Deanship of Graduate Studies

Al-Quds University

The Socio-economic impacts of reusing treated wastewater for agriculture purposes: Case study from Hebron(Nuba village)

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M.Sc Thesis

Jerusalem –Palestine

2017/1438

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A thesis Submitted in partial fulfillment of requirements for the degree of master of Sustainable Development of Sustainable Rural Development institute.

Al-Quds University

1438-2017

Al-Quds University
Deanship of Graduate Studies
Sustainable Rural Development institute

Thesis Approval

Socio-economic impacts of reusing treated wastewater in agriculture purposes in governorate of Hebron(Nuba village).

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Declaration :

I certify that this thesis submitted for the degree of master, is the result of my own research, except where otherwise acknowledged, and that this study has not been submitted for a higher degree to any university institution.

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Acknowledgment

In the preparation of this thesis to my supervisors, Dr. Abed Al-Rahman Al-Tamimi and Dr. Azmi Atrash, Dr .Mohammad Bayyod and Dr.Ibraheem Awad for their patience and kindness, as well as their academic experience, have been invaluable to me.

The encouragement, contribution and supports of my family; my father, my mother, sister's are highly appreciated and acknowledged. My wife Mariam has been, always, my pillar, my joy and my guiding light, and I thank her.

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Abstract

Treated wastewater is a new source of non-conventional water sources that can be used to irrigate agricultural crops and for human use. The scarcity of water in the Palestinian territories (as a result of the occupation's control over water resources) has made it necessary and urgent to intensify the wastewater treatment projects and its reuse in agricultural production and the irrigation of parks and gardens.

The study aims at exploring the economic and social effects of the usage of treated wastewater in agriculture in addition to its potential usage fields and the possibly of paying for this type of water.

The study was based on the preparation and distribution of a questionnaire discussing the reuse of treated wastewater in agricultural production. Accordingly, a sample of 30 farmers from the village of Nuba south of Hebron in the West Bank was selected and interviewed.

The study showed that 80% of the targeted population did not know the Palestinian standards for wastewater reuse. In addition, about 63.4% of the participants believe that many crops can be produced safely for human use using this type of water while 56.6% indicated their willingness to use such water for agricultural purposes.

The study also showed that 53.3% are willing to pay for treated wastewater in agriculture, while 64.6% believe that fears of using the treated water are related to

weak marketing and that pathological and religious concerns are not the main cause for the current non-usage of the treated wastewater.

The results also provided solutions to overcome water scarcity by the study population. Such solutions are as follows: harvesting rainwater through ponds and wells, using treated water, using modern farming techniques and relying on irrigated rain fed agriculture.

Around 82% of the study sample sees that the use of treated water in agriculture will lead to the reclamation of new lands, will reduce the expenditure on the water bill and reduce the expenditure on the supply of food commodities and animal feed. Moreover, around 63.6% of the sample believes that the use of treated water will lead to a decline in spending on the use of fertilizers to contain the treated water.

The results of the study included an analysis of the social dimensions of the study area and the impact of these variables on the extent to which the population accepts the reuse of treated wastewater. The results show that there is no close correlation between the acceptance of the population to reuse the treated water and the number of family members and the same age and educational level. The existence of a close relationship and income, the number of beneficiary households, and the acceptance of reuse of treated wastewater in agriculture.

This study concludes that in light of the current water crisis, the reuse of wastewater produced in the Palestinian countryside must be considered as a viable alternative. Therefore, efforts should be intensified among institutions concerned with the management of wastewater for the establishment of treatment stations and the operation of such stations at the community level to treat wastewater in most rural areas in the West Bank.

List of abbreviations

PSI	Palestinian Standards Institution
NGO	Non-Governmental Organization
OPT	occupied Palestine territory
EU	Europe Union
PWA	Palestine Water Authority
PCBS	Palestine Central Bureau Of Statistics
MENA	Middle East North Africa
MCM	Million Cubic Meter
I/CLD	Litter Cubic Per Day
WHO	World Health Organization
ICA	Israeli Civil Administration
PNA	Palestine National Authority
JWC	Joint Water Committee
MOA	Ministry Of Agriculture
GIS-RS	Geographic Information Sys - Remote Sensing
GDP	Gross Domestic Product
BOD	Biochemical Oxygen Demand
COD	Chemical Oxygen Demand
EPA	Us Environmental Protection Agency
UK	United kingdom
UNEP	United Nations Environment Program
UNEP	United Nations Environment Program
EPA	U.S. Environmental Protection Agency
BOD	Biochemical Oxygen Demand
COD	Chemical Oxygen Demand
TWW	Treated Wastewater
WWTP	Wastewater Treatment Plant
EQA	Environmental Quality Authority
MoA	Ministry of Agriculture
MENA	Middle East and Northern Africa
CMWU	Coastal Municipalities Water Utility
UNRWA	United Nations Relief and Works Agency
ARIJ	The Applied Research Institute Jerusalem
CENTA	Spanish Centre of New Water Technologies
WSRC	Water Sector Regulatory Council

Chapter One

1. Introduction:

The reuse of treated wastewater offers opportunities of reducing demand on scarce potable water resources, especially within the semi-arid environment of the West Bank. The benefit of such additional supplies of water is further augmented by a reduction in the disposal of raw wastewater to the nearby wadis existing in the West Bank.

Reuse of wastewater for domestic and agricultural purposes has been occurring since historical times. However, planned reuse is gained importance only two or three decades ago, as the demands for water dramatically increased due to technological advancement, population growth, and urbanization, which put great stress on the natural water cycle. Reuse of wastewater for water-demanding activities, which, so far consumed limited freshwater resources is, in effect, imitating the natural water cycle through engineered processes. Several pioneering studies have provided the technological confidence for the safe reuse of reclaimed water for beneficial uses. While initial emphasis was mainly on reuse for agricultural and non-potable reuses, the recent trends prove that there are direct reuse opportunities to applications closer to the point of generation. There are also many projects that have proved to be successful for indirect or direct potable reuse.

Wastewater quantities generated yearly in the West Bank estimated at approx 62 MCM annually a daily rate, 170Ml/day including municipal. Industrial wastewater, in addition to 35 MCM annually 96Ml/day of untreated wastewater discharged by settlements and industrial zones into the West Bank environment. Less than 5% wastewater is generated from industrial activities like in Nablus, Ramallah and Hebron ,In the West Banks there is about 15 WWT plant, in the Hebron with Capacity 25.0 (mcm/year) and municipality operating in a proper way.

1.1 Research Problem:

This study deals with Socio-economic impacts of reusing treated wastewater in agriculture purposes in governorate of Hebron (Nuba village). the researcher believes that the treated wastewater plays a great role and apparently, significant role in addressing Water Scarcity and Droughts as a way of addressing long term imbalances between demand and water supply. Water scarcity is a major challenge for countries with arid or semi-arid environments. The problem is exacerbated by factors such as intensive urban and industrial development, irrigation due to agriculture, climate change and increasing population concentrations in cities. Reducing water consumption, water reuse is an effective solution to help alleviate the pressure on water resources. However, the recycling of wastewater requires many different considerations and variables — the degree to which the water should be treated, the impact of heightened nutrient levels on crop growth, and potential public health implications — which make the development of rigorous and accurate cost-benefit analyses a daunting task.

The following questions guide the study:

1. What are the economic benefits of reusing Sewage treated water? Does the value of cubic meter is higher than cubic meter of fresh water?
2. What are the social benefits of reusing Sewage treated water? Does the social value of treated cubic water being higher than cubic fresh water?
3. Are the farmer's willing to use treated wastewater?
4. Are the farmer's willing to pay for using treated wastewater?

1.2 Aim and Objectives

This study will explore and evaluate **Socio-economic impacts of reusing treated wastewater in agriculture purposes in governorate of Hebron**. It will also identify the characteristics that can describe the situation of water reuse in Palestine, economic, social impacts of reusing treated wastewater in agriculture. And finally, this study will look into if there is and explaining the importance of wastewater reuse, especially in agricultural purposes .

The specific goals of this research study are the following **:**

- Exploration of economic benefits of reusing Sewage treated water .
- Exploration of social benefits of reusing Sewage treated water.
- Enhancing of acceptance the idea of reusing treated wastewater in agricultural purposes, which leads to willingness to use and pay .

1.3 Importance of study

The importance of the research is to identify the economic and social benefits of reusing treated wastewater in agriculture purposes in governorate of Hebron, role of the public awareness toward wastewater treatment and reuse from the perception of farmers in the targeted areas, after explaining the importance of wastewater reuse .

The researcher believes that this study very useful and important and the usefulness of this study is reflected in:

- Exploration of economic, social benefits of reusing Sewage treated water.
- This study would help to measure and improve public acceptance, willing to pay among reusing treated wastewater in agriculture purposes.

1.4 Research Questions:

The following questions guide the study:

1. What are the economic benefits of reusing Sewage treated water? Does the value of cubic meter is higher than cubic meter of fresh water?
2. What are the social benefits of reusing Sewage treated water? Does the social value of treated cubic water being higher than cubic fresh water?
3. Are the farmer's willing to use treated wastewater?
4. Are the farmer's willing to pay for using treated wastewater?

1.5 Research main Hypotheses:

This study was based on the following assumptions:

1. Sewage treated water have economic benefits.
2. Sewage treated water have social benefits .
3. Farmers willing to use treated wastewater.
4. Farmers willing to pay for using treated wastewater.

Chapter Two

2.1 wastewater

2.1.1 What is the wastewater:

wastewater is defined as “a combination of one or more of:

- domestic effluent consisting of black water (excreta, urine and faecal sludge) and grey water (kitchen and bathing wastewater); .
- water from commercial establishments and institutions, including hospitals;
- industrial effluent, storm water and other urban run-off;
- agricultural, horticultural and aquaculture effluent, either dissolved or as suspended matter” (Wastewater Management A UN-Water Analytical Brief,2015).

2.1.2 Wastewater Treatment:

The aim of treatment is to reduce the level of pollutants in the wastewater before reuse or disposal into the environment, the standard of treatment required will be location and use-specific. The year 2014 marks the centenary of the publication of the seminal paper on activated sludge which provided a basis to treat sewage by biological means. Since then there have been extensive developments in both scientific knowledge and processes to treat wastewaters of all types. There are now many aerobic, anaerobic and physicochemical processes that can treat wastewaters to almost any standard of effluent from the simple removal of gross solids to membrane systems that can produce drinking water quality. They vary from the very simple to the highly complex and each has its own characteristics in terms of efficiency, reliability, cost, affordability, energy consumption, sludge production, land requirements and so on. Treatment strategies range along a continuum from high technology, energy-intensive approaches to low-technology, low-energy, biologically and ecologically focused approaches (UN Water, 2011). For example, explored the potential of natural treatment technologies (i.e. those based on natural processes that use attenuation and buffering capacity of natural soil aquifer and plant-root systems, where the process of contaminant removal is not aided by the input of significant amounts of energy and/or chemicals) including waste stabilization ponds, duckweed and hyacinth ponds and constructed wetlands for wastewater management . In an examination of 12 cases they found that performance varied widely and that institutional and organizational issues were very important for sustainable system operation.

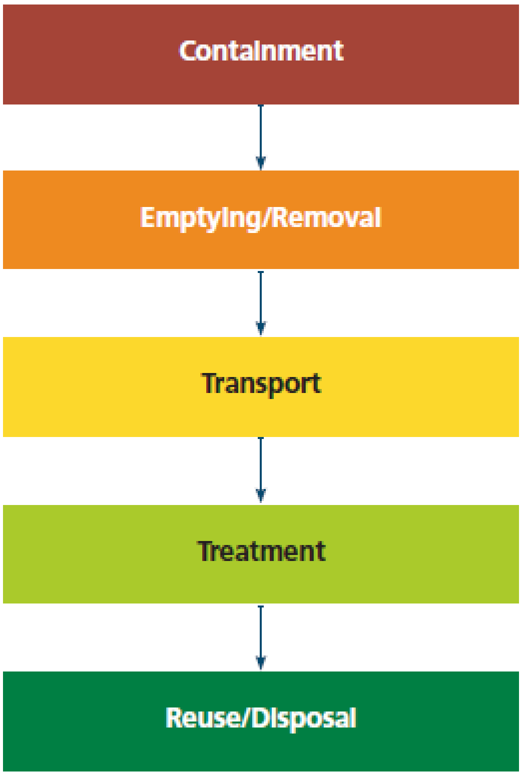


Fig.2.1 Sanitation Service Chain

2.1.3 Sewage/Wastewater Treatment Procedure

2.1.3.1 Unit Processes of Treatment

There are a lot of pollutants and wastes in the wastewater such as, nutrients, inorganic salts, pathogens, coarse solids etc, which are really dangerous for ecology and human, for removing these pollutants, different processes have been exposed.

There are specific processes and unit operations in sewage/wastewater treatment, the primary goal of these processes is to reduce the pollution of the water the polluting starting point until the end of the treatment process which can be disposal or reusal and these reduction processes can be chemical, physical or biological. (Lettinga, G. and Pol, L. H. (2008))

Chemical unit processes are playing an important role in advanced cleansing.(Henza. Harremoes, l. C. J. A. (2002)) mentioned that chemical unit processes are the procedures that cause reactions in wastewater components such processes are used while the physical and biological processes are in action. There are quite a lot of different chemical processes, such as precipitation, coagulation, neutralization and stabilization, ion exchange, oxidation and advanced oxidation that may be added to sewage water during the purifying procedure (Lettinga, G. and Pol, L. H. (2008)). Physical unit operations are some treatment methods which cleanse the wastewater by using the physical forces such as flocculating, floatation, mixing, filtration, screening and gas transfer.

Biological unit processes is the procedures that break down the grease/oil, Suspended solids, organic matter, nitrogen and phosphorus by bacteria which grow naturally in a

biological reactor. The bacteria consumes the carbon-based material in the sewers, also the primary goal of this treatment is to decrease the biological elements in wastewater (M. Rosen, T. W. and Lofqvist., A. (1998)).

2.1.3.2 Stages of Treatment

The processes and operations which were mentioned are being used in different stages of treatment; Pereliminary, Primary, Secondary and Advanced wastewater treatment which are persuing diffrent objectives in the treatment process.

2.1.3.3 Preliminary wastewater treatment:

The objective is to remove the large materials like coarse solids which are being frequently seen in wastewater. Furthermore, it separates the floating materials which are being carried by water flow. Preliminary treatment procedures usually contain grit removal, coarse screening and comminution of large objects. In addition this treatment helps in removing the greases and oils. This process decreases the wastewaters BOD, by approximately 15 to 30% and the devices which are being used during this treatment are Grit chamber and Comminutor: This device consists of a screen to prevent the large materials from accessing further into the following treatment processes and some cutters are also installed after the screen to chop the solids which had made it through the screen (Kawamura, S. (2000)). Grit chamber: its objective is to remove the oils and semi-liquid elements. There are two kinds of Grit chamber; Aerated and Vortex .

2.1.3.4 Primary wastewater treatment:

The objective is to remove solid components of wastewater by sedimentation, these components can be organic elements such as, phosphorus, nitrogen, and metals connected to solid components. On the other hand, colloidal and dissolved elements will remain and not be affected. The waste from primary sedimentation units is known as primary effluent and the wastes which have been produced by this process is called Primary effluent (Qasim, S. R. (1998)). The devices which are being used in primary treatment are Sedimentation tank and clarifiers and Anaerobic Digester. Sedimentation tank and clarifiers: "Upflow clarifiers and Rector clarifiers are two types of sedimentation tanks, perform very well if both the raw water is characteristics and the hydraulic loading rates are constant " (Kawamura, S. (2000)).. Anaerobic Digester: Most of the primary waste is being treated biologically in this system. Anaerobic digester is being used in huge plants.

2.1.3.5 Secondary wastewater Treatment:

This treatment is used after the primary treatment which completes the cleansing process through reducing the amounts of remaining organic elements and solid particles; in addition biodegradable removal and colloidal or ganic matter used aerobic biological 1 in secondary treatment processes (Tilley, D. F. (2011)). Bacteria will decompose the fine organic matter, in some biological units to produce a clear effluent while aerobic bacteria oxidize the organic matter in some treatment units which called as treatment reactors and may consist of oxidation ponds, aerated lagoons, aeration tanks, rotating biological contactors and trickling filters.

2.1.3.6 Tertiary/ advanced wastewater treatment and wastewater reclamation:

The objective is to remove the specific wastewater constitutes which cannot be removed by secondary treatment including toxic substances, organic elements and solid particles. Tertiary removal uses the stream of a river for recycling or industrial heat reduction and groundwater renewal (Donald R. Rowe, I. M. A. M. (1995)).

2.1.3.6.1 Current Status of the Wastewater Sector in Palestine

2.1.3.6.1.1Wastewater Collection, Treatment and Final Disposal

The environmentally sound management of waste requires adequate collection and treatment of wastewater and disposal/reuse of treated effluent. To date, the current management practices for the wastewater sector in Palestine are mostly limited to the collection of wastewater by sewage networks and cesspits. Furthermore, wastewater treatment facilities are restricted to a few Palestinian localities. The lack of sufficient and appropriate infrastructure for wastewater collection and treatment has been the limiting factor in the development of Palestine's wastewater and sanitation sector.

Based on the per capita wastewater generation, the total volume of wastewater generated for the year 2015 was estimated at 114.36 MCM, from which 65.82 MCM are generated in the West Bank and 48.54 MCM are generated in the Gaza Strip Fig(2.2) (ARIJ, 2015c; PCBS, 2013c, 2015c).

In the West Bank the wastewater treatment and collection service is the responsibility of the local authorities (utilities, municipalities and village councils). These providers do not and should not make profit from the collection service, but do keep their accounts on basis that guarantee the sustainability (operation, maintenance and future expansion needs) of the services and the infrastructure. In the refugee camps, the UNRWA has been providing the sewage collection service. In the Gaza Strip, the water and wastewater services are provided by the Coastal Municipalities Water Utility (CMWU).

