 that customers are paying very high price for the first block used while they pay less when consume more. Assuming that those who use less water are those of low income and poorer people, mean that the current tariff structure charging them more price per cubic meter they use than those richer people who uses more water quantities. Moreover, the current structure doesn't encourage water conservation since the price paid by those who use more is very little.

When comparing the current structure with the proposed one, we can clearly see that the proposed structure ensures that the less water is used the lower you pay for the water. The first blocks which secures lifeline for those poorer people are charged at cost. The more water is used the more you pay and when the price paid per 100 m³ is compared between the current and the proposed structure we realize that according to the current structure the price is nearly 100 NIS while it is nearly 350 NIS according to the proposed structure.

In addition, wastewater service has to be incorporated in the future update of the current proposed tariff structure. It is anticipated that the price of produced wastewater from household would be set at nearly 70% of the water use bill given that the proposed demand management improvement are considered and that no much water is used for agriculture within the household. If so then the Municipality needs to develop a detailed survey to account for household water uses in order not to overcharge for wastewater.

Commercial and Industrial Block Structure: Existing Commercial Structure

The existing tariff system differentiates commercial water purchases from those for households through a specialized block structure that is generally characterized by higher pricing. This setting is the proper approach as commercial users are profit generating establishments and generally consume much higher amounts of water.

Taken this understanding, the standard technique in formulating a commercial block structure is basing it upon cost recovery calculations. Additionally, revenue from commercial purchases may be premeditated to subsidize potential net loss from certain blocks in the household structure, a phenomenon that is expected since the household block structure is predominantly constructed upon certain socio-economic factors that especially serve the vulnerable groups.

For the reasons mentioned above, commercial tariff should directly be linked to cost recovery of O&Ms in the first rank. Additionally, a financially efficient commercial tariff system- and tariff system as whole for this matter- would also cover the following costs: depreciation, interest rate, environmental preservation, and marginal costs. The existing tariff structure for the commercial use is shown in Table 11.

Table 28: The current commercial water tariff

Category	Consumption Quantity	Fee	Number of Customers (2009)	Tax (Maintenance+ Meter Reading)
Min.	30 NIS/cycle			
1	0 -20 m ³	1 NIS/m ³	275 Customers	10 NIS
2	21 -50 m ³	2 NIS/m ³	69 Customers	10 NIS
3	51-100 m ³	4 NIS/m ³	37 Customers	10 NIS
4	> 101 m ³	5 NIS/m ³	36 Customers	10 NIS
Total # of Commercial Customers			417 Customers	

As can be noticed from Table 11, nearly 66% of the commercial users are using 10 m³/ month or less. They are most likely small shops and small businesses who run this activity for living. They are possibly the same as the vulnerable households. Therefore, it is logic to treat them as a low income group and set the price differently as we propose in Table 12.

Table 29: Proposed Commercial and Industrial water tariff

Type of consumption	Tariff blocks (m ³)						
	0 - 20		21 to 30	31 to 50	51 - 70	70 - 100	>100
	0 - 10	11 to 20					
	Price NIS / m ³						
Commercial and tourism	10	2	3.5	5	6	6.5	7.5
Industrial	10	2	3.5	5	6	6.5	7.5

As an alternative to this proposal and especially for the first block, the Municipality of Jericho may consider to apply the rate of domestic tariff on this block since it would serve small business and shops and start charging higher rates from the second block onward as stated above.

.Agricultural Tariff Structure

Jericho city has for decades been known for being an agricultural haven, as agricultural activity took up approximately 22%²⁹ of GDP in Jericho city. This cultivation activity is normally fed by either agricultural wells –which are turning increasingly brackish by the moment- or Ein Sultan Spring the most relied upon water source in the city.

The water of Ein Sultan has been traditionally used for domestic as well agricultural purposes via open canals flowing across the city by gravity. The first division of the spring's water was done in the year 1935 among the six main Jericho families by a British General called "Sheppard" as follows:

"One third of the water to irrigate orchards and denoted as "Basateen Water" and two thirds of the spring water was allocated for the people who grow crops such as wheat, barley, etc. and denoted as "Muftalah Water".

The quantity of water discharged by the spring is being divided into time shares and then allocated to both types through the open canals. The definition of both Muftalah and Basateen water is as follows:

Muftalah: The equivalent quantity of water that corresponds to the time shares which have been allocated to the six Jericho Families to be used by individuals who grow crops. The shares can be owned, traded, rented and exchanged as well as inherited separately from agricultural land.