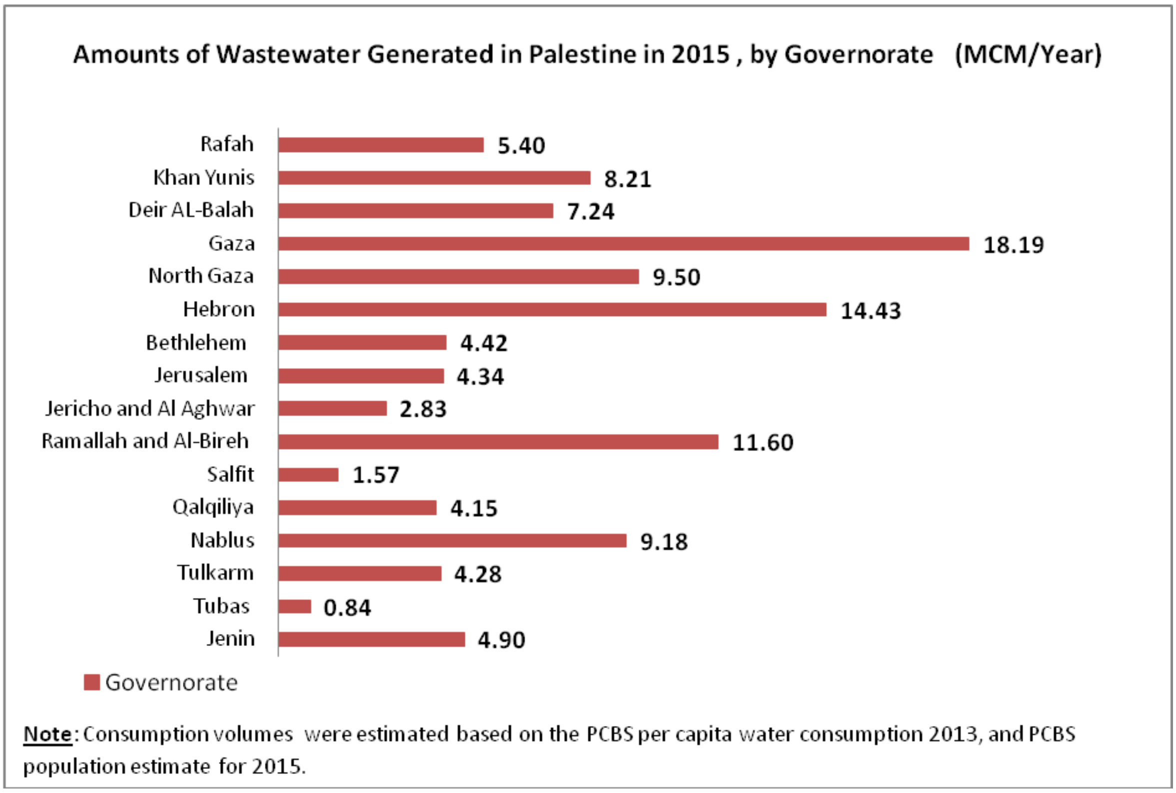
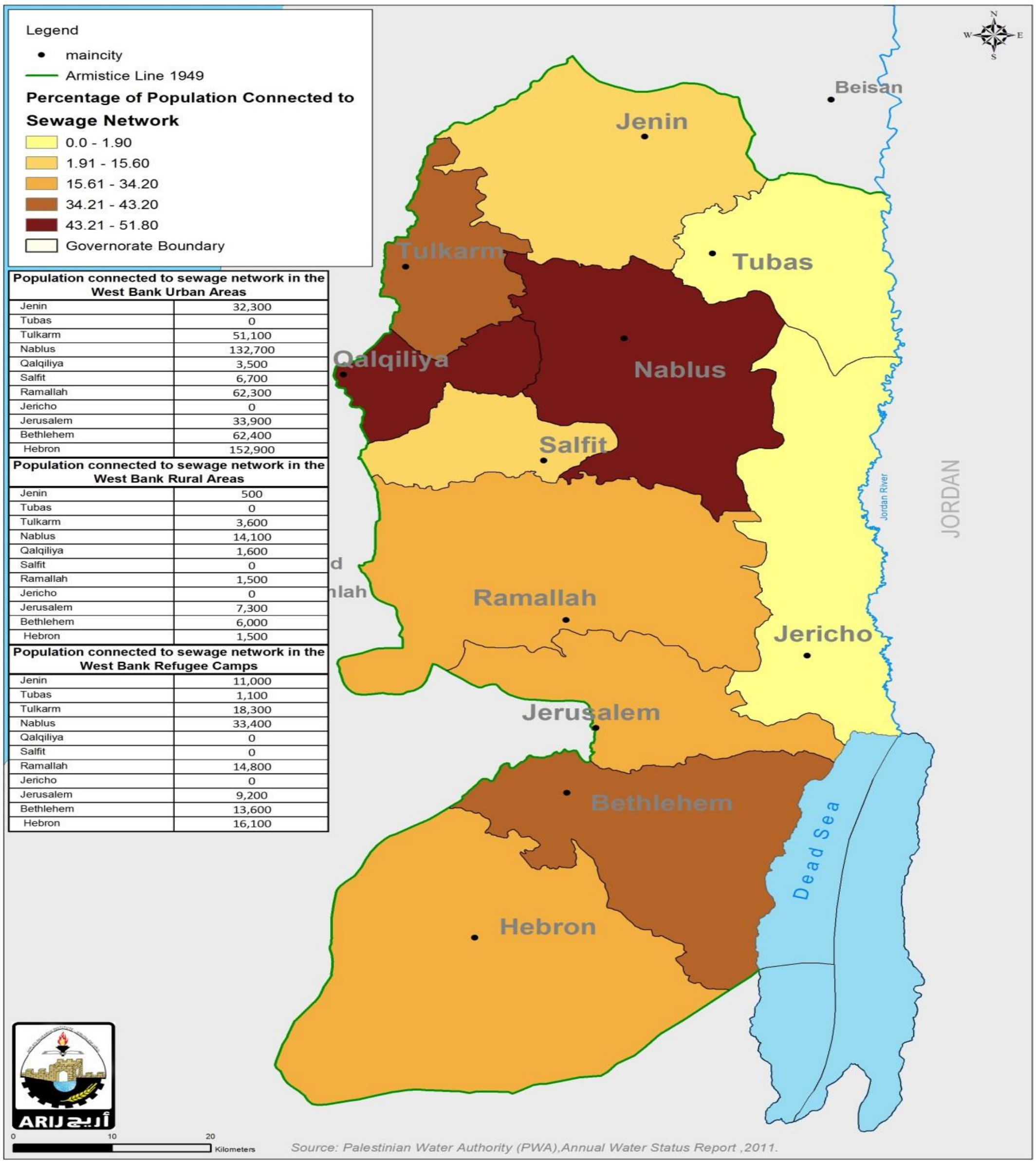


Figure.2.2: Estimated Volume of Wastewater Generated in Palestine in 2015

2.1.3.6.1.2 Connection to Sewage Systems

The wastewater collection and treatment services provision has a limited coverage due to years of neglect during the Israeli occupation when limited investments were expended in networks rehabilitation and expansion projects as well as for the development of wastewater treatment infrastructure(World Bank, 2009).

Since 1999 however, there was significant progress in the level of sewage connection. According to the PCBS, there was an increase in the connection coverage of households from 39.3% for the year 1999, to 52.1% for the year 2009 and to 53.9% for the year 2015 (PCBS, 2009a). Wastewater collection network is mostly limited to the major cities and refugee camps (Map2.1). In many rural areas, it is not financially feasible to connect rural housing units to conventional centralized wastewater management systems due to the high capital cost of installing sewage collection networks in areas with dispersed housing patterns. Alternatively, household-level small scale wastewater treatment plants are "more" economically feasible than centralized systems and reusing the treated wastewater can: create an additional water resource for irrigating fruit trees and forages; improve soil fertility and organic content; increase crop yield while decreasing the need for inputs of synthetic fertilizers; reduce contamination of soil, surface and ground water resources; and subsequently reduce the health risks of contracting water-borne diseases.



Map 2.1 : West Bank Connection to Sewage Networks, 2015.

According to the PCBS, the geography of sewage collection network coverage is as follows: (1) 83.5% of the households in the Gaza strip are connected; (2) only 38.4% of the households in the West Bank are connected as follow:

In the northern part of the West Bank only 33.5% of the households are served by sewage collection network, followed by the Southern part where only 36% of the households are served, followed by the Middle part of the West Bank where 47.9% of the households are served by sewage network (PCBS, 2015a) (Figure 2.).

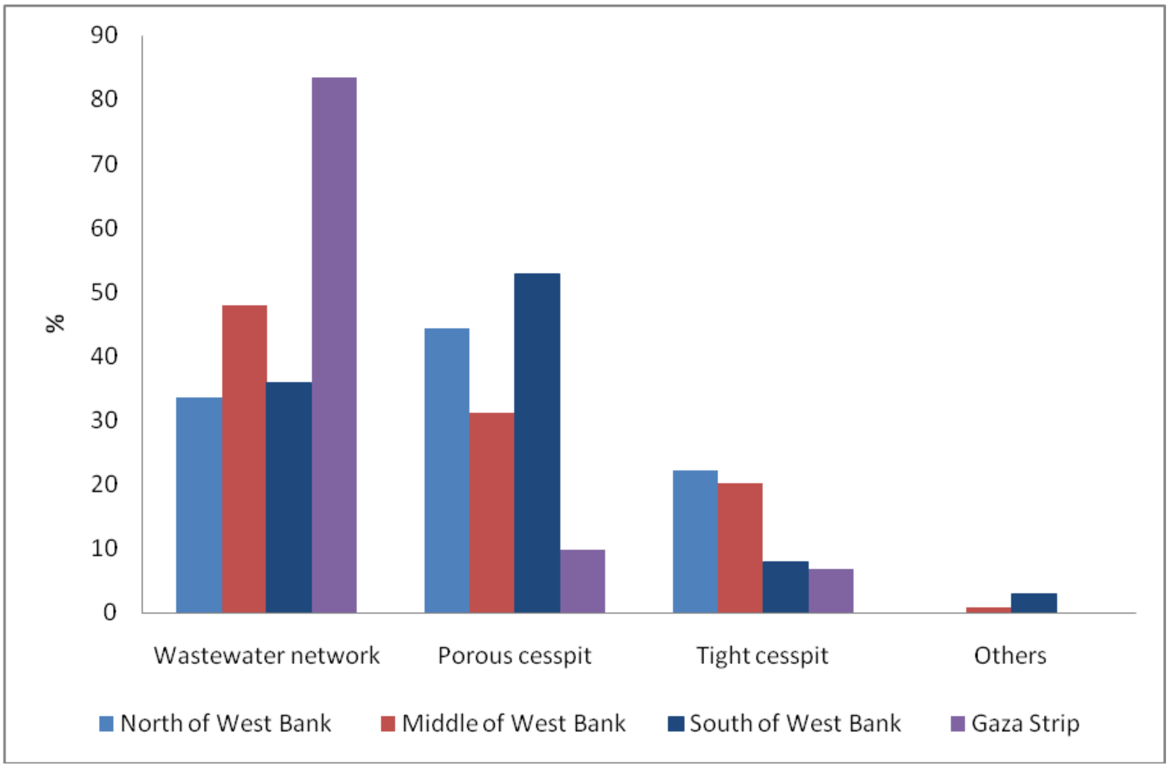


Figure 2.3: Households Percentages in accordance to wastewater collection system, 2015

Note: (1) North of West Bank refers to: Jenin, Tubas, Tulkarm, Qalqilya, and Nablus Governorates.

(2) Middle of West Bank refers to: Ramallah, Salfit, Jerusalem, and Jericho Governorates.

(3) South of West Bank refers to: Hebron and Bethlehem Governorates.

At locality level, the data from the PCBS revealed that only 104 Palestinian localities out of 557 are served totally or partially by wastewater networks. It should be noted that many of these networks are old and poorly designed as they were established before 1967 through Jordanian Administration and were neglected during the years of Israeli occupation(PWA, 2012). The remaining localities (approximately 81% of the total Palestinian localities) rely on septic tank and cesspits or simply release raw sewage directly into the environment without any treatment.

Table(2.1) illustrates the number and the distribution of the localities by the wastewater collection system. According to the PCBS, in the year 2015, 80 Palestinian localities out of 524 in the West Bank had sewage networks, 456 had porous cesspits and 181 had tight cesspit (septic tanks)(PCBS, 2015c). In the Gaza Strip, 24 localities out of 33 had sewage networks, 26 had Cesspits and only one had tight cesspit(PCBS, 2015c). From the above, it can be concluded that porous cesspits are still the most widespread collection method in the West Bank. This is a dangerous situation as a broad list of wastewater pollutants (heavy metals, pharmaceuticals, disinfection by-products, etc.) can slowly leach into groundwater sources from which almost all communities in the West Bank draw drinking water. In the Gaza Strip, sewage collection networks became the most common method of wastewater collection.

Table 2.1: Distribution of Localities in Palestine by Wastewater collection system, 2013

Governorate	Wastewater disposal method - Number of localities				
	Exposed wastewater network	Exposed wastewater channels without network	Sewage network	Cesspit	Tight cesspit
Jenin	1	1	4	76	23
Tubas	2	1	0	15	7
Tulkarm	2	1	7	32	14
Nablus	0	2	13	56	15
Qalqiliya	1	0	6	33	14
Salfit	0	0	2	18	8
Ramallah and Al-Bireh	2	6	9	68	45
Jericho and Al Aghwar	0	1	1	13	4
Jerusalem	3	4	22	23	13
Bethlehem	3	4	10	37	20
Hebron	5	8	6	85	18

Governorate	Wastewater disposal method - Number of localities				
	Exposed wastewater network	Exposed wastewater channels without network	Sewage network	Cesspit	Tight cesspit
West Bank	19	28	80	456	181
North Gaza	0	0	5	3	0
Gaza	0	0	4	4	0
Deir AL- Balah	1	2	10	8	1
Khan Yunis	1	2	2	7	0
Rafah	0	0	3	4	0
Gaza Strip	2	4	24	26	1
Palestine	21	32	104	482	143

Improving the sewage collection infrastructure is a crucial component of the wastewater sector and a prerequisite for an integrated system that includes treatment and reuse. Several projects were recently completed or are still under construction to increase the volume of generated wastewater collected in networks (Table. 2.2).

Table.2.2: Some recent sewage collection network projects in the West Bank

Wastewater Project	Status	Components
Wadi Zomar Sewage Project (9 localities in Tulkarm Governorate)	Under construction	Collection system, trunk line, pre-treatment
Expansion of Jericho sewage network	Delivery phase	Collection system
Beit Qusein and Beit Wazn sewage network project	Design phase	Collection system, capacity building and wastewater treatment and reuse
Habla, Baqa al Sharqieh, Barta'a	Completed	Collection System
Artas Sewage Project	Completed	Collection system & boosting station

Source: (ARIJ, 2015c; PWA, 2013a, 2016a)

2.1.3.6.1.3Treatment and Final Disposal

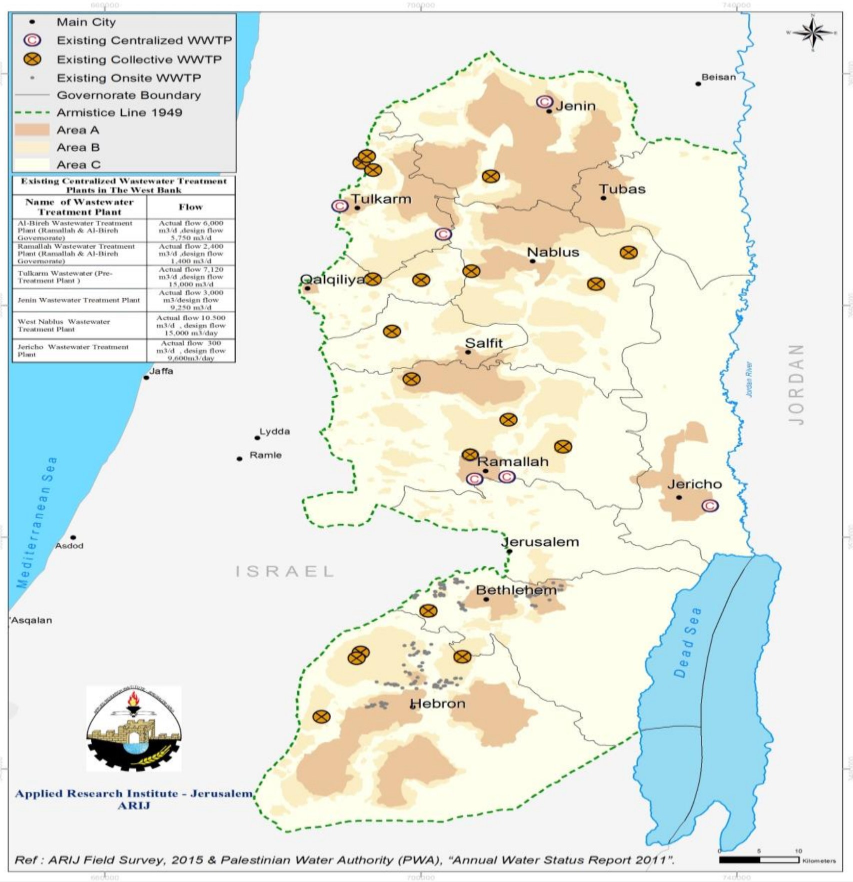
Only two thirds of the generated wastewater collected in sewage networks is discharged into a wastewater treatment facility. The annual wastewater collected by sewage networks reaches 15 MCM/year in the West Bank, and around 10.3 MCM of it is treated or partially treated (PWA, 2012) in 6 centralized wastewater treatment plants and in 16 collective wastewater treatment plants (ARIJ, 2015c)(See Map 2.2).

Existing centralized wastewater treatment plants that are operating at a good efficiency rate are: West Nablus, Jenin, Jericho and theTulkarm pre-treatment plant. The Ramallah and Al Bireh WWTPs are overloaded and functioning at low-moderate efficiencies(ARIJ, 2015c) (Table 2.3).

Table 2.3: The Existing Centralized Wastewater Treatment Plants in The West Bank

Name of Wastewater Treatment plant	Actual and Design Flow (m3/day)	Status of WWTP
Al-Bireh WWTP	Actual Flow = 6,000 Design Flow = 5,000	Operational year 2000; overloaded, currently under rehabilitation and upgrade
Ramallah WWTP	Actual Flow = 2,400	Operational year 1975 and rehabilitated in 2002/2003; not operating well (overloaded) and does not meet the requirements for effluent discharge
Tulkarm Wastewater Pre-Treatment Plant	Actual Flow = 7,120	Operational year 1972 and rehabilitated in 2004. Operating well with high efficiency
Jenin WWTP	Actual Flow = 9,000	Operating after being rehabilitated
West Nablus WWTP	Actual Flow =10,000 Design Flow =12,000	Operational year 2013. Operating under monitoring after start up
Jericho WWTP	Actual Flow =300 Design Flow = 9,600	Operational year 2013. Treating only 300 m3/d due to the lack of sewage collection network

Source: (ARIJ, 2015c; PWA, 2013a) Al Bireh WWTP has been facing various operational and maintenance problems and is currently under rehabilitation. The new centralized wastewater treatment plants of West Nablus and Jericho are expected to achieve efficient treatment. Unfortunately, the households of Jericho are not yet connected to a sewage network and the Jericho waste water treatment plant receives wastewater collected by tankers and a very limited sewage collection network. The treatment capacity of Jericho WWTP is 9,600 m3/d but is currently treating 300 m3/d due to the lack of sewage collection network infrastructure in Jericho. Other wastewater sewage networks discharge the collected wastewater into open streams creating serious environmental problems. One must therefore challenge the wisdom and/or the conditions that have led to the construction of wastewater treatment facilities where no sewage collection system exists and vice versa discharging the collected wastewater in networks into open streams especially that the costs of establishing a collection network far exceeds the costs of treatment.



Map 2.2: Existing Wastewater Treatment Plants in the West Bank

In spite of the collection of some 15 MCM and the treatment of 10 MCM of wastewater per year, the reused volume of treated effluent in agriculture or in industrial process remains close to zero MCM/year. The existing centralized wastewater treatment plants in Palestine should treat the wastewater to standards suitable for reuse. New wastewater treatment projects are including a reuse component as an integrated part of system design. Social acceptability or the lack thereof of reusing treated wastewater in agriculture and industrial processes should also be addressed. Reusing wastewater should reduce water scarcity problem and contribute to the financial sustainability of the collection and treatment systems through fees collected from the sales of treated wastewater to agricultural and industrial enterprises.

In addition to the potential of irrigated agriculture to partially recover the operational and maintenance costs of WWTP, irrigation with wastewater can significantly improve agricultural yields. In the West Bank, irrigated field crops, for example, produce an average yield 11 times greater than would be possible with rain-fed agriculture. Similarly, gross revenue from open-field irrigated agriculture is 10 to 11 times greater than that from rain-fed agriculture. Hence, reusing treated wastewater can improve the livelihoods of resource-poor farmers by increasing the supply of domestic savings and capital formation. Irrigated agriculture can also promote development in other economic sectors in Palestine.

Existing collection networks and centralized wastewater treatment systems if not constantly maintained and updated to serve a growing population and hence larger influents become obsolete and incapable of treating the wastewater to the national standards set by the Palestinian Standards Institute (PSI).

In addition to the centralized wastewater treatment plants (WWTPs), a number of the non-governmental organizations (NGOs) and academic institutions have established two types of decentralized WWTPs:

Collective wastewater treatment systems: These were established in several localities that lacked sewage collection networks and that depended on cesspits for wastewater disposal. Such wastewater treatment systems are composed of a vacuum truck collection system plus a collective WWTP.

Table(2.4) outlines the location of the existing collective treatment systems, the applied wastewater treatment process, the operational year of the system, design flow and actual flow.