Basateen: The equivalent quantity of water that corresponds to the time shares which have been allocated to the six Jericho Families to be used by individuals to irrigate orchards. This type of water shares is attached to land and can't be traded or

²⁹ PCBS (annual report 2011)

exchanged separately from the land they belong to. Its status changes with the change of land ownership or with the change in the land status and use. For example, if the agricultural land classified under Basateen category is converted into building area then the water entitlement or share that belongs to this land diminishes and is claimed by the Jericho Municipality, yet the ownership of water remains for the land.

Both the domestic as well as irrigation water is currently being distributed through a pressurized pipe system where the historic time shares have been converted into quantities and then adjusted to suite the new pipe system. Accordingly, the discharge of Ein Es Sultan spring of 650 m³/hr is being divided according to the preliminary understanding (agreement) that has been worked out between Jericho Municipality and Ein Sultan Irrigation Society as follows: 42% from the spring's discharge should go to domestic uses "i.e. 273 m³/hr", whereas, 58% should go to the agricultural uses "i.e. 377 m³/hr". However, PHG has realized, during the Master Plan studies, that the current quantity supplied to agriculture is less than the agreed on percentage. Our agricultural survey concluded that over 95% of farmers in Jericho still rely on Ein Sultan for irrigation (PHG, 2009).

In any case, the existing municipal agricultural tariff system in Jericho city has been a target of PHG's study, evaluations, and recommendation as will be seen later in the report.

21. The existing tariff structure:

The existing tariff system for agricultural water shares is extremely sophisticated and appears to amalgamate laws from previous historical eras, that is: Ottoman, British Mandate, Jordanian, and current. One of the main challenges of managing such a tariff system pertains to the different classifications of Ein Sultan water shares owned and rented (muftalah or Basateen).

The owned water shares are converted into hourly pumping shares and their range differ whether it is being muftalah or basateen. The one hour time share under Basateen equals 60 minutes of pumping whereas the one hour under muftalah equals 23 minutes of pumping. Now these minute shares are divided into weekly minute shares by owner and categorized under four major types as follows:

Type 1: 1 – 11 minutes

Type 2: 12 – 20 minutes (charged at fixed quota of 19 m³/week).

Type 3: 21 – 30 minutes (charged at fixed quota of 39 m³ / week).

Type 4: >30 minutes

The first type of water shares is supplied through the domestic network and charged a price of 1NIS/m³ for the quantities equivalent to the share and 3 NIS/m³ for any excess quantity of the share. In the mean time, the other three types are supplied through the irrigation network and regulated either by water meter (in case of type 2 & 3) or hydrometer (in case of type 4). The price charges for these types are either 0.2 or 0.36 NIS/m³ in addition to annual tax of 3NIS/minute share. However, users under type 2 and 3 are charged based on a fixed quota of 19 m³/week and 39 m³/week respectively regardless of the quantity they use actually.

Table (30) summarizes the different types of water shares, their characteristics, the transaction used for it, and the associated prices. The abbreviations below the table will help in understanding what some symbols stand for.

Table 30: Existing agricultural water tariff

Municipal Agricultural Water Tariff System In Jericho City						
Share Category	Owned Water Shares				Rented Shares	
Type	Type I	Type II a	Type II b	Type III	Type I	Type II
Seller	N/A	N/A	N/A	N/A	Municipality	Share Owner through Municipality
Delivery Period	Year-round	Year-round	Year-round	Year-round	5 Month Cycle	Year-long Transaction
Range of Owned Minutes (Real)	1-11 Minr	12-20 minr	21-30 minr	≥ 31 minr	Depends	Unlimited
Pumpage Fees (NIS/M3)	1.00 NIS/ m ³	0.20 or 0.36	0.20 or 0.36	0.20 or 0.36	1.00 NIS/ m ³	0.20 or 0.36 NIS
Annual Tax (NIS/ Minr)		3 NIS/ Owned minr	3NIS/ Owned minr	3 NIS/ Owned minr		3 NIS/m ³ (billed to original owner)
Quantity Delivered (m3)	Depends on share	19 m ³ (fixed)	39 m ³ (fixed)	Depends on share	Depends on rented amount	Depends on rented amount
Delivering Water Network	Domestic	Agricultural	Agricultural	Agricultural	Agricultural	Agricultural
Fee for Excess Use	3 NIS/ m ³	-	-	-	-	-
Transaction Fees	N/A	N/A	N/A	N/A	None	An approximate 5% of trans.
Price of Water	1.00 NIS/ m ³	N/A	N/A	N/A	1.00 NIS/ m ³	Depends on agreement (normally 150 J.D/ Minr)

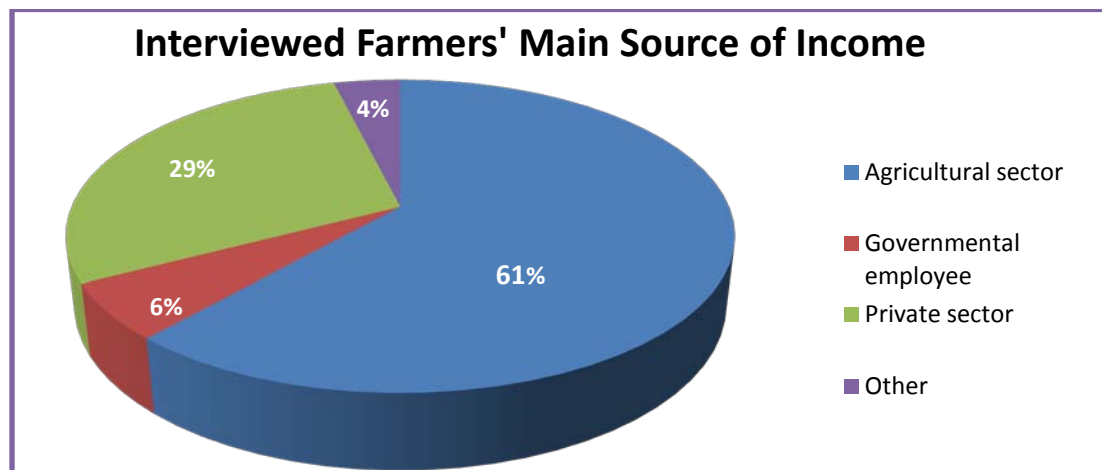
As can be noticed from Table 30, that the agricultural tariff is complicated and it is not understood clearly how it is being designed. It was not easy to understand the prices set for the various categories and why there are two price ranges or the farmers are given the choice of paying either one of them. The other issue is the farmers under Type 2 & 3 share categories, they are being charged on the basis of fixed quota while the actual quantity they may use can be less or higher than such quota. With all these difficulties, it will be not easy to come up with a new agricultural tariff.

However, we will attempt to define the production cost per cubic meter of agricultural water and try to propose a price per cubic meter without entering into the complication of where such price can be applied. We may also propose some preliminary ideas on pricing in accordance with the socio-economic condition of farmers and their ability and willingness to pay for the water.

21. Famers' Socio-economic Background (Survey Findings):

As mentioned earlier, agriculture is an intrinsic element of Jericho residents' way of life, thus it could either be exercised as a profession or as smaller-scale cultivation around dwellings. For this reason, owners of agricultural water shares in Ein Sultan are not necessarily distributed to full-time farmers. Figure (5) below reveals the distribution of main sources of income for farmers interviewed in our survey. It is worth mentioning that aside from interviewing farmers receiving water through Hydrometers (corresponds with high quantities of water), the survey also included owners of water-meters (lower quantities) who are predominantly non-farmers.

Figure 16: Farmers main source of income



Generally speaking, it could be assumed that farmers are for the most part low income citizens, specifically in Jericho, struggling to sell their local harvest in a market flooded with cheaper settlement produce. Table 31 below shows that over 85% of our interviewed farmers are receiving an *average monthly income*³⁰ underneath the 3000 NIS level.

³⁰ Due to the fact that income varies widely for farmer depending on month, crop type, market conditions, etc., the values market here represents rough estimations of our interviewed farmers.

Table 31: Average Monthly income of farmers

Income group	Frequency (No. of Answers)	Valid Percent
< 1000 NIS	6	12.2%
1000 - 2000 NIS	21	<u>42.9%</u>
2000 - 3000 NIS	15	<u>30.6%</u>
3000 - 5000 NIS	4	8.2%
> 5000 NIS	3	6.1%
Total	49	100%

Furthermore, as shown in the Table 32 below, most fulltime farmers (agriculture is their main source of income) receive average monthly incomes below 2000 NIS (An approximate 75% of them). Despite this fact, it has been a social phenomenon in Palestine as a whole that farmers have larger families than a other citizens; this is mainly because they have the mentality that children would naturally help in the fields. A further reasoning for high growth rates, as many social scientists choose to endorse, may be linked to the relatively low educational attainment levels. PHG survey results conclude that the weighted average family size for farmers in Jericho is 8.0 members, compared to a 6.4 average for the rest of the population.