Table 2.4: Existing Collective Wastewater Treatment Systems

WWTP Name	Governorate	Wastewater Treatment Process	WWTP related information*
Kharas WWTP	Hebron	Up flow Anaerobic Sludge Blanket (UASB) - Horizontal Flow Constructed Wetlands	O =2003 and was rehabilitated in 2016, D=120, A=100
Nuba WWTP			O=2002 and was rehabilitated in 2016, D=120, A=200
DeirSamit WWTP		Septic Tank - Anaerobic Upflow Gravel Filter	O=2001, D=13.5, A=na
Sair WWTP		Activated Sludge	O=Under Construction, D=1,200, A=na
Al-Quds University** WWTP	Jerusalem	Extended Aeration Process – Chlorine Disinfection and Sand Filtration	O=2007, D=50, A=na
Bani Zeid (Al-Gharbiyeh) WWTP	Ramallah & Al-Bireh	Upflow Anaerobic Sludge Blanket (UASB) - Vertical Flow Constructed Wetlands	O=2004, D=100, A=20
Al-TirehWWTP		Activated Sludge - Membrane Bioreactor (MBR)	O=2013, D=na, A=2000
'EinSiniya WWTP		Anaerobic Baffled Reactor – Activated Sludge Process – Multimedia Granule Filtration – Ultraviolet Disinfection	O=2007,D=10, A=na

WWTP Name	Governorate	Wastewater Treatment Process	WWTP related information*
Rammun - El Taibeh WWTP		Rotating Biological Contactor (RBC)	O=2014, D=na, A=450
Sarra WWTP	Nablus	Constructed Wetlands	O=2004, D=na, A=130
Bait Hassan WWTP		Constructed Wetlands	O=2013, D=na, A=80
Bait Dajan WWTP		Activated Sludge	O=2014, D= na, A=100
BiddyaWWTP	Salfit	Septic Tank – Horizontal Flow Constructed Wetlands	O=2007 and was rehabilitated in 2014, D=35, A=20
‘Anza WWTP	Jenin	Activated Sludge	O=2015, D=na, A=80
Zeita(1) WWTP	Tulkarm	Septic Tank – Constructed Wetland	O=2004, D=na, A=na
'Attil WWTP	Tulkarm	Septic Tank – Anaerobic Upflow Gravel Filter – Aerobic Trickling Filter – Polishing Sand Filter	O=2006, D=14, A=na (Overloaded)
Zeita (2) WWTP	Tulkarm		O=2008, D=14, A=30-35
Sir WWTP	Qalqiliya		O=2006, D=14, A=15
Hajja WWTP		Sedimentation Tank – Horizontal Flow Constructed Wetlands	O=2004,D=30-40 , A=40
Note: O=Operational Year, D=Design Flow (m3/d), A=Actual Flow (m3/d),, na: not available. ** The Al-Quds University WWTP was moved from Nahhalin village to the University in the year 2016 due to technical reasons.			

Source: (ARIJ & CENTA, 2010; ARIJ, 2015c)

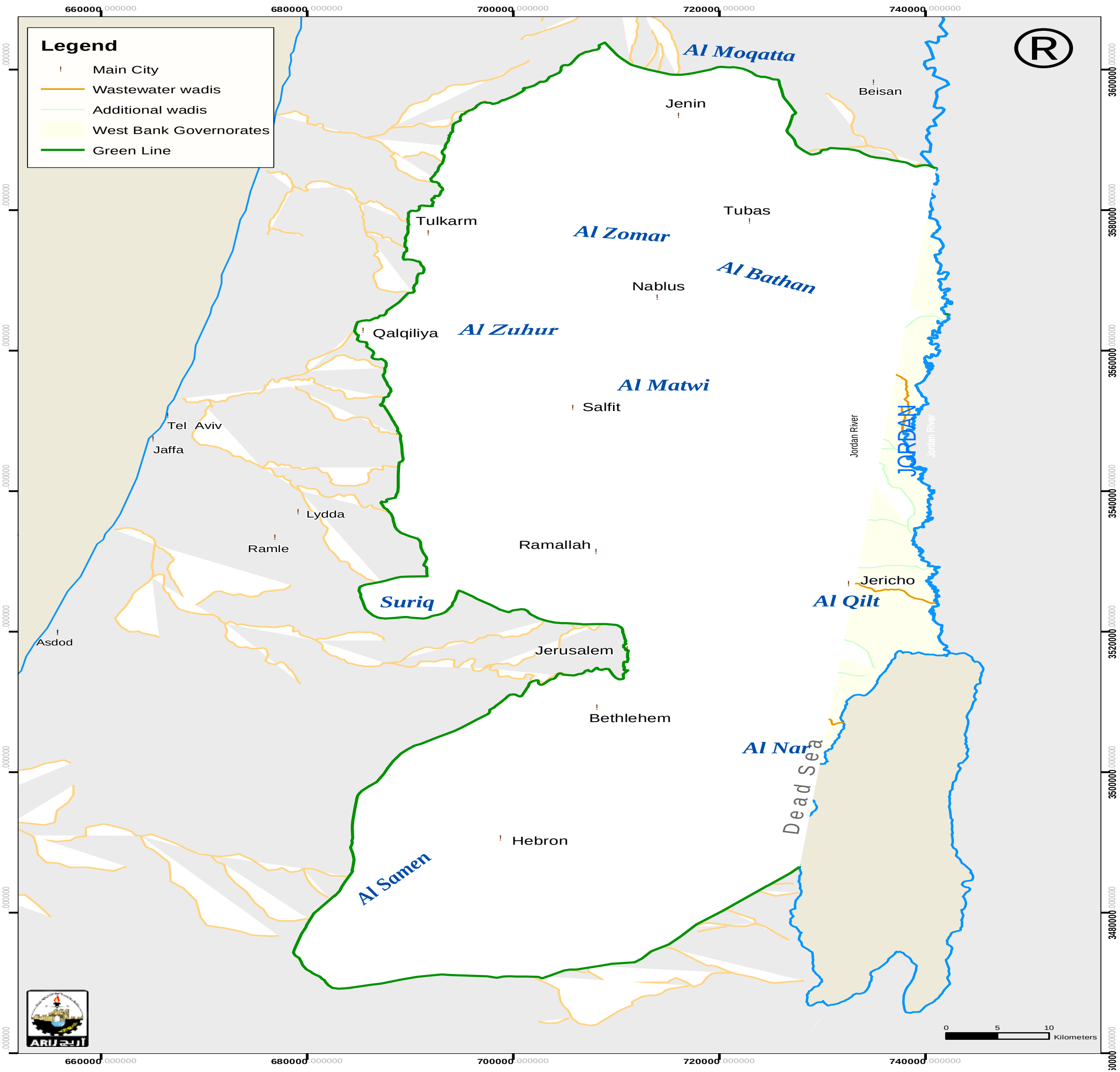
Onsite small scale wastewater treatment plants have been established in several rural localities of the West Bank, where the dispersed pattern of houses in these rural localities makes it economically unfeasible to construct wastewater collection networks and centralized wastewater treatment plants. On-Site small scale wastewater treatment plants, which often serve a single house or building, respond to the needs and conditions in rural localities. They can solve the wastewater collection and disposal problems in such communities, along with the benefit of generating a water resource that can be utilized for irrigation purposes where land is available and agriculture is a main subsistence source or a source of income. Two types of onsite small scale wastewater treatment systems were implemented in the West Bank, namely: (1) Black wastewater treatment and, (2) Grey wastewater treatment. Table (2.5) shows the agencies that implemented on-site small scale black/grey wastewater treatment plants, and the number of the implemented units.

Table 2.5: Agencies that implemented on-site small scale black/grey wastewater treatment plants

Implementing Agency	WWTP Type	Total Number of WWTPs
Applied Research Institute – Jerusalem (ARIJ)	Black WW	252
	Grey WW	107
Palestinian Hydrology Group (PHG)	Grey WW	156
Union of Agricultural Work Committees (UAWC)	Grey WW	67
United Nations Food and Agriculture Organization (FAO)	Grey WW	67
Palestinian Wastewater Engineers' Group (PWEG)	Grey WW	81
Palestinian Agricultural Relief Committees (PARC)	Grey WW	80

Source: (ARIJ & CENTA, 2010)

In the absence of sufficient wastewater infrastructure and limited number of wastewater treatment plants in the West Bank to deal with the generated wastewater, the Valleys (Wadis) in most of the cases are converted to wastewater streams, polluting the surrounding environment; leaching contaminants into groundwater, and increasing the health risks of waterborne diseases. Among the major wastewater streams in the West Bank are: Wadi Al Zomar, (Nablus), WadiSuriq (Ramallah), Wadi Al Samen (Hebron) and Wadi Al-Nar (Bethlehem) (Map 2.3).



Map 2.3: Main wastewater streams in the West Bank

Table 0 (2.6) illustrates the daily estimated flow for some wastewater stream (PWA, 2012).

Table 02.6 : Measured flow for some wastewater streams in the West Bank

Stream	The measured daily flow (Cubic Meter / Day)
Wadi Al Zuhur (Qalqilia City)	6,000
Wadi Al Samen (Hebron City and KiryatArbaa Settlement)	10,500
Wadi Al Moqatta (Jenin City & Jenin Refugee Camp)	3,000
Wadi Al Zomar (West Nablus, EinBeit Alma and some adjacent communities)	4,000
Wadi Al Zomar (Tulkarm City , Tulkarm Camp and Nur Shams Camp)	11,000
Wadi Al-Sajour (East Nablus,Askar and Balata Camps, Azmut, Salim and surroundings)	8,800
Wadi Suriq (Ramallah City)	3,300
Wadi Al-Nar (Bethlehem and BeitSahour)	4,500

Source:(PWA, 2012)

It should be noted that some of the partially treated wastewater and untreated wastewater streams flow into Israel. Approximately, 14.97 MCM/year of the wastewater produced in the West Bank flows into Israel and is treated or partially treated in five Israeli treatment plants and thereafter reused in the Israel's agricultural sector(PWA, 2012). The cost associated with this treatment is charged to the PWA and deducted annually by Israel from Palestinian tax revenues(Yasin, 2015).According to the Water Sector Regulatory Council, Israel deducted approximately over 82 million NIS from the Palestinian tax revenues in 2015(WSRC, 2016) for the treatment of the Wastewater produced in the West Bank (Figure 2.4). It is worth mention that the tariff for the treatment is different from one place to another, for example Israel charges the PNA around 1.88 NIS(1) for the treatment of one cubic meter of wastewater that is discharged in WadiBeitJala and treated in the Israeli treatment plant "EinSoreq' in West-Jerusalem, where in WadiSurik they charge the Palestinian around 2.12 NIS/cubic meter (ARIJ, 2015c).

1-This value includes the addition of 16% for the value added tax.

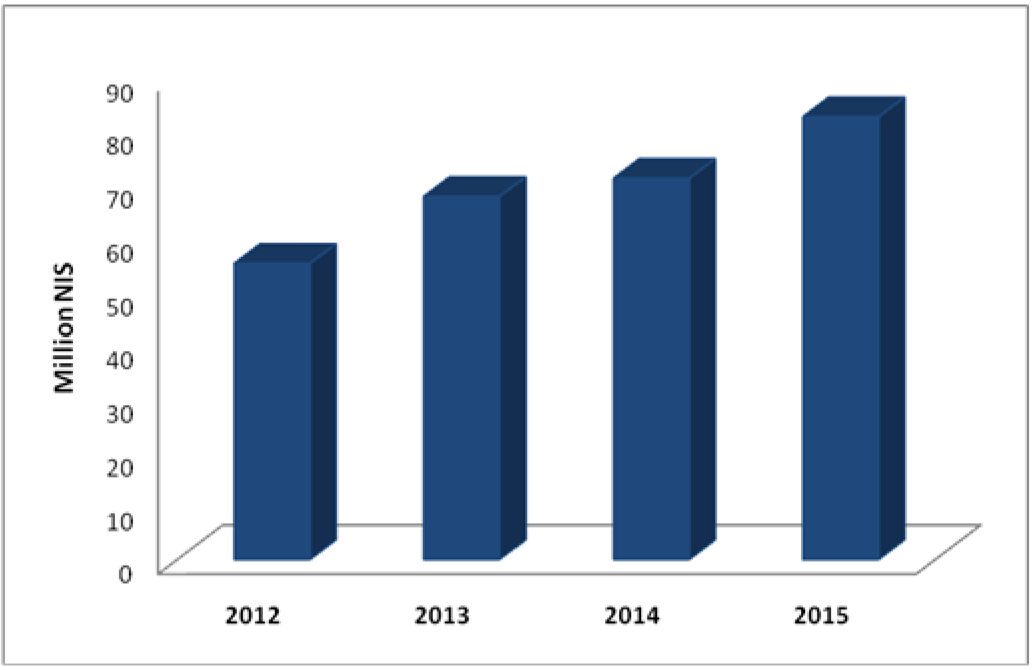
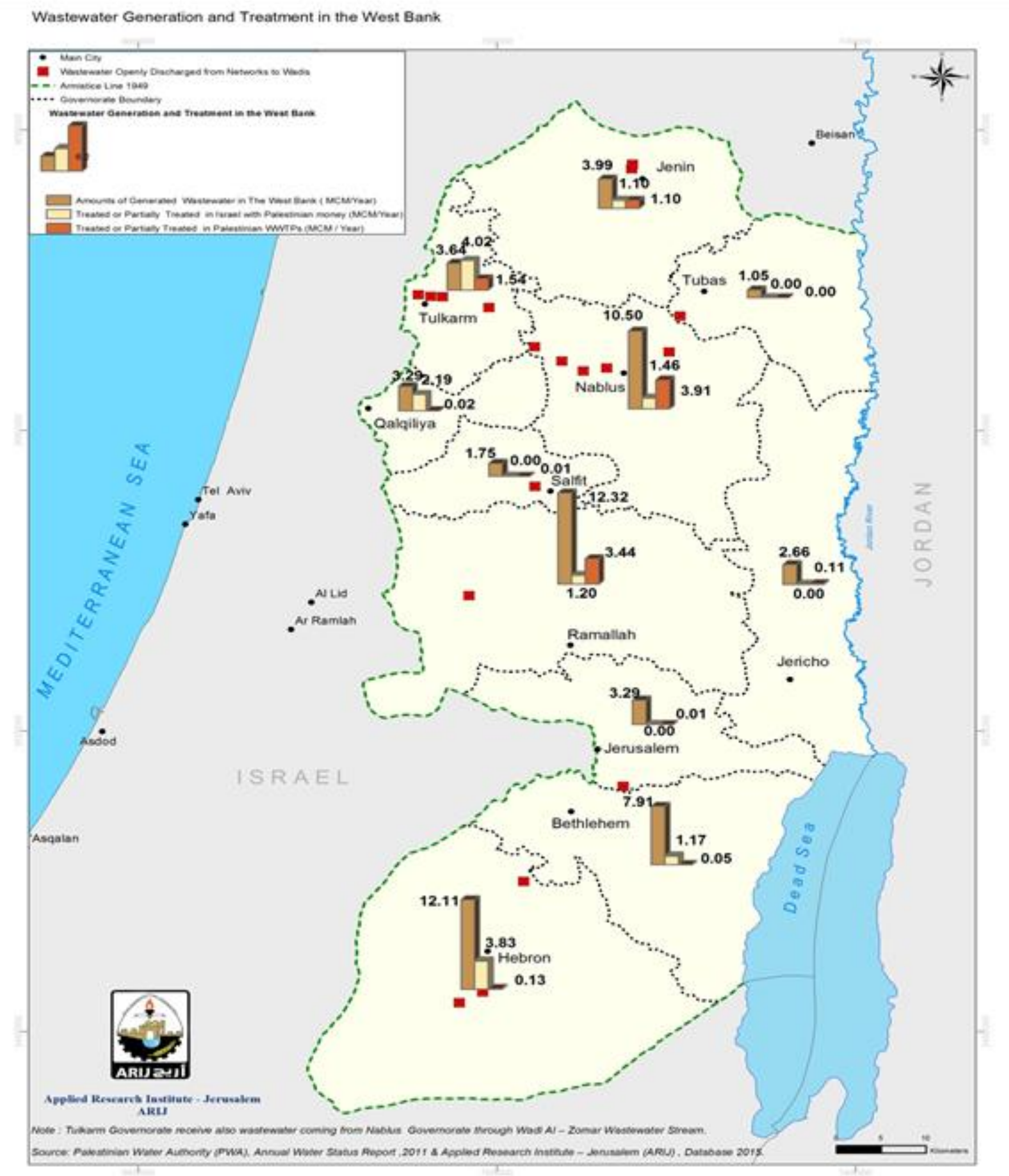


Figure 2.4: Tax Revenues Deducted Annually by Israel for the Treatment of the Palestinian Wastewater

Israel's unilateral decision to build a wastewater treatment plant in the Palestinian Lands of Al-Nabi Musa (to treat Wadi Al-Nar wastewater stream), without the joint water committee approval, is a clear example of Israel violation to the Interim Israeli-Palestinian Agreement, demonstrating once again the lack of Israel's commitment to signed agreements, the construction of this wastewater treatment plant by Israel,can result in making Palestinians pay to Israel fees as wastewater treatment concept, when at the same time treated effluent is expected to serve Israeli agriculture activities in the area. Taking this approach not only will deteriorate the Palestinian economy, but also will prevents the development of the Palestinian agriculture sector in the area, since the treated effluent can contribute to the development of the Palestinian agriculture sector in the Dead Sea area, and to the creation of new job opportunities for Palestinians.



Map 2.4: Wastewater Generation and Treatment in The West Bank

2.1.3.6.1.3 Challenges and Limitations Facing the Palestinian Water and Wastewater Sector

The Palestinian water and wastewater sector is facing many limitations and challenges that prohibit its sustainable development. The unique status of Palestine, of being an occupied territory in which Israel controls Palestinian natural resources, imposes new challenges not often faced by other developing countries. Improving water and wastewater management is hence one of the greatest challenges facing environmental planners in Palestine.

The main challenge could be summarized as following: (1) The Political Situation, (e.g. (a) Israeli obstacles, Israel didn't approve several water and wastewater projects as: Abu Dis, project submitted in 1997 and Ramallah, project submitted in 1997, (b) Conditioned aids to political situation(USAID cancelled Hebron wastewater project in 2006 as consequence of election results) (2) Financial, (e.g. limited availability of fund and citizen affordability) (3) Technical, (e.g.(a) Minimization of Operation & Maintenance costs related to water and wastewater infrastructures, (b) selection of appropriate systems and technologies that fit the particularity of Palestine), (4)Institutional,(e.g. Legislations: Enforcement of laws and standards) (5) Social and Environmental aspects.

2.1.3.6.1.4 Political situation

Prior to the establishment of the PNA in 1993, Palestinians have had limited control over the water and wastewater management sector. None of the municipalities and village councils possessed any power of regulation or legislation. Moreover, the Israeli civil administration made various amendments to the Jordanian law following the 1967 occupation to fit their own interest. The political and bureaucratic hurdles put in place by the Israeli Civil Administration caused various negative effects on the economic, social and environmental situation; therefore, minimum progress in the sector has been made in Palestine.

Restrictions imposed from the Israeli occupation continue to be the most significant impediments to the development in the sector; chief among them are: (1) Area C geographical territory division, where Palestinians have no control over this territory (2) Israeli Settlement and Israeli settlers practices against the Palestinians (3) Physical restriction on access to water and sanitation.

2.1.3.6.1.4 History of Wastewater Reuse:

The term "wastewater" properly means any water that is no longer wanted, as no further benefits can be derived out of it. About 99 percent of wastewater is water, and only one percent is solid wastes. An understanding of its potential for reuse to overcome shortage of freshwater existed in Minoan civilization in ancient Greece, where indications for utilization of wastewater for agricultural irrigation dates back to 5000 years. Sewage farm practices have been recorded in Germany and UK since 16th and 18th centuries, respectively. Irrigation with sewage and other wastewaters has a long history also in China and India.

In the more recent history, the introduction of waterborne sewage collection systems during the 19th century, for discharge of wastewater into surface water bodies led to indirect use of sewage and other wastewaters as unintentional potable water supplies. Such unplanned water reuse coupled with inadequate water and wastewater treatment, resulted in catastrophic epidemics of waterborne diseases during 1840s and 50s. However, when the water supply links with these diseases became clear, engineering solutions were implemented that include the development of alternative water sources using reservoirs and aqueduct systems, relocation of water intakes, and water and wastewater treatment systems. Controlled wastewater irrigation has been practiced in sewage farms many countries in Europe, America and Australia since the turn of the current century.

For the last three decades or so, the benefits of promoting wastewater reuse as a means of supplementing water resources and avoidance of environmental degradation have been recognized by national governments. The value of wastewater is becoming increasingly understood in arid and semi-arid countries and many countries are now looking forward to ways of improving and expanding wastewater reuse practices. Research scientists, aware of both benefits and hazards, are evaluating (it as one of the options for future water demands.(S.Vigneswaran, M.Sundaravadivel, (2004).

2.1.3.6.1.5 Wastewater reuse:

The term wastewater reuse is often used synonymously with the terms wastewater recycling and wastewater reclamation. Because the general public often does not understand the quality difference between treated and untreated wastewater, many communities have shortened the term to water reuse, which creates a more positive image. The U.S. Environmental Protection Agency (EPA) defines wastewater reuse as, "using wastewater or reclaimed water from one application for another application. The deliberate use of reclaimed water or wastewater must be in compliance with applicable rules for a beneficial purpose (landscape irrigation, agricultural irrigation, aesthetic uses, ground water recharge, industrial uses, and fire protection). A common type of recycled water is water that has been reclaimed from municipal wastewater (sewage).” (Caigan McKenzie,2005) .