Table 32: Income level of full time farmers

Income Groups	Weighted Avg. Family Size	% of full-time farmers in each income group	Average HH Monthly Expenditure (NIS)					
			< 1000	1000 - 2000	2000 - 3000	3000 - 5000	> 5000	Total
< 1000 NIS	8.8	17 %	0%	100 %	0%	0%	0%	100 %
1000 - 2000 NIS	7.9	<u>59 %</u>	4.8 %	<u>19.0 %</u>	<u>66.7 %</u>	9.5 %	0.0 %	100 %
2000 - 3000 NIS	7.2	17 %	0.0 %	53.3 %	<u>6.7 %</u>	<u>40.0 %</u>	0.0 %	100 %
3000 - 5000 NIS	9.8	7 %	0.0 %	50%	25%	<u>0%</u>	<u>25 %</u>	100 %
> 5000 NIS	11.0	0 %	33.3 %	0.0%	0.0%	66.7 %	<u>0.0 %</u>	100 %
Total	Avg. family size= 8.1	100 %	12%	43%	31%	8%	6%	100 %

Consequent to the socio-economic information provided above, it is within our conviction that such indicators should be used to evaluate the affordability levels of

farmers. Such an understanding should constitute the foundation for an equitable agricultural tariff system that would insure farmers are able to generate moderately accepted profit rates.

Willingness to Pay:

As was elaborated upon in the household tariff system section, people's perspective on pricing and the resulting willingness to pay plays a vital role in both determining the form of a modified tariff system as well as the feasibility for its effective implementation empirically. The latter implies that such a proposed tariff system would hypothetically be widely accepted as it safeguards vulnerable groups and other socio-economic factors. Table 33 shows farmer's perception on water prices.

Table 33: Farmer's perception on water prices

Question: Water prices are considered (cost of supply & pumping)...		
Status	Frequency	Valid Percent
Too expensive	24	45.3 %
Expensive	16	30.2 %
Fair	13	24.5 %
Total	53	100 %

As is obvious from the survey results, most farmers consider current water prices too expensive for them to be able to profit from farming. These results, however, may be misleading as it remains unknown to what extent they truly reflect economic hardships. An alternative explanation feeds into the idea of farmers in Jericho still believing that water from Ein Sultan is a commodity that should always be available for free. Some even express their discontent with the distribution of water through a water network and demanded that the old canal system be re-emplaced. Table 34 displays farmers' willingness to pay higher price for water in a set of different circumstances:

Table 34: Farmer's conditional willingness to pay more

Question: Willing to pay...		
Condition→ Action	Frequency (# of answers)	Valid Percent
More in return for an increased supply	4	7.7 %
More in return for the same quantity but more continuous supply	7	13.5 %
More in return for better services	6	11.5 %
Disagree with increasing water prices	35	<u>67.3 %</u>
Total	52	100 %

It appears that the extreme majority of farmers are not willing to accept any increase in water prices regardless of whether services improve or not. This rate does not account for farmers who are willing to tolerate the normal costs arising from the existing tariff system. This might be perceived as a disadvantage to any change in the current tariff system, however it cannot be taken for granted – at least with a large degree of confidence- especially once put into the context of how much farmers have suffered from a poorly managed agricultural network system, specifically during the dry summer season. This is to imply that enhancing services to a level that would increase the yield and income of farmers would only naturally be followed by more trust in the providing body and a higher willingness to use and pay. The most pressing issues and problems identified by farmers were:

- the weak pressure of water supply,
- insufficient amounts,
- the expensive water fees per cubic meter (operation and maintenance),
- the lack of timely distribution of water shares,
- Mismanagement and lack of follow up measures.

These issues are of high importance and need to be considered when developing the tariff structure. If these concerns continue and farmers or users in general can't see any improvement in the system, it will be very difficult for them to participate and agree on any new tariff.

22. Proposed Agricultural Tariff Structure

Given that the majority of farmers are of low income farmers and that the agricultural water is divided into shares where farmers has certain rights and historically they have been obtaining such water at a very minimum cost, it will be a huge challenge to develop a tariff that might different from what is accepted today. The only attempt here is going to be on how to ensure cost recovery of running the irrigation system properly and how to ensure its sustainability. For this reason, it is important to calculate the production cost of each cubic meter.