2.2 Current Status of Wastewater Treatment and Reuse in Palestine :

Years of neglect during the occupation from 1967 to 1994 have created severe environmental problems in West Bank and Gaza. Lack of wastewater treatment plants, of sewerage systems and of wastewater collection for recycling lead to the uncontrolled discharge of wastewater into the environment. There were insufficient financial resources within the Palestinian community to pay for new wastewater collection, disposal and treatment systems. Israel was collecting taxes from Palestinians through the Israeli Civil Administration, but they never employ the money for the infrastructure for the Palestinian communities. The situation is worsened by the discharge of untreated wastewater from Israeli colonies (MEDAWARE, 2004).

The percentage of population connected to sewer networks in Palestine counts for approximately 45.8% distributed as 66.3% in Gaza Strip and 34.6% in West Bank while cesspits and septic tanks receive the rest. (MOH, 2004). There are seven main wastewater treatment facilities in the Palestinian Territories; three are located in Gaza strip while the rest in the West Bank . In addition there are six small-scale Wastewater Treatment (WWT) facilities located in the West Bank .

The deterioration of the environmental situation in the West Bank and the high water scarcity level needs for an immediate action for the treatment of raw sewage and the upgrading of existing over loaded treatment plants. Wastewater reuse will also play an important role in the re-allocation of scarce water resources among sectors of the economy. The development of a sustainable and affordable wastewater treatment system will have a positive impact on the Palestinian economy through poverty alleviation. The wastewater sector in the West Bank is characterized by poor sanitation, insufficient treatment of wastewater, unsafe disposal of untreated or partially treated water and the use of untreated wastewater to irrigate edible crops. Whether in urban or rural areas, the reuse of treated wastewater is practiced on a small scale and this option has been generally absent from wastewater treatment plans. However, few studies have examined the overall picture of wastewater treatment and reuse in WB, particularly inclusive of rural areas, in order to derive key priorities for actions at the strategic level and identification of practical pilot studies to be carried out. Wastewater is a very significant pollution source that has serious adverse impact both on the environment and local residents. In the Palestinian Territories raw wastewater is disposed in wadis or left to infiltrate through cesspits into the underlying vulnerable groundwater. Many, especially in marginalized rural areas, leave the wastewater to simply seep into the streets inducing bad odors, spreading insects and possibly causing diseases.

2.2.1 Motivational Factors for Recycling/Reuse

Reuse of wastewater can be a supplementary source to existing water sources, especially in arid/semi-arid climatic regions. Most large-scale reuse schemes are in Israel, South Africa, and arid areas of USA, where alternative sources of water are limited. Even in regions where rainfall is adequate, because of its spatial and temporal variability, water shortages are created. For example, Florida, USA is not a dry area, has limited options for water storage, and suffers from water shortages during dry spells. For this reason wastewater reuse schemes form an important supplement to the water resource of this region.

Costs associated with water supply or wastewater disposal may also make reuse of wastewater an attractive option. Positive influences on treatment costs of wastewater and water supplies, and scopes for reduction in costs of head works and distribution systems, for both water supply and wastewater systems has been the motivation behind many reuse schemes in countries like Japan.

Concern about water supply or environmental pollution may emerge as a political or institutional issue. Community concern about the quality of wastewater disposed to sensitive environments may lead to political pressures on the water industry to treat wastewater to a higher level before discharge, that can be avoided through reuse of wastewater. Institutional structures may also provide incentives for reuse. Because responsibility for different parts of water use and disposal system may rest with different organizations, a water utility may also be faced with standards of service set in agreements with other industry bodies. (S.Vigneswaran, M.Sundaravadivel, (2004).

Major among the motivational factors for wastewater recycle/reuse are:

- opportunities to augment limited primary water sources;
- prevention of excessive diversion of water from alternative uses, including the natural environment;
- possibilities to manage in-situ water sources;
- minimization of infrastructure costs, including total treatment and discharge costs;
- reduction and elimination of discharges of wastewater (treated or untreated) into receiving environment.
- scope to overcome political, community and institutional constraints.

2.2.2 Driving forces behind increasing wastewater use

Wastewater is being increasing used for irrigation of agricultural crops in both developing and industrial countries .The principal forces driving the increasing use of wastewater are :

- increasing water scarcity and stress, and degradation of freshwater recourses resulting from improper disposal of wastewater ;
- population increase and related increased demand for food and fibre;
- a growing recognition of the recourses value of wastewater and the nutrients it contains;
- The millennium development Goals (MDGs),especially the goals for ensuring environmental sustainability and eliminating poverty and hunger ;

2.2.3 Increasing Water scarcity and Stress

Fresh water is already scarce in many parts of the world ,and population growth in water-scarce region will further increase its value. In 1995, 31 countries were classified as water-scarce or water stressed, and it is estimated that 48 and 54 countries will fall into these categories by 2025 and 2050, respectively . These numbers do not include people living in arid regions of large countries where there is enough water but it is poorly distributed – e.g china, India and united states of America (China is predicted to reach water scarcity by 2050 and India by 2025) (Hinirichsen, Roby & Updahyay,1998). Growing competition between agriculture and urban areas for high-quality freshwater supplies, particularly in arid ,semi-arid and densely populated regions, will increase the pressure on this recourses.

Global fresh water resources constitute about 2.5 per cent of the total volume of water on Earth, and a considerably small fraction of less than 1 per cent of this resource is the usable fresh water supply for ecosystems and human utilization (UNEP, 2008).

Available fresh water resources, however, are not evenly distributed, and are already scarce in many parts of the world, affecting almost every continent. Figure 2.4 illustrates that about one-third of the world's population lives in basins that face water scarcity, either physically or economically. Whereas physical water scarcity describes a physical lack of available water to satisfy the demand, economic water scarcity refers to a lack of institutional capacities to provide necessary water services and infrastructure development to control storage, distribution and access

By 2025, a total number of 1.8 billion people will be living in countries or regions with absolute water scarcity. Two-thirds of the world's population could be living under water-stressed conditions, and in Africa alone, it is estimated that 25 countries will be experiencing water stress (UNEP, 2008).

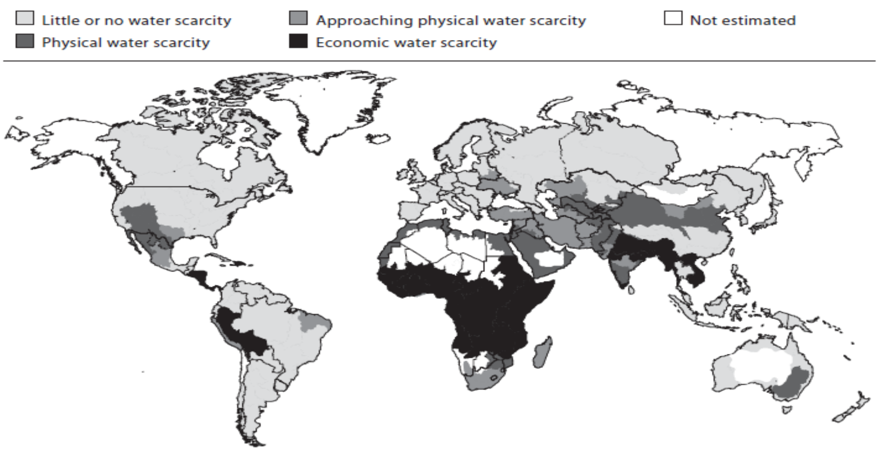


Fig.2.5 Areas of Physical and Economic water Scarcity .

Source : Comprehensive Assessment of water Management in Agriculture

Regardless of whether the availability of water is limited for physical or economic reasons, a variety of interrelated drivers cause water scarcity. Generally, water scarcity arises when the demand for water gets close to or exceeds its availability. Demographic pressures, urbanization and pollution are all putting unprecedented pressure on a renewable but finite resource and serving to increase water scarcity levels even further. Most population growth will occur in developing countries, mainly in regions that are already experiencing water stress and in areas with limited access to safe drinking water and adequate sanitation facilities. Agriculture is by far the largest user of fresh water resources. In order to satisfy growing food demands, related rises in agricultural water use are expected to increase the severity of water scarcity in some areas even further.(Safe Use of Wastewater in Agriculture,2013)

2.2.4 Growth Population

Within the next 50 years ,it is estimated that more than 40% of the world's population will live in countries facing water stress or water scarcity (Fig2.5) .Most population growth is expected to occur in urban and per urban areas in developing countries (United Nations Population 2002).For example , most of the 19 cities predicted to grow the most rapidly during 2000-2015 (with populations Fig 2.11 expected to more than double in this period) are in chronically water-short regions of developing countries (United Nations Population Division, 2002) .

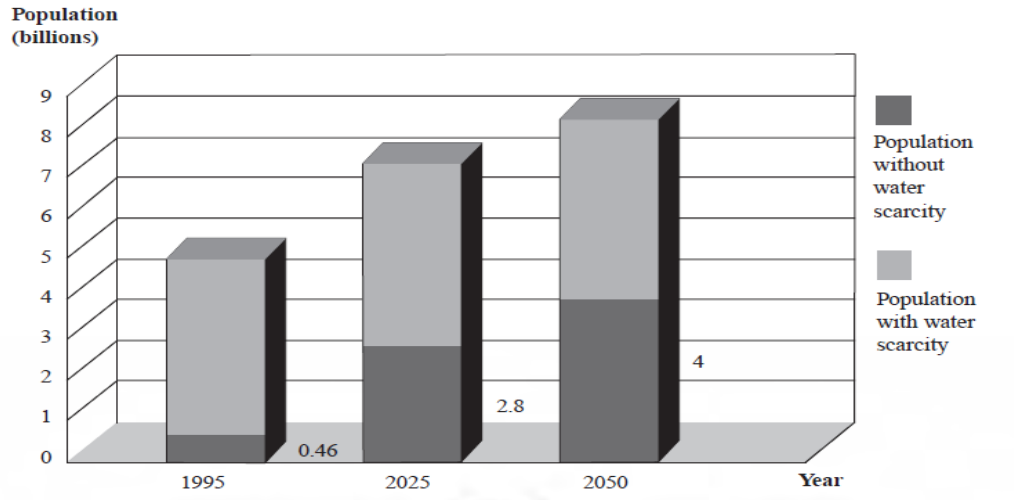


Figure 2.6: Population living in water- scarce and water-stressed countries,1995-2050 (United Nation Population)

Currently, the world population continues to grow though more slowly than in the recent past. Ten years ago, world population was growing by 1.24 per cent per year. Today, it is growing by 1.18 per cent per year, or approximately an additional 83 million people annually. The world population is projected to increase by more than one billion people within the next 15 years, reaching 8.5 billion in 2030, and to increase further to 9.7 billion in 2050 and 11.2 billion by 2100 (United Nations Population Division, 2015)

As populations grow and become more urban, water use and consequent wastewater generation increase .For example , water usage in North America increased by approximately 800% during 1900-1995, and global water use in 2000 was estimated to be nearly three times what it was in 1950.Annual households water consumption ranges from approximately 1m3 per person in urban areas in the United States of America *(Gleick,2000).*

The growth of urban population, especially in developing countries ,will influence the production ,treatment and use and wastewater in several ways:

- Higher population densities in urban and per urban areas will generate more waste(much of which will be discharged into the environment with little or no treatment).
- Urban populations consume more water than rural populations , which also increase the amount of wastewater produced.
- Sewage systems become dominant in urban areas, because on-site waste disposal is not always feasible in many densely populated areas.
- Urban agriculture (with wastewater as a common water source) will play more important role in supplying food to cities.
- Municipal wastewater will become the sole water source for many farmers in water-stressed areas close to cities.

2.3 Wastewater as recourse

In a world where we have finite water resources to feed a growing world population and increasingly concentrated in urban areas, we face major challenges in water supply, disposal of treated effluent and environmental protection of aquatic environments. In addition, climate models anticipate greater uncertainty (irregularity) rainfall, an uncertainty that affects the geographical and seasonal rainfall patterns, with more intense and longer droughts, and with special emphasis in our latitudes. Thus, the main challenge is the regularity of flows, having to face the risks of both meteorological and hydrological drought.

In this situation, reclaimed water is seen as a new source of water resources, unconventional and alternative, with a reliability far superior to that of conventional sources. Moreover, this water quality exceeds the quality of many conventional sources, and it can be set depending on the needs. Regeneration and water reuse appear as a new strategy, complementary to the already used ones, to attend to the water demands. But reuse strategy is complex and has multiple dimensions (technical, public health, economic and financial, regulatory, institutional management, environmental, territorial planning, industrial, public perception and policy on integrated management of resources).

On the other hand, it can be said that regeneration of water has two motivations. The first is to provide new supply sources of local character, so that self-sufficiency is favored. The second motivation is to facilitate the management of treated water, offering alternatives to discharge to the environment, and even enabling the "zero discharge". (*UN-water annual International Zaragoza conference ,2015*)

2.3.1 Quality Issues of Wastewater Reuse/Recycling

Despite a long history of wastewater reuse in many parts of the world, the question of safety of wastewater reuse still remains an enigma mainly because of the quality of reuse water. There always have been controversies among the researchers and proponents of extensive wastewater reuse, on the quality the wastewater is to meet. In general, public health concern is the major issue in any type of reuse of wastewater, be it for irrigation or non-irrigation utilization, especially long term impact of reuse practices. It is difficult to delineate acceptable health risks and is a matter that is still hotly debated.

Issues other than quality of reuse water includes, socioeconomic considerations, and hydro-geologic conditions. The socioeconomic considerations include community perceptions, and the costs of reuse systems. Wide community level surveys in various States of Australia during early 1990s indicated that in general, public is not averse to the concept of wastewater recycling within the community. In one of such surveys, however, less than 15% readily agreed for potable reuse. While non-potable reuse options was a technically accepted option, concerns about possible health risks were frequently raised by the public. Documented public health investigations available in USA is given in US Environmental Protection Agency Guidelines which considered that epidemiological studies of exposed populations at water reuse sites are of limited value, because of the mobility of the population, small sizes of such study populations, and difficulties in determining the actual level of exposure of each studied individual. Despite the limitations of epidemiological investigations, the wastewater reuse in the US has not been implicated as the cause of any infectious disease outbreaks. A more specific study of the city of St. Petersburg, Florida to estimate the potential risk to the exposed population concluded that:

- there is no evidence of increased enteric diseases in urban regions housing areas irrigated with treated reclaimed wastewater, and
- there is no evidence of significant risks of viral or microbial diseases as a result of exposure to effluent aerosols from spray irrigation with reclaimed water.

However, the study recommended that adequate treatment schemes must always be designed to eliminate, or at least minimize the potential risks of disease transmission. The economic considerations are necessary because, when “first-hand” water is available at a cheaper price, it may not be worthwhile to reuse wastewater, unless there are other special conditions. Consideration of hydro-geologic conditions helps to compare the reuse water quality and the quality of alternative sources intended for the same kind of use.

Almost all the guidelines and standards for wastewater reuse deal mainly with the reuse of wastewater for irrigation purpose. It is mainly because irrigation is the highest water consuming activity in any country, and hence is the first option considered in any reuse planning. For example, 90 percent of available water supply in the Indian subcontinent, and a staggering 98 percent in Egypt, is used in irrigation. Though there are no generalized guidelines for reuse water quality for other options, in countries like Japan, where domestic reuse also is widely practiced, there are standards for such reuse. (S.Vigneswaran, M.Sundaravadivel, (2004).

2.3.2 Treated Wastewater Quality Standards

The wastewater quality achievable in practice depends on the treatment processes provided at any particular treatment plant and it is essential to match the use of the final water requirements with that level of quality. From the point of view of wastewater re-use in agriculture, however, additional quality characteristics important for health and agronomic reasons are necessary including bacteria, viruses, helminthes, protozoa and physico/chemical parameters such as conductivity and the sodium absorption ratio. Primary treatment of municipal wastewater will remove primarily settled solids together with any adsorbed or entrained materials, such as heavy metals, which might be associated with the solids. The effect of primary treatment on health and agronomic parameters is of minor significance, except that there may be a high level of toxic heavy metals accumulated in the sludge. Conventional secondary treatment of sewage in biological filters or activated sludge plants is designed to remove more of the biologically degradable organic material, and typically removes up to 80–90% of the BOD5 remaining after primary treatment. Again, the health and agronomic parameters are little affected by conventional secondary treatment processes. Further upgrading of secondary effluent is possible in tertiary treatment processes but complex combinations of unit processes are required to achieve a high quality of effluent for unrestricted use in agriculture. Stabilization ponds can achieve high quality effluent standards with low cost, easily operated systems but the land take is high. In order to meet the need for highly quality treated wastewater new technologies are being developed and studied throughout the world.(Quantifying the Environmental and socioeconomic Benefits of the DWWT,PHG 2012).

2.3.3 Risks And Potential Constraints

Because there are risks associated with the reuse of treated wastewater and sludge in agriculture, any proposed wastewater re-use scheme must be carefully planned and strictly controlled through local and national institutions. There are several constraints to wastewater reuse: Health problems, such as water-borne diseases and skin irritations, may occur if people come into contact with reclaimed water or products that were produced with reclaimed water. In some cases, reuse of wastewater is not economically feasible because of the requirement for an additional distribution system. The reuse of reclaimed wastewater may not be culturally or religiously accepted in some societies therefore; treated wastewater standards must be achieved by the involvement of different key ministries like EQA, MOH, PCBS among others PSI,EQA, PWA, MoH and MoA has conducted a standers draft study for treated wastewater for irrigation The success of a wastewater re-use scheme depends on the strong commitment of the wastewater treatment organization to achieve consistent operational performance at all times. The need for a properly empowered body to control the allocation of land for irrigation with treated wastewater was seen as an urgent priority. .(Quantifying the Environmental and socioeconomic Benefits of the DWWT,PHG 2012).

2.3.4 Types of Wastewater Reuse

Wastewater can be recycled/reused as a source of water for a multitude of water demanding activities such as agriculture, aquifer recharge, aquaculture, fire fighting, flushing of toilets, snow melting, industrial cooling, parks and golf course watering, formation of wetlands for wildlife habitats, recreational impoundments, and essentially for several other non-potable requirements. Potential reuses of wastewater depends on the hydraulic and biochemical characteristics of wastewater, which determine the methods and degree of treatment required. While agricultural irrigation reuses, in general, require lower quality levels of treatment, domestic reuse options (direct or indirect potable and non-potable) reuses need the highest treatment level. Level of treatment for other reuse options lie between these two extremes.

2.3.4.1 Wastewater Reuse in Agriculture Sector

2.3.4.1.1 Reuse for Irrigation

Wastewater reuse is not a new practice, though there is no comprehensive global data on wastewater reuse, it is estimated that about 7% (or 20 million hectare) of irrigated land uses wastewater or polluted water Of this 20 million ha only 10% uses treated wastewater (who ,2006), Agricultural irrigation has, by far, been the largest reported reuse of wastewater. About 41 percent of recycled water in Japan, 60% in California, USA, and 15% in Tunisia are used for this purpose. In developing countries, application on land has always been the predominant means of disposing municipal wastewater as well as meeting irrigation needs. In China for example, at least 1.33 million hectares of agricultural land are irrigated with untreated or partially treated wastewaters from cities. In Mexico City, Mexico, more than 70 000 hectares of cropland outside the city are irrigated with reclaimed wastewater. Irrigation has the advantage of “closing-the-loop” combination of waste disposal and water supply. Irrigation reuse is also more advantageous, because of the possibility of decreasing the level of purification, and hence the savings in treatment costs, thanks to the role of soil and crops as biological treatment facilities. As the water supply requirements of large metropolis are growing, the option of reuse of wastewater for domestic purposes is increasingly being considered. Judging from international experience, there is potential for reuse at all system scales, from household level to the large irrigation schemes. Reuse has advantages as well as disadvantages at each level. The choice is conventionally technical and economic one, though some view it as important that the community as a whole should become more involved in the working of reuse system. (Phillipa Kanyoka and Tamer Eshtawi,2012)

Agricultural irrigation has, by far, been the largest reported reuse of wastewater. About 41 percent of recycled water in Japan, 60% in California, USA, and 15% in Tunisia are used for this purpose. In developing countries, application on land has always been the predominant means of disposing municipal wastewater as well as meeting irrigation needs. In China for example, at least 1.33 million hectares of agricultural land are irrigated with untreated or partially treated wastewaters from cities. In Mexico City, Mexico, more than 70 000 hectares of cropland outside the city are irrigated with reclaimed wastewater. Irrigation has the advantage of "closing-the-loop" combination of waste disposal and water supply. Irrigation reuse is also more advantageous, because of the possibility of decreasing the level of purification, and hence the savings in treatment costs, thanks to the role of soil and crops as biological treatment facilities. As the water supply requirements of large metropolis are growing, the option of reuse of wastewater for domestic purposes is increasingly being considered. Judging from international experience, there is potential for reuse at all system scales, from household level to the large irrigation schemes. Reuse has advantages as well as disadvantages at each level. The choice is conventionally technical and economic one, though some view it as important that the community as a whole should become more involved in the working of reuse systems.