Again due to the fact that it was not easy to obtain sufficient information on the existing infrastructure from the Municipality, it was not easy to calculate the exact production cost per cubic meter. However, using our own estimates and judgment we came up with some figures which are presented in Table 35.

Table 35: Production cost of agricultural water

Agriculture	Total	%
Total Quantity supplied (m3/year)	2606976	100
Total Quantity Billed by Jericho City (m3/year)	1900920	
Losses (m3/year)	706056	27%
Water Production Cost Categories	Costs (NIS)	
Salaries	421779.2	

O&M	52930	
Depreciation (Flat rate for 20 years), Irrigation infrastructure	100000	
Total production cost	574709.2	
Production Cost per m3 including losses	0.22	
Production cost without losses (total production cost / billed quantity)	0.3	
Safety margin 10%	0.33	

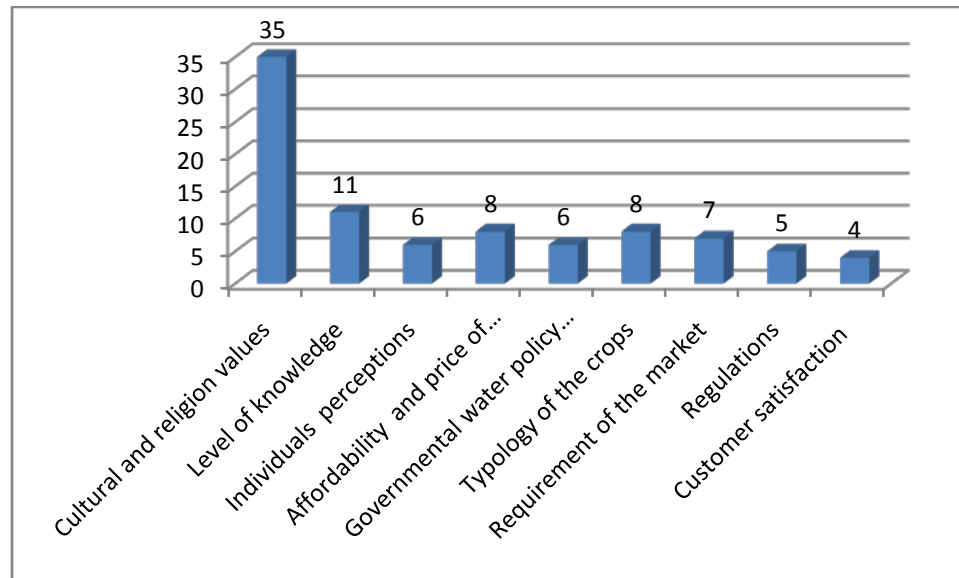
Based on this calculation, the production cost of each cubic meter supplied to agricultural use including the depreciation cost is nearly 0.3 NIS. If we consider the O&M expenses only, the production cost per cubic meter becomes 0.26 NIS. However, more information is needed for the actual values of the assets in order to calculate the actual production cost.

In the light of this information, and given that the depreciation cost was estimated, it will be advisable to set the price at 0.33 – 0.36 NIS. The other components of the water tariff to remain the same. However, the users under type 2 and 3 needs to be charged with actual amounts they use and the tariff can be unified to all the users so that no can feel unfair.

In the same time it was realized that the 60 m3/hour that was allocated to domestic use from the agriculture share was meant to subsidize the price that farmers are paying to receive the water. In a quick calculation, we concluded that this quantity if sold to the municipality at the current production cost that the municipality is encountering for domestic use, it will be sufficient to cover the entire production cost of the irrigation water with each cubic meter produced is priced at 0.359 NIS.

The following chart illustrates that the religion and cultural values are the main obstacles for treated waste water reuse while customer satisfaction is the minimum obstacles, the chart leads to the following results:

1. The people don't care about the regulation since they know the lack of law enforcement (4%)
2. Lack of knowledge about the quality of water will be improved after treatment to the safe level and can be used for some crops (11%)
3. Affordability and price is a big issue if water is available and accusable (8%) since the people are willing to receive it free, the fresh water cost is lower than expected treated waste water
4. Because the lack of transparency and monitoring the farmers they don't pay attention to the market rules.