Irrigation reuse of wastewater can be for application on:

(i) agricultural crops, woodlots and pastures, or

(ii) landscape and recreational areas.

The choice of type of irrigation application generally depends upon the location and

quantity of wastewater available for reuse.(S.Vigneswaran, M.Sundaravadivel, (2004).

2.3.4.1.2 Irrigation of Agricultural Crops

As discussed earlier, the oldest and largest reuse of wastewater is for irrigation of agricultural crops. Potential constraints in this type of application are:

(i) surface and groundwater pollution, if poorly planned and managed;

(ii) marketability of crops and public acceptance;

(iii) effect of water quality on soil, and crops;

(iv) public health concerns related to pathogens.

However, many research studies have proved that in addition to providing a low-cost water source, other side benefits of using wastewater for irrigation include increase in crop yields, decreased reliance on chemical fertilizers, and increased protection against frost damage. Modern reuse for irrigation of agricultural purposes in developed countries were the result of two pioneering studies that were conducted in California during the 1970s and 1980s: The Pomona virus study and the Monterey wastewater reclamation study for agriculture.

The Pomona virus study was conducted in Los Angeles in an effort to determine the degree of treatment necessary to minimize potential transmission of waterborne diseases via surface water. The study concluded that complete virus removal is possible through tertiary treatment of wastewater by either direct filtration or activated carbon followed by adequate disinfection, thus proving the possibility for reclamation of “microbiologically risk free” water from wastewater. These results of this study have opened up the possibilities of wastewater reuse for various applications. Since the virus removal through treatment has been established by Pomona study, investigations of Monterey study concentrated on virus survival on crops and in soils in the field. Based on virological, bacteriological, and chemical results from sampled tissues of vegetables grown using wastewater as irrigant, the study established the safety of this type of reuse. Both studies demonstrated conclusively that even food crops that are consumed uncooked could be successfully irrigated with reclaimed municipal wastewater without adverse environmental or health effects.

In many countries in the Mediterranean region, spanning from Spain to Syria, shortage of water has been the main driving force for wastewater reuse. Wastewater from Tunis, the capital city of Tunisia, has been used to irrigate citrus fruit orchards since the 1960s. From 1989 onwards, secondary treated wastewater has been allowed for growing all types of crops, except vegetables. In countries like Morocco, Jordan, Egypt, Malta, Cyprus, and Spain, several large-scale wastewater irrigation schemes are already in operation or under planning. In Israel, the percentage of wastewater reused for irrigation purposes is highest in the region, at 24.4%, which is expected to be increased to 36% by the year 2010. In temperate zones of Australia, reclaimed water is being used to irrigate a variety of crops including sugarcane. A recent development is the use of reclaimed water for irrigation of tea-tree plantations, which will produce tea-tree oil as a cash crop. Eucalyptus forestry also is a major reuse option followed in Australia, which provides timber for a number of purposes including pulp wood and fire wood.

2.3.4.1.3 Irrigation of Landscape and Recreational Area

Application of reclaimed wastewater for landscape irrigation includes use in public parks, golf courses, urban green belts, freeway medians, cemeteries, and residential lawns. This type of application is one of the most common application of wastewater reuse worldwide. Examples of such uses can be found in USA, Australia, Japan, Mexico and Saudi Arabia among others. These schemes have been operating successfully in many countries for many years without attracting adverse comments. This type of application has the potential to improve the amenity of the urban environment. However, such schemes must be carefully run to avoid problems with community health. Because the water is used in areas that are open to public, there is potential for human contact, so reuse water must be treated to a high level to avoid risk of spreading diseases. Other potential problems of application for landscape irrigation concern aesthetics such as odor, insects, and problems deriving from build-up of nutrients.

The “water mining” project is an innovative concept followed in Australia, in which wastewater from a main sewer in the reticulated wastewater collection system is diverted to be treated and reclaimed for use in landscape irrigation. The first of such a water mining plant was opened in May 1995 at South well Park in Canberra. The plant design focused on health issues, noise and odor control, and preservation of neighbourhood amenity.

2.3.4.1.4 Basic economic considerations of water reuse:

Water reuse combines the benefits of freshwater conservation, surface and groundwater resource protection, and total water supply augmentation. Indeed, water reuse allows the preservation of freshwater resources for higher quality uses (such as potable water supply) and postpones potentially more costly water supply approaches (e.g., storage, transfer or desalination schemes). As such, water reuse is emerging as an established water management practice in several water-stressed regions of the world.

The spread of water reuse has been surprisingly uneven and slow across the Middle East and North Africa (MENA), despite its ranking as the most arid and water-scarce in the world. In the region to date, many reuse projects are either (i) pilot scale projects whose sustainability and replicability are uncertain or (ii) involve unplanned reuse of wastewater that is not treated to meet standards, such as those set by the World Health Organization (WHO). Further, even in locations with a policy climate favorable to water reuse, many of these projects face serious operational, financial and environmental obstacles. (Water Reuse in the Arab world from principle to practice ,2011)

In general, the development and implementation of water reuse strategies across the Arab world is challenged by a complex set of factors:

- High cost of wastewater treatment and conveyance infrastructure;
- Insufficiency of economic analysis on wastewater treatment infrastructure projects;
- Technical and social issues affecting the demand for reclaimed water
- Low pricing of irrigation water that does not adequately reflect its cost;
- Difficulty in creating financial incentives allowing safe and efficient reuse.

2.3.5 High cost of wastewater treatment and conveyance infrastructure

A major prerequisite to the development of water reuse schemes is upstream investment in adequate wastewater treatment, rates of which continue to lag behind those of wastewater collection. Though countries across the Middle East and North Africa have made significant progress in extending wastewater collection services to urban populations in particular, significant gaps remain. Wastewater treatment plants, if they exist at all, are further often overloaded, under-designed and, plagued by poor operation and maintenance, do not consistently provide water quality that can be safely reused. The cost of transferring reclaimed water from urban centers (where most of the wastewater is produced) to agricultural areas (typically located in more distant, rural settings) is a further investment cost that can significantly impact the total cost of water reuse planning.(Water Reuse in the Arab world from principle to practice ,2011)

2.3.6 Risks and Benefits of Wastewater Use in Agriculture

Although reuse of wastewater has a high positive potential to environmental relief and social and economic development, obviously there is also the danger of the opposite effects if the reuse schemes are not properly planned and managed. For instance, as a primary disadvantage, the demand for wastewater is usually only during the growing season whereas its production is continuous, which might cause high environmental and health hazard risks if the water is not treated and stored adequately (Kretschmer et al., 2002). Therefore the treatment and storage of wastewater should be made accordingly to prevent both hazardous cases and high costs of storage.

Wastewater use in agriculture has substantial benefits, but can also pose substantial risks to public health—especially when untreated wastewater is used for crop irrigation. Farmers often have no alternative but to use untreated wastewater because there is no wastewater treatment (Figure 2.6) and freshwater is either unavailable or too expensive. The major risks to public health are microbial and chemical. Wastewater use in agriculture can also create environmental risks in the form of soil and groundwater pollution. However, if properly planned, implemented and managed, wastewater irrigation can have several benefits for the environment, as well as for agriculture and water resources management. Given these risks and benefits, countries seeking to improve wastewater use in agriculture must reduce the risks, in particular to public health, and maximize the benefits.

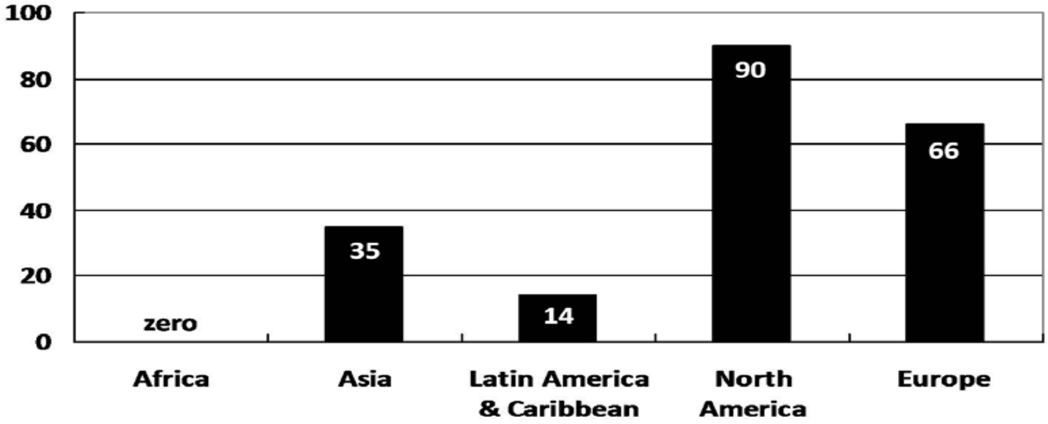


Figure 2.7 Percent of wastewater effectively treated in 2000/Source

Notes: (1) The bulk of wastewater effectively treated in Asia is accounted for by Japan, followed by China. (2) No definition of "effective" wastewater treatment was given by WHO/UNICEF (2000), but it is normally interpreted as the proper operation of at least secondary treatment. However, Box 2.5 suggests that effective treatment in LAC may be closer to 6 percent than 14 percent. *Source:* WHO/UNICEF 2000.

On the other hand, as the agricultural production constitutes the main component of the economy and social structures in many Mediterranean countries, wastewater reuse may enable a productivity improvement in this sector and an increase in the range of products. This would be an important contribution to social and economic development of the countries in the Mediterranean region. However, it seems that these impacts are not considered yet adequately.((Kretschmer et al., 2002)

2.3.4.8 Wastewater Economic risk and benefits:

The main economic risks are:

- The economic impact of public health epidemics or environmental pollution resulting from unsafe treated wastewater reuse practice due to lack of guidelines and guideline application, or access to good practice know how.
- Weak economic justification when water prices do not cover the true cost.
- The local market demand for treated wastewater is not clearly defined and agreed
- Good opportunities are lost through simplistic economic analysis that does not consider whole life cost or economic externalities.

- High distribution and storage costs due to the distance between supply and demand locations.
- Negative branding of treated wastewater reuse by the general public.

2.3.4.9 Economic benefits

Treated wastewater can:

- Serve as a more dependable water source. The quantity and quality of available water may be more consistent compared to surface water, as municipal treated wastewater volumes are less affected by droughts than surface and groundwater bodies. This can lead to reduced production costs, sustained agricultural and industrial production and associated employment (e.g. Costa Brava, Gerringong and Kwinana).
- Enhance urban, rural and coastal landscapes, thereby increasing employment and local economy through tourism (e.g. Barcelona, Costa Brava, Sainte Maxime, Sperone, Honouliuli, and Gerringong).
- Be substituted for freshwater or potable water to meet specific needs and purposes (such as irrigation, toilet flushing, cooling and process water etc.), thereby contributing to more sustainable resource utilization and sound demand management.
- Contain useful materials, such as organic carbon and nutrients like nitrogen and phosphorous. The use of nutrient-rich treated wastewater for agriculture and landscaping may lead to a reduction or elimination of fertilizer application or increased productivity (e.g. Costa Brava, Gerri gong and Berlin).
- Reduce overall water consumption and treatment needs, with associated cost savings. In many applications, treated wastewater reuse is less costly than using freshwater, pumping deep groundwater, importing water, building dams or seawater desalination. (e.g. IWVA Toreelle and Orange County).
- Reduce the investment in new water head works for water abstraction and treatment, distribution networks and new sewerage investment by substituting treated wastewater for non potable applications and thereby increasing the availability of potable water (e.g. Eraring, Durban & Honouliuli).
- Meeting a growing demand for water resources (especially in urban areas) may require the development of additional large-scale water resources and associated infrastructure. By meeting some of this demand through treated wastewater reuse and

efficiency improvement, additional infrastructure requirements and the resulting financial and environmental impacts can be reduced or, in some cases, eliminated altogether.

2.3.4.10 Technical and social issues affecting the demand for reclaimed water

Despite the potential for reducing fertilizer costs and promoting higher yields, demand for reclaimed water in the Arab world is generally lower than that of alternative sources of freshwater. Consistent with economic theory, the relative demand for reclaimed water depends on the availability of substitutes. In the West Bank and Gaza for example, where farmers frequently lack water supply, surveys suggest that 80% of farmers accept reuse. Similarly, farmers living on the northern coast of Tunisia also accept water reuse because they have no alternative water source for irrigation due to groundwater salinity. In contrast, farmers who have a choice between reclaimed water and other sources consistently prefer to use the alternatives in spite of higher costs, because of social stigma and crop restrictions associated with reuse. The role of social marketing and awareness raising is thus critical in reducing opposition to water reuse in the Arab world. Though the involvement of religious authorities in awareness raising activities has strongly diminished opposition to such projects for example, the pervasive lack of consumer awareness of water scarcity in general remains a major obstacle in many cases across the Arab world.

2.3.4.11 Social And Health Benefits And Risks

2.3.4.11.1 Social and Health benefits

The social benefits of treated wastewater reuse include the following:

- The use of common treated wastewater reuse guidelines that include an appropriate risk management approach and good practice know how helps to protect public health for all applications and especially for fruit and vegetable production to ensure food safety .
- Helping to achieve Millennium Development Goals (MDG) through increased water availability and poverty reduction (e.g. Durban) through the use of appropriate technology solutions.

- Contributes to food security, better nutrition and sustains agricultural employment for many households.
- Be a cohesion tool that encourages the drinking water, wastewater and environment agencies and other stakeholders to work closely together using an integrated approach, thereby helping all to recognize the benefits and risks of treated wastewater reuse and encourage good practice that benefit the community (e.g. Costa Brava).
- Increased quality of life, well being and health through attractive irrigated landscapes in parks and sports facilities in rich and poor communities (e.g. Empuriabrava and Costa Brava) and improvement of urban environment (e.g. urban parks and fountains).

2.3.4.11.2 Social and health risks

These include:

- Threat to public health, especially if illegal and unhealthy wastewater reuse practice expands rapidly due to water scarcity, over stringent regulation or the lack of appropriate treated wastewater reuse guidelines and good practice know-how. Social tensions in case of non-acceptance: a common percept

treatment is needed to dispose of waste rather than a community's responsibility to protect public health, the environment and increase water availability needed for economic growth.

2.4 Drought:

Palestine is a semi arid region that is vulnerable to global climate change. The restricted access to water resources and the Israeli control of water resources and development projects, in addition to the high population growth, make the water vulnerability to climate change in the Palestine high.

Changes in the distribution of monthly precipitation, decreased amounts of annual or seasonal precipitation, and increased temperatures in critical periods are all factors that decrease groundwater recharge rates, and hence, water availability. Recently, the region has been affected by series of droughts.

In Palestine, years of below average rainfall i.e. drought, are more frequent than years of above average rainfall. The rainy season 2010-2011 has registered just 73% of the average annual rainfall in the West Bank and only 66% of the average rainfall in Gaza Strip (MoA, 2011) .

A decreased amount of rainfall means a decreased amount of groundwater recharge, and hence, an increased water scarcity. The increase in water scarcity will result in an increase in the water demand's competition between all the different sectors; domestic, agricultural, and industrial. Not only water availability will be affected, the quality of water will also be affected and deteriorated.

2.5 Agricultural Resources:

2.5.1 Agricultural holding size:

Based on the PCBS and MoA agricultural survey conducted in the year 2010, there are 111,310 agricultural holdings in oPt (81.7% in the West bank and 18.3% in Gaza Strip) of which 79,175 (71.1%) are plant holdings and the remaining are livestock holdings. Compared to the year 2005, the number we found that the number of agricultural holdings increase in the year 2010 by 10,138 holdings, this mainly due to the land heritage system in Palestine. Up to 29% of the agricultural holders aged 40-49 years old (PCBS & MoA, 2011)

The survey has resulted in calculating a total area of agricultural lands in the oPt as 1,207,061 dunums, of which 1,105,146 dunums in the West Bank and 101,915 dunums in Gaza Strip. This refers to the type of the survey which was based mainly on certain definition for the size of the agricultural holding and also for the physical agricultural areas not seasonal areas (they have registered only the land more than half dunums as agricultural holding for irrigated lands and those with area equal one dunum and more are rainfed holding). Compared to the year 2008 the total agricultural area was 1.854 million dunums. Compared this however to ARIJ, GIS-RS, 2011 analysis for agricultural areas in the year 2010, showed that the total agricultural areas in the West Bank is 2,150,800 dunums (ARIJ, 2011). This difference in areas is due to the fact that PCBS and MoA had surveyed the actual agricultural lands and dismiss the fragmented small size agricultural lands which are dominated in the urban areas and in certain areas where springs are located. Also, this showed high percentage of small and fragmented ownership in Palestine where it is being cultivated by families. This means additional 1,045,654 dunums of small land ownerships could be added to the PCBS and MoA official agriculture survey of the year 2010.

2.5.2 Agriculture water resources for irrigation:

Water available for agriculture amounts to 150 million cubic metres (mcm) per year, and constitutes 45% of the total water used to distribute to 70 mcm in the West Bank, and 80 mcm in the Gaza Strip. Ground water wells are the main water source for irrigation in the Gaza Strip. In the West Bank, irrigation water is supplied by groundwater wells and springs, and Israel confiscates 82% of Palestinian ground water in the West Bank. The largest ground water resources in the West Bank are concentrated in the Jordan Valley area (MoA, 2010). Based on the World Bank report, which was issued in the year 2009, if the Israeli restrictions on water resources removed and additional provision of additional water quantities occurs this will increase agricultural sector’s contribution to the Gross Domestic Product (GDP) by 10% and will create approximately 110,000 additional job opportunities (World Bank, 2009).

Currently, Irrigated agriculture covers about 12% of cultivated land in the oPt and uses about two thirds of Palestinian water resources and contributes gross output of about $500 million annually. Overall, agriculture contributes 25% of exports, and the sector is the third largest employer: formal employment in the sector in 2005 was estimated at 117,000 people (World Bank, 2009).

Due to over pumping of ground water in Gaza Strip, water quality reduced significantly which led to a significant effect on agricultural yield. Additionally, the destruction of about 370 agricultural wells by the Israeli aggressions on the Gaza Strip also affects the quality and quantity of pumped water. Furthermore, the closure of the boarders causes significant losses for agricultural sector. Thus, the quality of water become so low due to the over pumping and cause water salinization.

Despite the scarcity in water resources in oPt, the available resources are not efficiently used due to the over irrigation and existing old damaged irrigation networks. Also, the investments in wastewater treatment have been blocked due to limited financing resources and restrictions imposed by the occupation on establishing wastewater treatments, especially in area C.

2.6 Agriculture Production

Based on the Palestinian Central Bureau of Statistics (PCBS) agricultural yearly report of the agricultural production for the agricultural year 2007/2008 (PCBS, 2008), the total cultivated area was estimated at 1.854 million dunums which forms 31% of the Palestinian territory area, out of which 91% is in the West Bank and 9% in Gaza Strip. The rain-fed area constitutes 86% while the irrigated area constitutes 14% of the total cultivated land (56% of the irrigated area is located in Gaza Strip and 44% in the West Bank). The rangeland amounts to 2.02 million dunums. However, the area accessible for grazing is only 621 thousand dunums (only 30.7% of the Palestinian rangeland). UP to 62.9% of the Palestinian arable lands are located in Area C, while 18.8% are located in area B and only 18.8% are located in area A. This means that most of the Palestinian agricultural lands are exposed to the occupation obstacles and aggression and threatened to be damaged or confiscated by the occupation. Furthermore, almost 184,899 dunums of arable land, permanent cultivations, green houses are being isolated by the Western part of the Segregation Wall which causing approximately USD 62 million losses a year to the agricultural sector.