Figure 17: Level of drivers for social acceptance

However if waste water is the choice and making water available the following table shows that only 15% of people in Jericho area accepting to use it while 75 % completely refuse and they are believing that the reputation of Jericho crops is very high in market due to the use of fresh water

Large amount of people prefer onsite treatment since in Jericho the cost of treated waste water will be higher than the prices of fresh water (table36)

Item	%
people agreed completely to use treated water	15
People refuse completely to use treated water	75
Accepting decentralized system	45
Accepting onsite sanitation and reservations	55

Table 36. % of people perception towards different treatments approaches

23 . Social acceptance of different IWRM options

The following graph shows the following results which indicate the trend of social acceptance

The large percentage of the people prefer water harvesting because it is cheap option and no need for Israeli permits

Very little percentage of people willing to purchase water from Israel or from other farmers this is because the price and no trust for sustainability of access water

Large amount of farmers (24 %) prefer to drill their own well to avoid high price (when he purchase water) or mistrust of external resources.

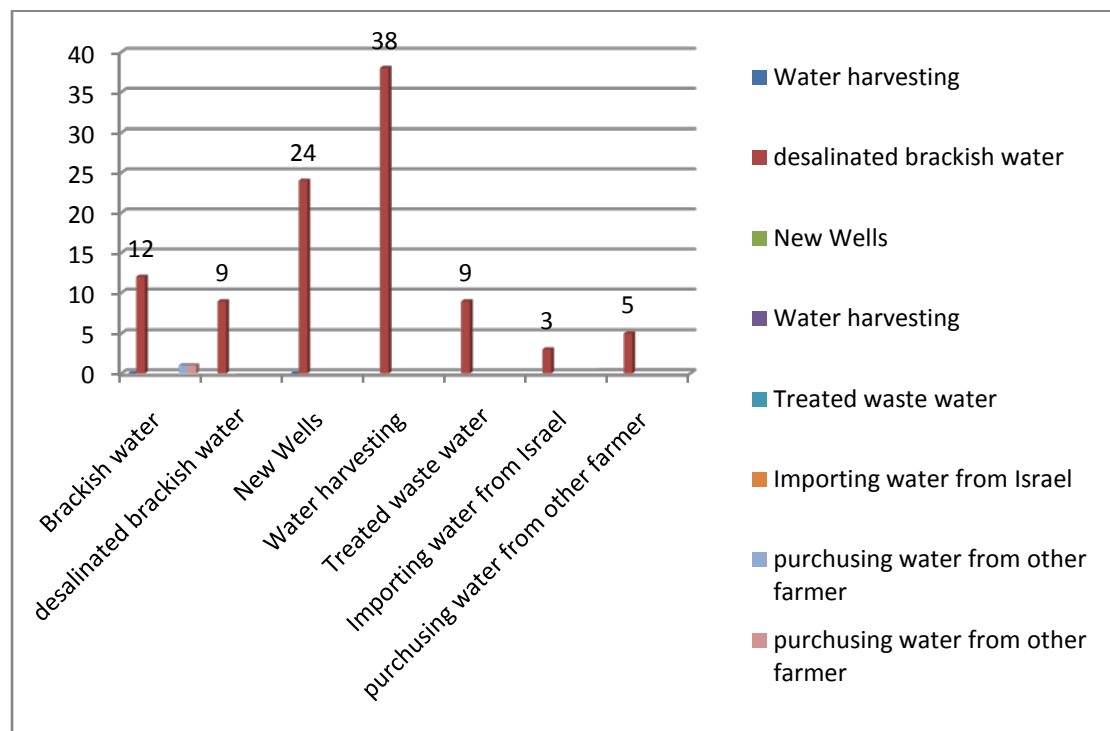


Figure 18: willingness to pay the real cost

The application of willingness to pay in Palestine is more sensitive than any place else .since the ownership of the water is in dispute between Palestinians and Israelis, additionally the physiological dimension (Palestinians think they shouldn't pay to water managed and controlled by enemy). Taking into consideration the above mentioned measure the CVM should be applied very carefully and the number of sample size should be large enough in terms of number and the coverage of geographical areas in order to avoid the effect of political and physiological effect.

However the following graph showed the following conclusions

Most of the farmers they willing to pay the real cost of water harvesting and new wells, simply because they know the real cost

Minimum percentage they prefer to pay the cost of purchasing water from Israel or from other source

Willing to pay the real cost of waste water is very low and that contradict with national figures the due to water availability in Jericho in relative with other areas.

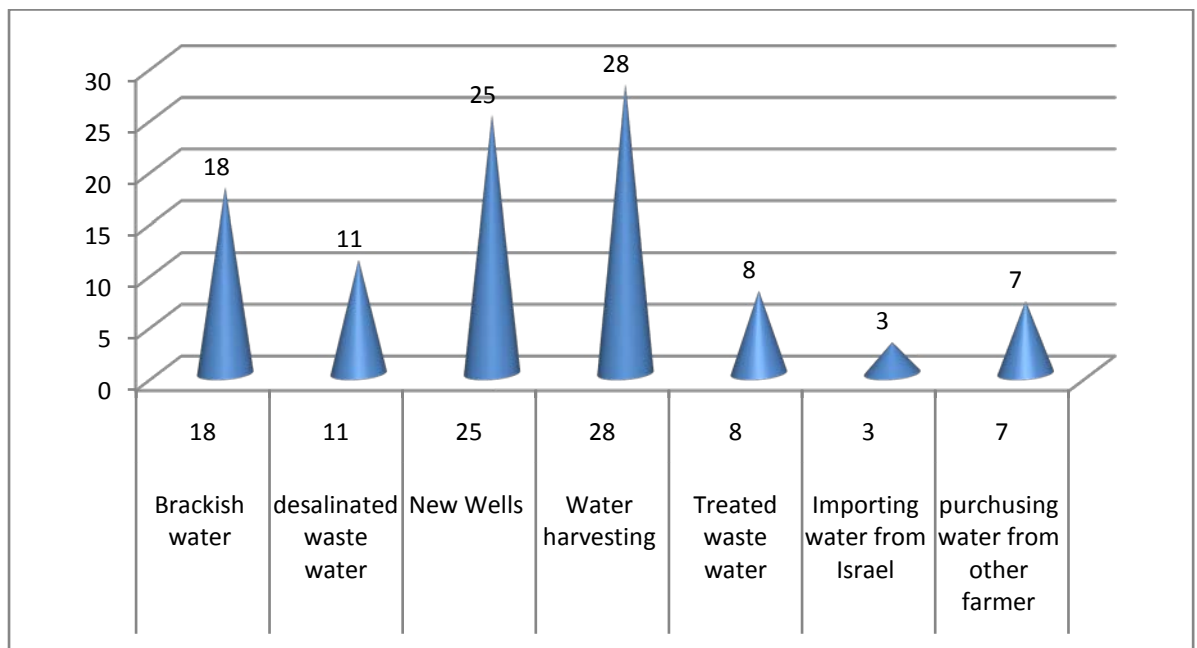


Figure 19. %of interviewed farmers willingness to pay for different options

Chapter 4: Conclusions and recommendations

Despite the fact that social acceptance is a very complex issue and needs a huge effort to differentiate between behaviors of the people and attitude, Social acceptance is a function of the following parameters

- .cultural and religion values
- Level of knowledge
- Individuals perceptions
- Affordability and price of the water
- Governmental water policy (incentives)
- Typology of the crops
- Requirement of the market
- Regulations
- Customer satisfaction

In order to deal with all above mentioned parameters the following actions need to be done

- all mechanisms of law enforcement
- proper institutional arrangement and good governance measures
- clear, transparent water policy for incentives to use waste water
- Reform of agricultural policy in order to encourage cash crops
- Public awareness campaign to introduce waste water as water resources
- Transparent education program among farmers for future water demand
- participatory based implementation of integrated water resources management