The diversified eco-systems of Palestine give it the uniqueness to diversify its produced crops as well as the production calendar. Currently up to 105 main crop types are cultivated, including; 38 types of fruit trees and 37 types of vegetable crops, and 30 types of field crops and grain in addition to the different types of cut flowers. Olives, citrus fruits, grapes and plums represent the leading fruit crops. As most of cultivated areas are under rainfed conditions, the production is usually affected by rain season based on the distribution and total precipitation as well as on the summer season. The past year witnessed low levels in total precipitation and the historical average annual rainfall and bad distribution, in addition to high temperatures. This has affected rain-fed crops especially field crops as the total production reduced by 35-40% and many of farmers in the marginal areas didn’t even manage to get seeds form their planted crops. On the other hand, thousands of the growing grapes vines and recently planted vines became wilted and died; especially in Hebron and Bethlehem Governorates, where 78% of the grape of the oPt are concentrated, due to drought and low rainfall. Furthermore, the olive production this year reduced by 15% of its historical average. In addition, this year, wilted olive fruit started appearing for the first time which the sign of significant drought. Accordingly the plant production size is usually affected by weather conditions, even irrigated agricultural, which might be affected by high temperatures and the prevailing of storm wind and frost (ARIJ, 2011a).

The PCBS agricultural statistic for the year 2007/2008 showed that the total cultivated area in the oPt was 1,854 thousand dunums (See Figure 2.8). The largest area was the fruit trees forming 63.2%, followed by field crops with 26.7% and vegetables with 10.1% of the total cultivated areas in the oPt.

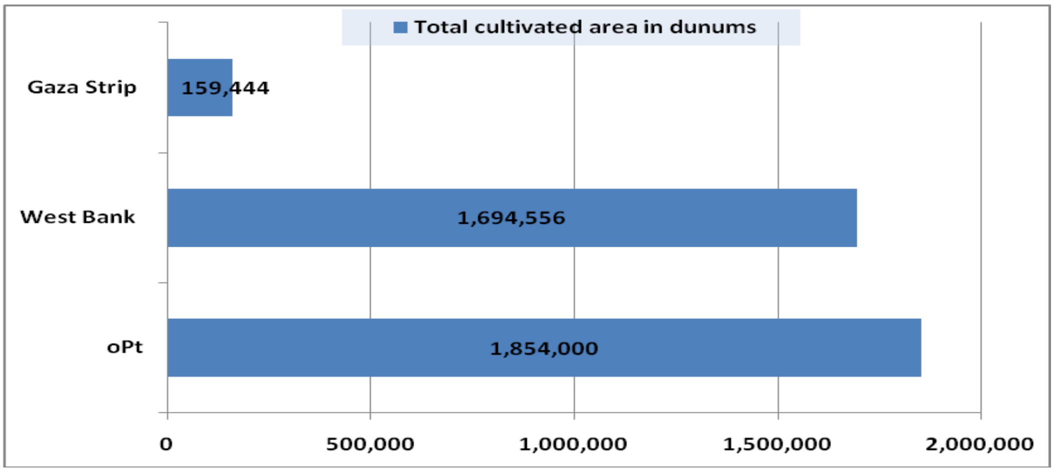


Figure 2.8: Distribution of Agricultural areas in the growing season 2007/2008 by Territory

Source: PCBS, 2009

Irrigated agriculture is dominated in Gaza Strip and forms 72% of the cultivated areas there, while rain-fed agriculture area is dominated in the West Bank and occupies 91.3% of the cultivated area there. Regarding the livestock sector, statistics showed there are 32,986 heads of cattle, 688,899 heads of sheep, 322,082 heads of goats, 27,682 thousand broiler poultry, 2,695 thousand laying poultry, 66,733 beehives and the amount of cached fish from Gaza Sea was 2,844 tons.

Olive trees area is dominated among the planted fruit crops with 81.1% of the total fruit trees cultivated area, while 75.5% of the vegetables area is located in the West Bank while 24.8% of the vegetables area located in Gaza Strip. The total area of the protected vegetables reached 45.3 thousand dunums and forming about 24.3% of the total vegetables area in the oPt. The main growing vegetables are cucumber, squash and tomato respectively. Regarding the field crops cultivations, the total cultivated area with field crops in the year 2007/2008 reached 495.9 thousand dunums. Wheat is the main planted crop and covers 46.3% of the field crops area in the oPt followed by barley with 21.7%.

2.7 Contribution of the Agricultural Sector in the Palestinian economy

The total value of the agriculture production in the oPt, for the agricultural year 2007/2008, reached 1,366.6 million $USD divided between 60.9% for plant production (44.4% form West Bank and 16.5% form Gaza Strip) and 39.1% for livestock production (31.2% from West Bank and 7.9% form Gaza strip). The total production cost reached 490.4 million $USD of which 37.2% for plant production and 62.8% for livestock production. The highest costs of agro-production inputs are feed 46.0% followed by fertilizers with 9.6%, veterinary medicines with 7.7%, pesticide with 7.3% and water and electricity with 7.0%. Accordingly, the total added value for the agricultural sector reached 876.2 million $USD distributed between 71.2% in the West Bank and 28.8% in Gaza Strip with a total contribution of 649.8 million $USD by plant production sector (74.2%) and 226.4 million $USD contributed by the livestock sector (25.8%). Of the total value of plant production in the oPt vegetables production including cut flower formed 55.6% followed by fruit trees production which contributed with 31.7%, then field crops which contributed with 12.7%, respectively. On the other hand, the total value of the livestock production in the oPt constituted of meat production with 55.2%, followed by milk and dairy products with 29.5%, then eggs with 11.1% followed with others which equal to 4.2% (Figure 2.9).

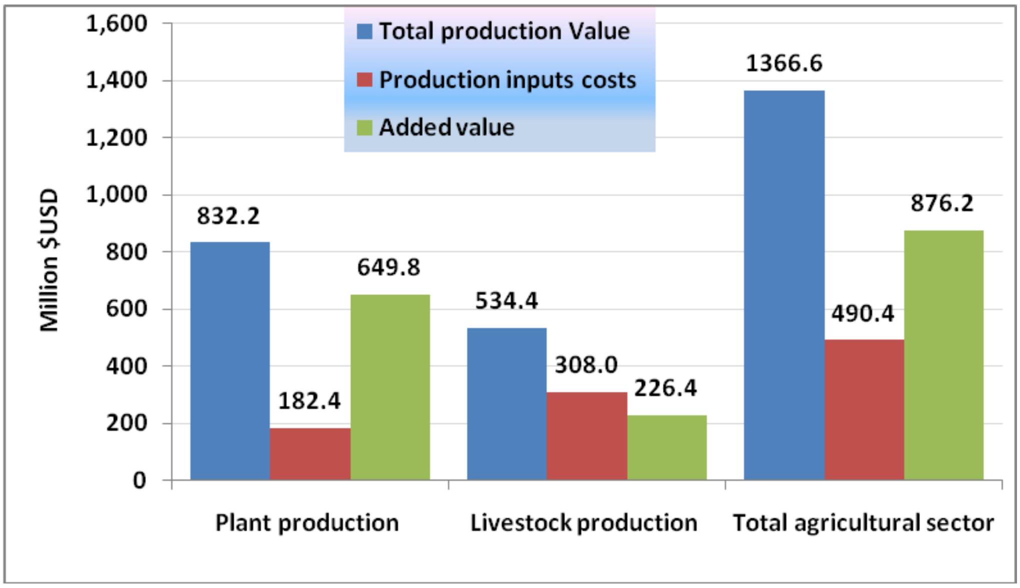


Figure 2.9 : Distribution of total prodcution value, cost and added value by agricultrual subesector

Source: PCBS, 2009

The Agriculture sector is vital for the Palestinian economy as it is the main sector that supports the Palestinian people, especially during in stabilized political conditions where restrictions on closure and movement are usually imposed on the Palestinian people. At least it provides these affected people with food and some income to reduce the impact of crisis on their lives including access to food. The value contribution of agricultural sector to the Palestinian GDP remained varied between 387.9 and 588.7 million $USD in the years 2000-2007 with exception of the year 2008 where it was at 876,181 million $USD. In 2013 -2014 reached 517.3 and 494.0 Also, the contribution of the agricultural sector compared to other sectors to the national economy has started decreasing from 12.1% of the total GDP in the oPt in the year 1998 to 5.5 in the year 2009 (Figure 2.9).

This showed that the growth in the agricultural sector is very limited and the allocated support by the Palestinian authority and donors is limited compared to other sectors. Also, restrictions imposed by the occupation on the agricultural sector include; restrictions to the exportation of agricultural commodities from Gaza, limitations of farmers access to lands in the West Bank, in addition to the destruction of agricultural infrastructure through bulldozing the greenhouses, uprooting trees and agricultural lands, land confiscation and taking most of the water resources. On the other hand, the impact of natural crisis such as drought, low rainfall, frost and storm winds. Furthermore, more than 80% of the agricultural activities are family based cultivations, where many of the family members are working as informal workers and their economic contributions don't included national economic resources. All these factors are affecting the development of the Palestinian agricultural sector and its contribution to the national economy. It is important to mention that these shocks and limitations are directly affecting small and medium sized Palestinian farmers.

In 2007, the agricultural sector had contributed to 16.1% of the total employment in Palestine, with a total number of 103 thousand workers, whilst later in 2014; the employment in agriculture was estimated at 7.8 % (PBC ,2015). In the years 2008 and 2009 the labor force in agricultural sector formed 15.7% and 14.2% in the West Bank and 10.7% and 6.4% of the Gaza Strip total labor force, respectively. Furthermore, the agricultural products formed about 23% of the total exported products from Palestine in the year 2007. In addition to the high number of informal employed workers, especially women. It is worth mentioning, that 42% of the Palestinians in the West bank and 17% in Gaza strip have been earning from the agricultural sector are a major supplementary income (MoA, 2009a)

Agricultural inputs are one of the sensitive factors affecting the feasibility and the sustainability of the agricultural sector as their prices keep increasing. For example, the expenses increased in the year 2009 at a rate of 5.7% from the previous year.

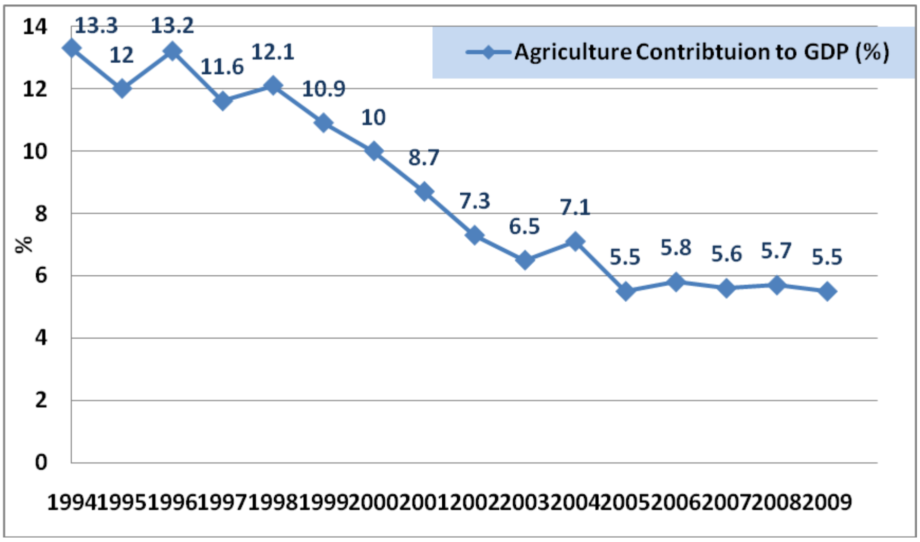


Figure 2.10 : Agricultural sector contribution to the total Palestinian GDP (1994-2009)
Source: PCBS, 2010

The Agriculture Strategy for the years 2011-2013 has developed a long term developmental Strategy objective through with its principal goal to increase self-sufficiency through increasing local agricultural products by overall value to over USD 1 billion. According to the strategy, this goal will be achieved by increasing the value of agricultural exports to USD 60 million and providing additional 50,000 jobs through increased water irrigation availability for farming by 60 million cubic meters and reclaiming 5,000 dunums of land. The question is how to achieve such an optimistic plan as the occupation still continues its practices and aggressions on the Palestinian lands, farmers, water, access and movement.

More than forty years of Israeli occupation, combined with internal, regional, and international political developments have affected the Palestinian socioeconomic conditions. The recent internal Palestinian conflict has created tensions and complicities inside the Palestinian socio-political contents and has affected it negatively, thus creating problems towards facing the continuous Israeli aggressions on the Palestinian people, land and resources and it weakened the international support to the Palestinian people and rights. Additionally this conflict has given the Israelis the pretext to impose more restrictions on the Gaza strip and it blockaded and completely closed the Gaza Strip boarders since June 2007 which collapsed the formal economy of Gaza. More than half of the households in Gaza are food insecure and almost 80% of the households are receiving relief support. Despite the fact that agricultural activities have somehow assisted in reducing the humanitarian problems in the Gaza Strip, but now we found the coastal people become imports fish from Israel and through tunnels under the Gaza-Egypt border due to the limited access imposed by Israeli military to the Gaza Sea shore which prevent the 3500 families from catching fish and leaving them threatened to become without food and income (FOA, 2011)

2.8 Nuba Village

2.8.1 Agriculture Sector

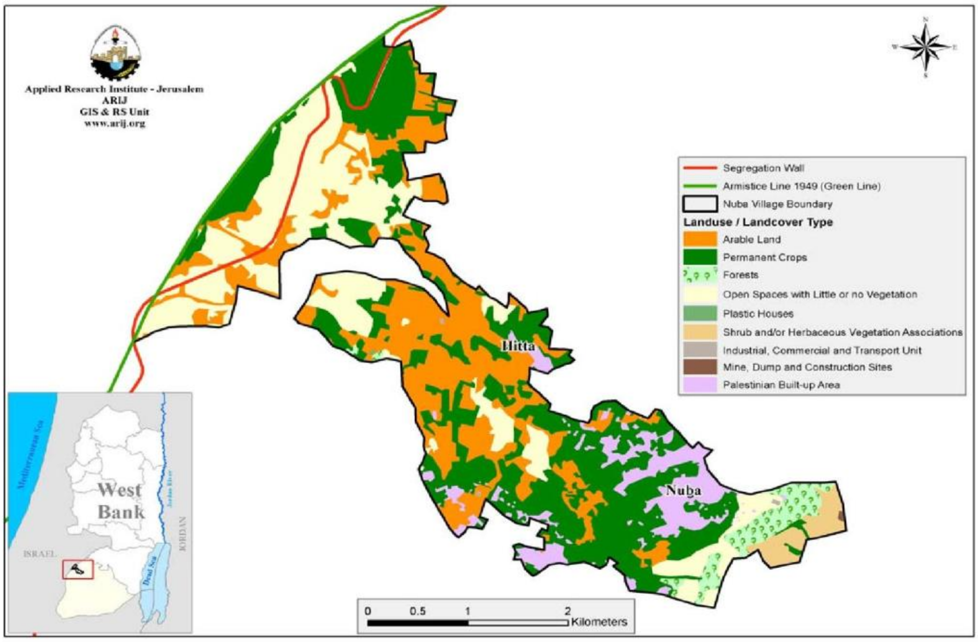
Nuba village lies on a total area of 15,460 dunums. 8,200 dunums are considered arable land; however, only 4,856 dunums are cultivated. (See table 9)

Table 2.7: Land Use in Nuba Village (dunum)

Total	Arable Land		Build up Area	Forests Arae	Open spaces and Rangelands
	Cultivated Area	Uncultivated Area			
15460	4856	3344	700	700	5860

Source: Palestinian Ministry of Agricultural (MoA), 2006

Map 2.11: Land use/ Land cover and Segregation Wall route in Nuba village



There are about 5 dunums of greenhouses, but no tunnels in Nuba village. 3 dunums are used for growing cucumber and 2 dunums are used for growing tomatoes.

Most agricultural activities in Nuba are dependant on rain, but farmers also use the water network and the storage cisterns for further irrigation. The main crops cultivated in the village include olives, grapes, field crops and vegetables.

Table 8 shows the different types of rain-fed and irrigated open cultivated vegetables in the village of Nuba. The rain-fed fruity vegetables are the most cultivated with an area of about 117 dunums. The most common vegetables cultivated within this area are gumbo and squash.

Table 2.8: Total area of rain fed and irrigated open cultivated vegetables in Nuba Village

Fruity vegetables		**Leafy vegetable**		**Green legumes**		**Bulbs**		**Other vegetables**		**Total area**	
RF	Irr	RF	Irr	RF	Irr	RF	Irr	RF	Irr	RF	Irr
117	12	5	12	15	3	0	6	0	20	137	53

Rf: Rain-fed, Irr: Irrigated

There are two types of aromatic medical plants in the village of Nuba, thyme and mint, which spread over a total area of four dunums.

In the village of Nuba, there is a total area of 3,820 dunums planted with olive trees. Other trees planted in the area are mostly grape vines trees, apricot trees and fig trees.

Table 2.9: Total area of horticulture and olive tree in Nuba Village (dunum)

Olives		**Citrus**		**Stone-fruits**		**Pome fruits**		**Nuts**		**Other fruit**	**Total area**	
RF	Irr	RF	Irr	RF	Irr	RF	Irr	RF	Irr	RF	Irr	Rf
3820	0	0	0	28	0	3	0	84	0	124	0	4059

Rf: Rain-fed, Irr: Irrigated

Table 10 shows the total field crops cultivated in the village of Nuba. Cereals, in particular wheat, white corn and barley, are the most cultivated crops with an area of about 960 dunums. In addition, the cultivation of dry legumes crops, mostly lentils, and forage crops is common in the village of Nuba.

Table 2.10: Total area of field crops in Nuba Village (dunum)

Cereals		Bulbs		Dry legumes		Oil crops		Seeds		Forage crops		Stimulating crops		Other crops		Total area	
RF	Irr	RF	Irr	RF	Irr	RF	Irr	RF	Irr	RF	Irr	RF	Irr	RF	Irr	RF	Irr
960	0	12	0	70	0	0	0	0	0	42	0	5	0	0	0	1089	0

Rf: Rain-fed, Irr: Irrigated

Data from the Village Council indicates that some families in Nuba depend on livestock rearing and dairy production.

Table 2.10: Livestock in Nuba Village

Cows*	Sheep	Goats	camels	Horses	Donkeys	Mules	Broilers	Layers	Bee Hives
80	1800	700	0	5	25	15	30000	2000	114

**Including cows, bull calves, heifer calves and bulls*

There are approximately 5 km of agricultural roads in Nuba. According to the Village Council, these roads are insufficient as the available roads are suitable only for tractors and other agricultural machines.

2.8.2 Infrastructure and Natural resources

- **Telecommunication Services:** Approximately 55% of Nuba's housing units are connected to the telecommunication network.
- **Water Services:** Nuba has been connected to the water network since 1975; almost 90% of the housing units are connected. The domestic water supply per capita is 81.0 (L/day), and currently, the Palestinian Water Authority (PWA) is the main provider for water resources. Cisterns are alternative resources to water networks. The village also owns a water reservoir with a 500 cubic meter capacity. The main problem that faces water services in the village is that the network is old and needs reconstruction.
- **Electricity Services:** Nuba has been connected to the electricity network since 1999 and approximately 90% of the housing units in the village are connected. The Village

Council of Nuba manages the distribution of electricity, which is supplied by the Israeli Electric Company.

- **Solid Waste Collection:** Solid waste management in Nuba is operated by the Joint Services Council of the north and west localities of the Hebron Governorate. Solid waste is collected from residential areas and sent to a dumping site owned by the Joint Services Council, which is located approximately 6km away from Nuba. Dumping is the main method used to dispose the collected solid waste.
- **Sewage Disposal Facilities:** Nuba Municipality had constructed a new sewage network in 2005. The new network covered less than 50% of the village housing units, and the rest rely on cesspits.
- In 2002, the Save the Children funded the construction of wastewater treatment plant under the supervision , design and implementation of the Palestinian Hydrology Group with (8") sewage pipe line from the station to Western Region in the town with 1.8 km long with Manholes without running.
- In 2005, the Oxfam funded the operating of the plant under supervision and implementation of the Palestinian Hydrology Group by connecting the branch lines with diameter (6 ") on the line of the exciting (8") line which connected to the station with a request for a contribution from the villager Nuba Council at that time, represented by house connections with diameter (4 ") pipe line and connection with the lines (6") in order to operate the plant in this stage about 56 home connected and and running of wastewater treatment plant. Nuba Council from that time operates the plant and technical maintenance and any needed works.
- In 2009 \ 2010 the Polish Endowment for the Humanities and the implementation of design and supervision of the Palestinian Hydrology Group funded project to improve the health situation and the extension of the sewerage network in the old town in the Nuba were at this stage to extend the line (10 ") and continued to station a key length of 1.5 km and reached sub-lines diameters 8 "and 6" it was connected to the boat 110 homes in this project and the village council at the time, doing household connections diameter of 4 "and are charged to the citizens as a religion that has been registered in the file for each citizen network was on this network.
- In 2009 \ 2010 the Polish humanitarian organization under supervision, implementation and design of the Palestinian Hydrology Group funded the project improving the health situation by installing of the sewerage network in the old town of Nuba .at this stage main line (10 ") installed and linked to the station with length

of 1.5 km and installed of sub-lines with 8 "and 6" diameters. At that time around 110 homes connected to the plant, also village council installed household connections with 4 " diameter .

- In 2010, American Near East Refugee Aid (ANERA) funded a project to expand the sewerage system in the town of Nuba under the supervision of the village council from the canter of the Town with (10) " diameter with length of 2 km lines and Sub-lines with 8" diameters and 6 " with lengths of 2.5 km and connection of 100 houses approximately .
- By 2011 , 2012 and 2013 the number of connected houses increased rapidly and the number of connected houses about 260 houses .

The overall goals were to improve the hygienic conditions, protect water quality, reduce pollution loads and demonstrate a village with sound collection and treatment of wastewater that could enhance surrounding villages to carry out such projects in their areas. Currently, sewers available in NUBA are with a total length of 6 km.

The design capacity of this treatment plant was 120 m^3/d that is equivalent to 200-300 houses service with future extension options being feasible cover the entire village. The fenced treatment plant site is 2000 m^2 area of which the treatment plant itself occupies an area of 1063m^2. Figure 1 shows the layout of the system and the existing units of operation.

The UASB is tank of 5 m depth and has square surface area (4m*4m). the sewage inters the tank bottom through 4 vertical 4' PVC pipes equipped with flow splitter. The water leaving the tank is draining through the V-notch channel at the water level meeting point. The actual flow are during the past 3 years varies from 25 to 50 m^3/d. The reactor is equipped with Gas-Liquid-Solid (GLS) separator with a deflector. A gas collection system, which allows collection and treatment of all the gas produced from the reactor, is available.

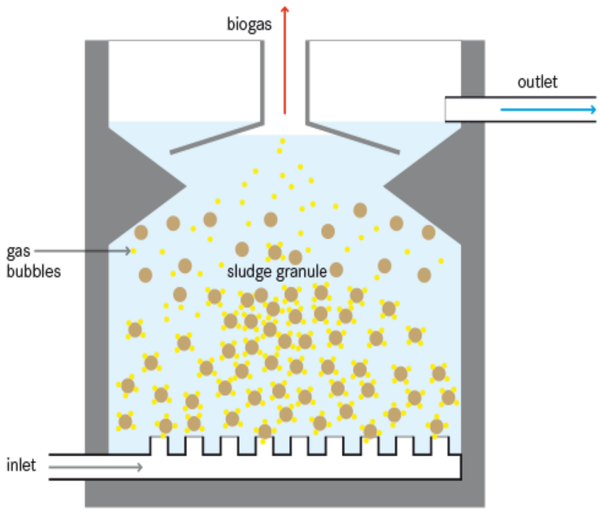


Fig: 2.12 Cross-section of an Upflow Anaerobic Sludge Blanket (UASB) reactor. Source: TILLEY et al. (2008)

The wetlands, which are selected, are subsurface flow wetlands and are planted with reed plants. This stage contains lagoons lined in base and sides with high density polyethylene (HDPE) that prevents any expected underground leakage. the wetlands include different size of gravel; the smallest are placed on the surface while the largest at the bottom, with reed planted at the surface. These plants make aeration in the upper half-meter of the water column through developing some 60 cm root zone. This enables the treatment to be aerobic. The basic biochemical reaction is the nitrification –de nitrification is expected to take place in the wetlands . The subsurface flow pattern suppresses the possibility of insects breeding at the water-air interface. The hydraulic retention time for the current flow conditions is about 14d while it will be 7 d under maximum design flow conditions. The surface area for the wetland is approximately 1000 m^2 while the water column depth is a bout 1 m.

2.9 Previous studies that were done regarding waste water reuse:

A study done by L.S. McNeilla_, M.N. Almasrib, N. Mizyed,2009,in the topic "A sustainable approach for reusing treated wastewater inagricultural irrigation in the West Bank – Palestine".

This study presents a casestudy in the West Bank town of Tubas, study includes a traditional engineering design and addresses socio-cultural issues through a detailed survey of public perceptions about reclaimed wastewater and an education plan for the various stakeholders in the town.

According to this study about 31 million cubic meters (MCM) of wastewater is collectedper year, and 75% is discharged directly into the environment without any treatment. 55% of the wastewater resulting of households is not connected to a sewer system and is discharged to cesspits, and percolates into the ground.

The study assumed that the proper use of treatedwastewater would make a significant increase in the available water, and would be much better for the environment than the direct discharge of raw sewage.Also, the study shows that there are still many unknowns about this practice. Many important questions need to be addressed to ensure sustainable implementation of reuse projects.

Possible locations of treatment plants, treatment methods, and locations of reuse areas and possible crops that could be irrigated were also investigated. That all came without neglecting information about the area, the site visits, the reuse potential (quality and quantity), and the socio-economic conditions of the residents.

Study shows that the reuse of treated wastewater cangreatly improve environmental conditions and enhance agricultural activities. Study also recommend Successful implementation of the reuse project requires proper engineering designas well as consideration of social and cultural factors.

Appraisal of Socio-Economic and Cultural Factors Affecting Wastewater Reuse in the West Bank, Samer "Mohammad Adnan" Fareed Al- Kharouf,2003

The study found that reusing treated wastewater offers opportunities in reducing the demand on the already scarce potable water resources, especially within the semi-arid environment of the West Bank. The benefit of such additional supplies of water is further augmented by a reduction in the disposal of rawwastewater to the nearby wadis existing in the West Bank.

Importantly, social acceptance issues may pose a barrier to the effectiveuse of this resource, where the concept might not be comprehensively presented. The research highlights the potentiality to reuse wastewater, identifies the areas of concern, and examines the most important factors that affectthe wastewater in the Palestinian Territories, particularly in the WestBank.

The research was conducted by applying questionnaires to different levels of the Palestinian community. The target groups were classified into four categories of different characteristics. The questionnaires included questions, which discussed several factors that may affect, and hence the acceptance of wastewater reuse.

The questionnaires were collected and analyzed descriptively. Several factors were found to be interacted and affect the community opinion. Study found that religion and traditions have negative effect of the acceptanceto the wastewater reuse. In this context, the psychological factor has anegative effect on the opinion of the community.

Study shows that the public awareness is weak, and the information provided is not sufficient.Most of the respondents accepted the reuse as it would provide them with additional water quantities. Accepting reusing treated effluent decreased by the increase of the opportunity to be utilized in human contact purposes or in unrestricted agriculture. People seem do not understand the religious opinion of the reuse; most ofthe respondents of the four types considered the treated effluent unclean

The Role of Public Awareness Towards Sustainable Use of Treated Wastewater in Agricultural Irrigation, Wesam Arafat,2012

The study aimed to identify the role of the public awareness toward wastewater treatment and reuse from the perception of students, households, and farmers in the targeted areas. It showed the need of adequate water reusing management practices that later result with efficient use and distribution.

Study considered treated wastewater of acceptable quality adds an additional water source that protect groundwater conservation. The lack of public awareness is one of major issues limits the success of wide spread of treated wastewater use in agriculture. The main objective of this study to investigate the impact of public awareness towards sustainable use of treated wastewater in agricultural sector.

The research methodology came in two folds: first, the conduction of technical workshops for three targeted group students, women and farmers in Anza, Beit Dajan and West Bani Zaid in west bank. second, distribution of questionnaires. SPSS data obtained from previous Palestinian studies were compared with those after workshops conduction. The study found that about 91% of students showed knowledge about wastewater definition, while 88% know about wastewater definition before conducting workshops. The majority of farmers agrees and supports the idea of constructing a WWTP in their villages.

The research concludes that training and public awareness programs must be conducted to raise awareness about the wastewater treated uses in order to ensure the sustainability of WWTP.

Socio-Economic Aspects of wastewater Reuse in Gaza Strip, AbedmajidR.Nassar ,H.Al-Jamal Y.Al-Dadah ,2009

The study investigates the socio-economic aspects of water reuse which rarely discussed in Gaza Strip. Questionnaire to farmers in three areas in Gaza strip have been conducted and analysis and two sites irrigated with treated effluent was monitored.Study indicates an economical improvement for farmers switching from groundwater to effluent irrigation.

Study assumed that water reuse will provide an alternative to groundwater for irrigation and is considered a priority in Gaza Strip; which also would increase the availability of freshwater resources for domestic and industrial use.

In this research, two approaches were followed. A field investigation looked for potential lands for reuse and models to identify the quality of irrigated water .Two sites,one in Gaza Governorate and the other in North,were irrigated with treated wastewater from 2002 to 2006. Regulations and reuse criteria of similar circumstances were cited.

Second, a questionnaire addressed a number of social aspects and was conducted in the North,Middle and south of Gaza Strip in 2006.A pre-test was carried out with a sample of 6 farmers. Later, SPSS software was used to analysis.

Study showed that the reuse of wastewater effluent for irrigation will definitely save potable water human usage in addition to introducing solutions for some environment problems. public acceptance of wastewater reuse is key factor in reuse success. On the other hand, the health and religious aspects are major concern of people. study recommended that great effort should be made to introduce safe wastewater as a water resource and to increase public awareness.

Study shows that through out conducting the questionnaire that farmers all around Gaza strip are increasingly agree to reuse wastewater resources, directly or restrictedly. Some expressed their hesitation and conservative attitude towards the idea. In general, farmers will be willing to use treated water if provided with enough information and mechanisms of reusing treated wastewater.

The obvious conclusion and all the socioeconomic indicators of relevant studies and the result of pilot projects carried out in –GS emphasized that a high degree of effluent reuse must be achieved in Gaza. That is to reduce the current levels of groundwater with drawal by the agriculture sector and to mitigate the negative environment consequences. It recommended that all future collection and treatment strategies should integrate reuse possibilities wherever practical. Also reuse of wastewater effluent offers a new complementary recourse, sustains the existing and expands the irrigated areas. It also will provide a renewable and valuable source for agriculture and free limited water supplies for domestic and industrial purposes, which indicates an economical improvement for farmers switching from ground water to effluent irrigation.

Treated Wastewater Reuse in Palestine, Y. Mogheir 1, T. Abu Hujair1, Z. Zomlot 1, A. Ahmed2 and D.Fatta3

The paper explained the Palestinian practices and plans in wastewater treatment and reuse. Treated wastewater resource is an environmentally, socially and economically beneficial if managed in appropriate way. Palestinian Territories, as in most of the neighboring countries in the Middle East region, appreciates the importance of this resource in improving the water deficit by reusing the treated wastewater in the agricultural production and the industrial sector. this resource is strictly sensitive and has adverse impacts on the public health. Both negative and positive impacts of the treated wastewater resource were considered in this study. An analysis of the current status of water and wastewater, in West Bank and Gaza Strip, showed clearly that the lack of wastewater treatment of sewerage systems and of wastewater collection lead to the uncontrolled discharge of wastewater into the environment. The expected amount of wastewater to be used for irrigation will progressively increasein the coming 20 years; saving more than half of groundwater needed for irrigation.

Impacts of Treated Wastewater Reuse Y. Mogheir[1], T. Abu Hujair[1], Z. Zomlot[1], A. Ahmed[2] and D. Fatta

The paper concluded that the interest in the reuse of treated effluent has accelerated significantly in the Palestinian Territories for many reasons, and the treated wastewater is now being considered as a new source of water that can be used for different purposes such as agricultural and aquaculture production, industrial uses, recreational purposes and artificial recharge. Using wastewater for agriculture production will help in alleviating food shortages and reduce the gap between supply and demand.

On the reuse environmental impact, the paper found that the discharge of poorly treated effluent into the near shore and estuaries is adversely affecting the marine environment. On the other hand, irrigation of arid lands will increase the organic content of these lands, will reduce the erosion and will increase the water retention. Besides, the treated water will attract and support the migratory and resident bird population.

Study assumed that there are major real potential health, environmental and economic impacts resulted from the poor sanitation, improper disposal of treated and untreated wastewater, and the use of raw or partially treated wastewater to irrigate edible crops.

Also study shows that Irrigation with raw wastewater in the West Bank and to a limited degree in Gaza Strip presents a major health hazard to consumers of vegetables, farm workers and farm workers families. The risk is represented through the fear of direct skin contact, eye contact, ingestion of the treated or untreated water, and the consumption of farm and marine animals fed on and exposed to the effluent.

An economically profiting, a healthy community is more productive as measured; directly by reduced health costs and minimal time lost on the job, and indirectly like healthy children miss less school. More and more economically productive through producing exportable vegetables and fruits, which meet international standards. Also, by not polluting the near shore environment, the tourist industry would increase in work.

The Role Of Socio-Economic Indicators For The Assessment Of Wastewater Reuse In The Mediterranean Region G. Özerol* And D. Günther

This study gives an overview about the employment of socio-economic indicators for the assessment of wastewater reuse practices in the Mediterranean region .The study showed that wastewater reuse could be an important brick to sustainable development in the Mediterranean region since it can contribute to decrease the impacts of water scarcity and to increase social and economic development.

Study assume reusing wastewater can contribute not only to decrease the impacts of water scarcity, but also to increase social and economic development in the Mediterranean countries.

The paper concluded that several potential benefits are expected from wastewater reuse in agricultural irrigation. it should be noted that the achievement of these benefits requires proper planning and management of wastewater reuse schemes, otherwise treated wastewater reuse might cause serious health problems for the exposed people as well as ecological problems due to contamination of both soil and water, hence also high economic costs. On the one hand, it was a priority issue to investigate the possible ecological impacts of wastewater reuse and to develop and use necessary indicators for monitoring the sustainability ofwastewater reuse schemes.

The review of the studies, which were made for analyzing the wastewater reuse practice in Mediterranean countries, demonstrated several problem areas including mainly the lack ofcooperative institutional settings, lack of tools for economic and financial analysis, and lack of awareness on technical, environmental and health related impacts of wastewater reuse. The study recommended that further research is necessary to developand use a set of systemic indicators for the assessment of the sustainability of wastewater reuse in the Mediterranean region. Within this context, a systemic approach to assess planned and installed wastewater reuse schemes is needed. Moreover, such a systemic perspective should be developedin a participatory process with a specific focus on the local or regional circumstances.

Socio-Economics Consequences of Reusing Wastewater in Agriculture in Faisalabad

Haq Nawaz Anwar , Farhana Nosheen , Shafqat Hus sain and Waseem Nawaz

This paper showed that the reuse of wastewater is affecting the natural environment aswell as economic, social, and cultural conditions of community. Therefore, the present research was envisaged to explore the socio-economic impacts of reuse of wastewater. The cities are expanding rapidly and the gap between the housing supply and demand is widening day by day. Consequently, the squatter settlements deprived of basic sanitation facilitiesare coming up in major urban centers.

The pumping station of wastewater situated at Narwala Road was selected as main source of wastewater for this study. In addition to four meetings with key informants were arranged in this village. A 10%sample of farmers who were usingwastewater since last forty years was selected by simple random sampling technique. The data from the selected respondents was ascertained through asurvey by using a well conceived “InterviewSchedule” in a face-to-face situation. (SPSS) wasused for data analysis.

Study found the reuse of wastewater for irrigation can change the value of land in two ways ;by Rent and price of agriculture lands may change (increase) due to accessible of land to wastewater, Productivity of agricultural land may change (increase) because of continuous use of nutritious-rich wastewater for irrigation, increasing in Farmers' Household's Monthly Income.

Socio-Economical and Environmental Impact for the Agricultural Use of Wastewater in the Wadi Nar Catchment/ Dead Sea Region, Marwan Ghanem, BirZeit University

This study handled the socio-economic analysis of the wastewater reuse and their impacton the inhabitants that are living in the suffered areas, and their impact on the environment and how the resultswould affect the related policies.

A Socio economical overview about Collection, treatment and reuse costs, Willingness to Pay, Affordability &Cost Recovery, Costs of Fresh Water and the Potential Benefits of the people in the study area were defined. The polluted sources in the southern part of the Jordan Rift Valley, especially in the Wadi Nar area were determined. There were major real potential health, environmental and economic impacts as a result of poor sanitation, improperdisposal of treated and untreated wastewater, and use of raw or partially treated wastewater to irrigate ediblecrops.

The methodology used in the study was to conduct several field visits in the area of Wadi El Nar in the western slopes of the Dead Sea in order toput the criteria needed for the factors that area affecting the socio economy of the adjacent living people in thearea. Two socio economic questionnaires were designed and distributed.

Results showed that the majority of the respondents are willing to use restricted water for irrigation but were reluctant on using unrestricted water for the same purpose. It is worthy to note that more than half of the respondents are willing to pay for treated wastewater, while the majority believe that the fee should be less than that of fresh water for both restricted and unrestricted water. The average amount thought to be a suitable fee for treated water used inirrigation is 1 NIS/m3 while the highest price the respondents were willing to pay for water used in irrigationaveraged to an amount of 1.5 NIS/m3.

the paper concluded that almost half of the respondents thought that the main objective of treating wastewater is to avoid health risks. Logically, the majority of the respondents replied that they are interested in knowing the source of water used for irrigation. Respondents believe that the main factor that influences the consumption of products irrigated with treated wastewater is the fear from health risks. More than half of the respondents do not reuse domestic water used for cleaning inirrigating their gardens. The reasons behind the respondents' hesitation for consuming products irrigated bytreated wastewater mainly being that the farmers will not use the right quality of water. More than half of the respondents refuse to pay for fruits and vegetables irrigated with treated wastewater. The paper found also that a good portion of the sample believes in theimportance of involving consumers in decision-making, while the majority believe in the great importance ofenvironmental and water awareness, and it is worthy to note that none of the respondents agreed that radio programs would be efficient.

Cost-Benefit Analysis Model for Treated Wastewater Use in Agricultural Irrigation: four Palestinian Case Studies, Eyad Y. Yaqob,Rashed Al-Sa`ed, George Sorial, MakramSuidan DEC.2015.

This study explored the economic benefits of treated wastewater reuse in agriculture considering the basis of comparisons of net benefits for TWW reuse in irrigation from WWTPs in the West Bank compared with those in "Israel"**.**

Different methodologies were applied to estimatethe cost and benefit of treated wastewater reuse in irrigation in Wadi Zomer area . The CBA covered three scenarios; Reuse of treated wastewater generated from the Nablus treatment plant only and leave the remainder discharging across thegreen line. The second one was the reuse of all TWW generated from the Nablus and Tulkarm treatment plants with zero discharge across the green line. The third scenario was the reuse of treated wastewater from WWTP inside the greenline and pumped back to the Zomer catchment area. EPANET program was used to design the pumps, conveyance linesand storage tanks.

The study presented several answers to decision-makers questions concerning the reuse of TWW in irrigation considering different scenariosfor the location of the WWTP and different types of crops. Cost benefit analysis for the different scenarios showed that treating wastewater and reuse inside the West Bank is more cost effective and has ahigher positive financial impact and return of more than 150% comparingwith treating Palestinian wastewater inside Israel and pumpingit back for reuse in the West Bank.

The generated wastewater in Palestine is expected to be 200 million cubic meters in 2035 and that the re-use of treated wastewater will provide benefits ranging from 200 to 1000 million USD per year, depending on the crops type and the components of the reuse system.

Reuse of reclaimed wastewater to irrigate corn's designated foe animal feeding, Ahmad Amer,2011

The research explored the possibility of reusing reclaimed municipal wastewater of Al-Bireh wastewater treatment plant for corn irrigation rather than discharging it into wadis. Moreover, soil quality will be studied before and after the experiment in order to study the effect of using reclaimed wastewater in irrigation.

This research was conducted in the research field of Birzeit University in order to study the effect of using secondary TWW from Al-Bireh wastewater treatment plant; in comparison with tap water on corn intended to be used for animalfeeding as well as the impact on the physical and chemical propertiesof soil, especially on its content of heavy elements. Corn seeds wereplanted in plastic pots filled with agricultural soil brought from the area of Qalqilia in the West Bank.

Results showed TWW has major benefits since it can be an alternative irrigation source to fresh water resources, and increase corn fodder production and reduce fertilizerusage.TWW effluent is safe to use for corn irrigation without causing significant heavy metals pollution to soil and fruits.The yield of those treatments was higher than treatments using TpW.Lastly, it found that TWW and fertilization stimulated the synthesis of chlorophyll land proline in corn leaves. Regarding health problems, the drip irrigation systemsgenerated minimum contact between the effluent and the aerial parts of the plants; the fruits (grains) were free from E.colipathogenic bacteria.