References

1. Abed, A. Wishahi, S. (1999) .Geology of Palestine :Palestinian Hydrology Group and Jordanian Geologists Union Publication .Amman
2. Abu Qdais, H. Al-Nassay, H. (2001). Effect of pricing policy on water conservation: a case study. *Water Policy* 3, pp. 207-214.
3. Abusaada, M. (2004).Development of an Integrated Management Tool for the Western Aquifer basin, Palestine. Ms Theses: New castle Upon Tyne University. School of Civil Engineering and Geosciences.UK
4. Ahmad, N. Sohail, M. (2004). Stake holders's response to the private sector participation of water supply utility in Karachi, Pakistan. *Water Policy* 6(2)
5. Alamarah , A.(2009) . Transparency in water sector in Palestine. : Palestinian enter for Transparency and accountability. Ramallah
6. Alamarh, A. (2007). Using Socioeconomic Indicator for integrated water resources management: case study Palestine. In .Shuval H, Dweik. H (Editors) *Water in the Middle East* .Springer Publisher.
7. Alamarh, A. Sohail, M. (2008).Development of a socioeconomic Based Meaningful Water Tariff in Palestine. in Ailawi ,A. Assaf ,K. Jayyousi, A.(editor).Proceeding of International Conference of Sustainable Development Management of Water in Palestine :UNESCO.Cairo.
8. Allan, A, Karshenas, M.'(1995).Managing Environmental Capital: The Case of Water in Israel, Jordan, the West Bank, and Gaza, 1947-1995'. Paper presented at the Conference on Water in the Jordan Catchment Countries: A Critical Evaluation of the Role of Water and Environment in Evolving Relations in the Region. SOAS.
9. AMNESTY International (2009) .Troubled Water Palestinians Denied Fair Access to Water. Amnesty Publications.UK
10. Assaf, K. (2004). Water as a human right: The understanding of water in Palestine Arab Scientific Institute for Research and Transfer of Technology (ASIR). Palestine, .
11. Blake, S. Goldschmidt, J. (1947). Geology and water resources in Palestine; Department of land and settlement and water commissioner .Palestine.
12. Barghothi, I. (2004). Background document on water sector; at the House Committee on International Relations Department: Palestinian Water Authority (PWA). Palestine, Ramallah.
13. Biswas, K. (2004) .Integrated Water Resources Management: A Reassessment; Water Forum Contribution .Water International.27 (2).248-256.
14. Falkenmark, M. (1990) .Rapid population growth and water scarcity: the predicament of tomorrow's Africa", in: "Resources, environment and population". (K .Davis and M.S. Bernstam, eds. 81-94. Supplement to "population and Development Review". Vol. 16.
15. FAO. (Food and Agriculture Organization). (1995).Water Policy Reform in the Near East Region: Policy Issues and Lessons Learnt. Proceeding of the Second Consultation on National Water Policy Reform: Rome.

16. Feitelson, E. (2005) Political Economy of Ground water Exploitation: The Israeli Case .Water Resources Development.21(3) 413-423
17. Feitelson, E. Chenoweth. J. (2002) Water Poverty: Towards A meaningful Indicator.Water Policy 4. 263-281
18. GTZ (Deutch gesellschaft fur technische zumsuammenarbeit(1997) Middle East Regional Study on Water Supply and Demand Development Phase III Report :Strategy and Key Activities . Report Submitted to The Multi-lateral Water Working Group for Middle East Peace Process.
19. Haddadin, M. (2002). Water Issues Iin the Middle East: Challenges and Opportunities. Water Policy 4. 205-222.
20. Hageman, R. (1985). Valuing Marine Mammal Populations: Benefit Valuations in a Multi-species Ecosystem. National Marine Fisheries Service, Southwest Fisheries Centre, La Jolla, California, 1985
21. Mahmud, N, Saa'd ,R. "Sustainability assessment of onsite sanitation facilities in Ramallah-Albireh district with emphasis on technical, socio-cultural and financial aspects: Management of Environmental Quality: An International Journal Vol. 17 No. 2, 2006 pp. 140-156
22. MOP. (Ministry of Planning). (2007).National Poverty Report. A report submit to the Palestinian National committee for Poverty Alleviation
23. Palestinian Water Authority (PWA). (1998) Water Resources Management Strategy- A paper presented to the cabinet. 20 September 1998
24. PWA and GTZ: (2005). Report on Technical and Institutional Reform of Water Sector: submitted to the first meeting of National Water Council meeting Oct, 2005.
25. PWA (2007) .Supply –Demand Report for the year 2007 (internal document)
26. PWA (2006).A modified Water Policy Document- submitted to the water sector working group in Palestinian areas.
27. PWA .(2004) .Water resources in West Bank and Gaza Strip: Official Document.
28. Shalabi, Y. (2003). Water, Agriculture, and Poverty in the West Bank and Gaza. Palestinian Water Authority (PWA). Palestine: Ramallah.
29. Tamimi A., Abu Ar-Rub, S. Isayed, A. (Unpublished.). (2005) .New Dimensions in Water Supply and Demand Management: Suggestions for Improvement in Water Management Policies. Palestinian Hydrology Group (PHG): Ramallah. Palestine
30. Tamimi, A. (2008). Reforming water sector Through Stakeholders Dialogue – Case Study from Palestine: Accepted Paper to be Presented in International Conference will be held in Jerusalem :Water Values And Rights April 2009
31. Whittington, D. (2003). Municipal water pricing and Tariff Design a reform agenda for South Asia. Water Policy. .5.
32. Whittington D., (1992). Possible Adverse Effects of Increasing Block Water