Astudy Done By S. Bakopoulou, I. Katsavou, S. Polyzos, A. Kungolos "Social Acceptability Of Recycled Water Use For Irrigation Purposes In Thessaly Region, Greece

The purpose of this study is to investigate social acceptability of recycled water use in Thessaly region, Greece. The method was contingent valuation which aims at evaluating non-market environmental resources through personal interviewing. researcher organized two separate surveys, one for farmers and one for consumers to determine both farmers' willingness to use recycled water for irrigation purposes and consumers' willingness to use agricultural products irrigated with recycled water. The data collected from our study were then statistically analyzed by use of SPSS statistic package. The main results show that farmers of Thessaly are willing to use recycled water especially when there is water shortage in the region. On the other hand, citizens of Thessaly seem to be willing to accept recycled water in their food consuming habits, if they have sufficient information regarding wastewater reuse practices in Greece.

Study done by Rima Saleh 2009"A benefit –cost analysis of treated wastewater reuse for irrigation in Tubas"

Wastewater treatment and reuse for irrigation purposes in Tubas, West Bank-Palestine, study focused on investigate social acceptability of treated wastewater by using cost-benefit analysis. Study found (92%) supporting idea of building wastewater treatment plants in Tubas , 77% of the residents of the study area agree to the use of treated wastewater to irrigate their trees , while 75% agreed to irrigate of fodder crops with this water, also 88% of them agree on the financial contribution when constructing the plants through public opinion, economy, land use, soil for the study area . study determinate of crops which irrigated with treated wastewater which fodder crops , barley and olive trees. One of the most important recommendations of the study is that it is important to establish wastewater treatment plants in Tubas to address the problem of scarcity of freshwater and the environmental problems resulting from improper disposal of wastewater.

Study done by Ilham Muneer 2006 "Reuse of wastewater in crop cultivation in Sudan"

The study revealed that most of the Arab region in general is dry and semi-arid, so most of the Arab countries suffer from water budget deficit due to increasing water needs resulting from increasing population, growing economic and social development requirements, due limited opportunities for development of traditional water resources, by the study the solution is to collect, process and reuse wastewater. this will bring about a new addition of available water resources to reduce the water deficit through the safe disposal of polluted water, water, soil, air and natural resources.

The study concluded that the use of water treated by natural methods in agricultural irrigation contributes to water and food security and that the soil that is irrigated with fresh water without the addition of fertilizers and organic matter will become not good for agriculture and becomes barren , study found that the quality of growth and freshness in plants irrigated with treated water is due to the richness of water treated with fertilized materials.

Study done by Sara Essam Nofal Nofal, 2013 "Socioeconomic dimensions of Reuse of Treated Wastewater in Agricultural Production, Focusing on Rural Areas"

The study aimed to study the economic and social dimensions of the reuse of treated wastewater in agricultural production as a non-conventional source in rural Palestinian areas, and to understand the dimensions from the point of view of the citizens who benefit from the use of this water.

This study was based on the distribution of a questionnaire that raises questions to discuss the reuse of wastewater treated in agricultural production. A random sample of 33 treatment plant was selected, in addition to conducting interviews.

The study used of the quantitative analysis method, the descriptive method . The results of the study showed that the main reason for 60.6% accept establishment of a treatment plant is the reuse of treated wastewater in agriculture. The results also showed that the direct benefits of having treatment plants by the study population were saving in the water bill followed by savings in the cost of perfusion of the cesspit and finally raising the level of health. Study found there is no impediment to the purchase and consumption of crops irrigated with treated water also showed that the treated water plants projects are economically feasible for the beneficiary families.

The study recommended monitoring the quality and quantity of wastewater in the West Bank and its effects on the surrounding environment. In this regard, the necessary laws and standards must be established and implemented by linking them to a judicial and executive force with effective authority also raise awareness and educate on the importance of establishing wastewater treatment plants among the public. As well as raising the degree of follow-up and coordination between the institutions implementing projects for the reuse of wastewater treated with the families and the Palestinian countryside benefiting from these projects

Study of Zuhair Deek, Maher Abu Madi and Rashed Al-Sa'd entitled "" Rural residents of Ramallah and Al-Bireh Governorate accept the use of treated wastewater "2010

The aim of this study was to identify social acceptance of rural areas of Ramallah and Al-Bireh to use of treated wastewater for different purposes, and to determine the factors affecting acceptance.

100 questionnaires were distributed in ten rural communities, including three Christian communities, with 10 questionnaires per group. The questionnaire was randomly distributed to 52 females and 48 males.

The results showed the acceptance of the rural population for some uses of treated wastewater: agriculture, forestry, car washing, construction and public baths, also study showed that women in rural areas of Ramallah and Al-Bireh governorate are more receptive than males to the use of treated wastewater, and difference in the acceptance of different age groups in Ramallah and Al-Bireh governorate for the use of treated wastewater. It was found that people with more education accept the use of treated wastewater more and that there is no difference between acceptance of Muslims in the rural areas of Ramallah and Al-Bireh to use treated wastewater, and accept Christians.

The study showed that the psychological factor occupies the first place in the refusal of the rural population to use treated wastewater, followed by the health worker, the religious factor.

The study recommended to share awareness of the importance of using treated wastewater in different areas and the feasibility of wastewater treatment projects.

A study by Jane Helal and Nadine Sahouri, "Extent of Community Acceptance for Reuse of Wastewater in Agriculture" ARIJ 2012

The aim of this study was to identify the social acceptability of reuse of treated water in irrigating crops from economic, social, cultural and environmental aspects.

Through the preparation of a questionnaire to obtain views and impressions of citizens. The survey included 265 random samples.

The study showed that some citizens in certain areas refuse to reuse the treated water in irrigating crops, while other farmers in similar conditions in the same area accepted the same purposes. The main reason for discouraging the citizens to reuse it was psychologically and not culturally. 80 %Of the citizens who were targeted do not encourage reuse in limited irrigation while the large percentage of citizens who do not accept the use of agricultural products irrigated with treated water which Reaching 43%.

The study showed that there is a possibility of using treated water for medium industrial purposes. It also shows that 25% of farmers do not want to pay any money for treated water, while 75% want to pay low amounts for treated water.

The study recommended using appropriate technologies for wastewater treatment, taking into consideration social acceptance before the establishment of plants , as well as promoting and raising public awareness among the different segments of the community, as well as the involvement of members of the local community in the decision-making process in the implementation of the projects of treatment plants.

Chapter Three

Methodology

3.1 Introduction

This chapter addresses the methodology details used in this research. The adopted methodology includes the population and sample with the selection criteria in addition to the research's main tool, i.e., questionnaire, and finally the statistical methods that were applied to data analysis. These details are as follows:

3.2 Research Method

This study will embrace the descriptive approach to research. This method of research is utilized in the aspect of collecting current information regarding the study. This information may be in the form of current events or any other contemporary data. According to Creswell (1994), the purpose of gathering information about the present existing condition is to describe the nature of the situation as it exists on the time of the study and to explore the cause/s of particular phenomena.

Through the descriptive approach, the researcher will be able to make sound judgment on the issues presented on the study. Also, this will allow the researcher to have an accurate and interpretation and analysis of the data. Furthermore , the descriptive approach makes use of the multi-method strategy. This strategy employs various research strategies as instrument in gathering data like the survey and the critical analysis of the literature.

Particularly, structured interview was used in this study. This approach is appropriate whenever the objects of any class vary among themselves and one is interested in knowing the extent to which different conditions obtain among these objects. In descriptive approach, it is important the psychological and sociological aspects of research by way of application or implementation of evidence to recognize between facts and influence.

In descriptive design, the purpose is to find a new information in the study. The information may have different forms such as increased quantity of knowledge, a new generalization, an increased insight into factors which are operating, the discovery of new relationship, a more accurate formulation of the problem to be solved and many others.

3.3 Research Design

The exploratory and descriptive research design was adopted due to the nature of the study. Exploratory research provides insights into and comprehension of an issue or situation. Exploratory research is a type of research conducted because a problem has not been clearly defined. Exploratory research helps to determine the best research design, data collection method and selection of subjects. While descriptive research, also known as statistical research, describes data and characteristics about the population or phenomenon being studied. Descriptive research answers the questions who, what, where, when and how (John W. Creswell (2003).

3.4 Research population

Population is defined by John W. Creswell (2003) as the aggregate or totality of those conforming to a set of specifications. Farmers, who living near the Nuba Treatment planet Or candidates to benefit will forming study population.

The population of the study was composed of farmers in the targeted area (Nuba village). According to the 2016 Palestinian Central Bureau of Statistics (PCBS) Census, the total

population of Nuba in 2016 was 5,726, approximately 65-70% of population working in agriculture and those population of study. The farmers were invited through the muncipality in the village through phone call for some farmers .

3.5 Sampling

Sampling refers to the process of selecting a portion of the population that conforms to a designated set of specifications to be studied. A sample is a subset of a population selected to participate in the study (Freedman et al., 2007). A purposive sampling method was used, which is most common in phenomenological inquiry. According to Prabhat P. & Meenu P. (2015), purposive sampling requires selecting participants who are knowledgeable about the issue in question, because of their sheer involvement in and experience of the situation. While Creswell (2003) states that purposive sampling refers to selection of sites or participants that will best help the researcher understand the problem and the research question, they must be willing to reflect on and share this knowledge. Farmers were found to be the best source of rich and valuable information regarding their experiences during working in their lands , as they are experts regarding their own agricultural practice's. The participants were selected based on their particular knowledge of the phenomenon, for the purpose of sharing their knowledge and experiences with the researcher .

3.6 Sampling criteria

The sampling criteria are the characteristics essential to the membership of the target population. These criteria are the characteristics that delimit the population of interest Prabhat P. & Meenu P. (2015). For this study the inclusion criteria were:

- The participant has to be registered for Palestinian Farmers' Union.
- living near the Nuba Treatment planet Or candidates to benefit .
- 30 farmers From Nuba Village, nearby Nuba treatment planet, it has been chosen purposely .

Table 1 shows the demographic characteristics of the sample:

Table 3.1: Demographic characteristics of the sample

Variable	Variable level	Number	Percentage%
Number of family members	less than 5 members	10	33.3
	5-10 members	11	36.7
	10 members and more	9	30.0
	Total	**30**	**100.0**
Age	18-30 years	5	16.7
	30-45 year	14	46.6
	46 year and more	11	36.7
	Total	**30**	**100.0**
Gender	male	28	93.3
	female	2	6.7
	Total	**30**	**100.0**
Educational level	Less level of middle school	15	50.0
	Level of secondary education and above	15	50.0
	Total	**30**	**100.0**
	agriculture	11	36.7
	building	9	30.0
	trade	10	33.3
	Total	**30**	**100.0**
Average monthly family income	1000-2000 Sh.	12	40.0
	more than 2000 Sh.	18	60.0
	Total	**30**	**100.0**
Experience in agriculture	more than 10 year	17	56.7
	5-10 year	7	23.3
	less than 5 year	6	20.0
	Total	**30**	**100.0**
Number of family members who work in	One person	20	66.7
	2 and more persons	10	33.3
	Total	**30**	**100.0**

Variable	Variable level	Number	Percentage%
agriculture			
The percentage of agriculture in the monthly income of the family	Less than 50%	22	73.3
	50% and more	8	26.7
	Total	**30**	**100.0**
Is water available for irrigation in appropriate amounts	**yes**	**0**	**0**
	no	30	100.0
	Total	**30**	**100.0**

3.7 The instrument

For effective and flawless data collection, survey, interview and case study methods were extensively used. Survey method is the most extensively used technique for data collection, especially in behavioral sciences, while interviews are an appropriate method to use when exploring practitioners perspectives due to the qualitative nature of the information. Case study methods are used for an in-depth investigation of a single individual, group, or an event. It provides a systematic way of looking at events, collecting data, analyzing information, and reporting the results. Thus, these methods have been widely used to extract the most relevant information and help in better analysis of the data.

3.8 Research Strategies

The methods of data collection include the structured interview and questionaire. The source of primary data comes from the research instrument of survey. On the other hand, the secondary source of data is derived from the interview desk research strategy.

3.9 Interview

The second stage of the data collection involved in-depth semi structured interviews. Interviews will be carried out with minimum of Five participants as focus groups who are purposely selected . It is believed that the five focus groups respondents are enough to acquire pertinent data for the study. After all, it is the quality of the answers of the respondents that is more important to the study. Among the topics or subjects that will be asked include the respondents’ perspective on Socio-economic impacts, the solutions that they can offer in order to address it and many more.

The interview is the tool in providing qualitative insights about the results of the survey conducted. Semi-structured interviews were carried out. Unlike structured interviews which are standardized and do not allow the interviewer to deviate from the questions (***Saunders, Lewis, and Thornhill, 2003***), this type of interview does not limit response of the interviewees.

3.10 Research Tool (Questionnaire) :

The researcher seeks through this study to analyze Socio-economic impacts of reusing treated wastewater in agriculture purposes in governorate of Hebron (Nuba village). For this end, a survey questionnaire was designed to collect the research’s primary data. The questionnaire included semi close-ended questions to facilitate the data collection process. The design of questionnaire affected the response rate and the reliability and validity of the data collected. Response rates, validity and reliability are maximized by careful design of individual questions, clear layout of the questionnaire form. The two-part questionnaire has been prepared as the main tool of this study. It consists of the following:

1. Part one includes the primary information about the demographic traits of sample
2. Part two includes three items, item one includes (7) paragraphs, and item two includes (10) paragraphs, and item three includes (11) paragraphs.

3.11 Ethical Considerations

The ethical consideration of the research involves the anonymity of the participants of the study. In the interview respondents will not be asked to indicate their names.

The data collected from the respondents is indispensable in the study. Therefore, the condition of confidentiality by the respondents will be highly respected and honored by the researcher. On the part of the interview respondents, a waiver is given declaring that their privacy and the confidentiality of the information will be observed.

3.12 The study variables:

3.12.1 Independent variables:

(number of family members, Age, Gender, Educational level, the nature of the work being done, Average monthly family income, Experience in agriculture, Number of family members who work in agriculture, the percentage of agriculture in the monthly income of the family, is water available for irrigation in appropriate amounts).

3.12.2 Dependent Variable:

Socio-economic impacts of reusing treated wastewater in agriculture purposes in governorate of Hebron (Nuba village).

3.13 Questionnaire Validity:

Validity refers to the degree to which an instrument measures what it is supposed to be measured. Validity has a number of different aspects and assessment approaches. Statistical validity is used to evaluate instrument validity, which include external and internal.

3.13.1 External Validity:

To ensure a high level of validity, the questionnaire has been handed to a number of concerned experts, from Palestinian Universities, for evaluation. These referees kindly presented their views on the questionnaire in terms of its content, clarity of items' meaning and suitability. They also proposed what they deem necessary to modify the formulation of items in order to avoid any misunderstanding and to assure that the questionnaire meets aims of the study. The final copy of the questionnaire was modified according to the experts' recommendations.

3.13.2 Internal Validity:

Internal validity of the questionnaire is the first statistical test used to test the validity of the questionnaire by measuring the correlation coefficients between each item and the whole field. The correlation coefficient between each with total degree.

Table (3.2): Results of Pearson correlation coefficient (Pearson correlation) matrix link each paragraph with the total degree of each field.

No.	paragraphs	R	The statistical significance
A.	**Measuring the role of using water treatment on the economic and social side**		
1.	Use of treated water saves water bills.	.876**	0.000
2.	Use of treated water leads to savings in the cost of fertilizer use.	.774**	0.000
3.	The use of treated water leads to savings in agricultural production costs.	.726**	0.000
4.	The use of treated water reduces expenditure on water supply.	.411*	0.000
5.	The use of treated water reduces the expenditure on livestock feed.	.563**	0.000
6.	The use of treated water leads to the reclamation of more land.	.428*	0.000
7.	The use of wastewater reduces expenditure on food commodities.	.612**	0.000
8.	The use of wastewater provides for the supply of commodities.	.596**	0.000
9.	Wastewater use provides opportunities to improve monthly income.	.636**	0.000
10.	Wastewater use provides job opportunities for the unemployed.	.815**	0.000
B.	**Measure the acceptability of the use and payment**		
11.	The most appropriate use of treated wastewater is the construction field.	.506**	0.000
12.	The most appropriate use of treated wastewater is the field of	.486**	0.000

No.	paragraphs	R	The statistical significance
	industry.		
13.	The most appropriate use of treated wastewater is the area of home use.	.391**	0.000
14.	The most appropriate use of treated wastewater is the car wash area.	.573**	0.000
15.	The most appropriate use of treated wastewater is the fire area.	.548**	0.000
16.	The most appropriate use of treated wastewater is the irrigation of public parks.	.372**	0.000
17.	The most appropriate use of treated wastewater is agricultural use.	.432**	0.000
18.	You are willing to contribute to the expenses of sewage treatment.	.364**	0.000
19.	The components of treated wastewater increase crop productivity.	.442**	0.000
20.	Wastewater treatment components are harmful to crop production.	.395**	0.000
21.	Your opinion on the authority's tendency to reuse treated water in the agricultural sector.	.487**	0.000

**** Statistically significant at the level of significance (α = 0.01), * statistically significant at the level of significance (α = 0.05)**

As table (3.2) shows, the correlation coefficients are significant at the level of 0.05, where the probability value of each paragraph is less than 0.05. Therefore, it can be said that paragraphs of the questionnaire are consistent and valid to measure what they were set for.

Table (3.3): Results of Pearson correlation coefficient (Pearson correlation) matrix link each field with the total degree of the tool.

No.	paragraphs	R	The statistical significance
1.	Measuring the role of using water treatment on the economic and social side	.683**	.000
2.	Measure the acceptability of the use and payment	.394*	.031

**** Statistically significant at the level of significance (α = 0.01), * statistically significant at the level of significance (α = 0.05)**

As table (3.3) shows, the correlation coefficients are significant at the level of 0.05, where the probability value of each paragraph is less than 0.05. Therefore, it can be said that paragraphs of the questionnaire are consistent and valid to measure what they were set for.

3.14 Questionnaire Reliability:

3.14.1 Cronbach's Alpha Method:

Cronbach's Coefficient Alpha is used to measure the reliability of the questionnaire.The researcher calculates reliability in a manner calculated internal consistency reliability Cronbach's alpha formula, so as shown in the table (4).

Table (3.4): Cronbach's Coefficient Alpha for the entire questionnaire

Field	No. of cases	No. of Paragraphs	Alpha Value
Measuring the role of using water treatment on the economic and social side	**30**	**10**	**0.830**
Measure the acceptability of the use and payment	**30**	**11**	**0.705**
Total degree	**30**	**21**	**0.769**

The data contained in the table above indicate that the he Cronbach's Alpha for the entire questionnaire is (0.77), which indicates a very good reliability of the entire questionnaire. Thus, the researcher is assured of the questionnaire reliability and validity for responding, results analyzing and hypotheses testing.

3.15 Statistical treatment:

The researcher used the five-point Likert scale to measure responses on questionnaire items. In terms of the agreement strength, the results ranging from strongly disagree (1) to strongly agree (5) appeared as shown in table (5) herein below. Numbers assigned to importance (1, 2, 3, 4,5) do not indicate that the interval between scales are equal, nor do they indicate absolute quantities. They are merely numerical labels.

Table (3.5) Likert Scale

Scale	strongly disagree	disagree	neutral	agree	strongly agree
Relative weight	1	2	3	4	5

The aim of the questionnaire is to measure theSocio-economic impacts of reusing treated wastewater in agriculture purposes in governorate of Hebron (Nuba village).

3.16 Statistical Methods:

Quantitative data analysis methods have been used. The data collected through questionnaire was processed and analyzed by means of the Statistical Package for the Social Sciences (SPSS), and the following statistical tools were used:

1. Descriptive statistics: such as, percentage, arithmetic average, standard deviation, which is used in order to identify the categories of variable frequency according to researcher's view presented in the description of the study variables.
2. Pearson Correlation Coefficient: to make verification of consistency amongst questionnaire paragraphs and to find out the relationship between the variables.
3. Cronbach's Coefficient Alpha: to test the reliability of questionnaire paragraphs.
4. Mann-Whitney Test It is a non-parametric test that is used to compare two sample means that come from the same population, and used to test whether two sample

means are equal or not. Usually, the Mann-Whitney U test is used when the data is ordinal or when the assumptions of the t-test are not met.

5. Kruskal Wallis Test is used for comparing two or more independent samples of equal or different sample sizes.

3.17 Scale Correction:

We were used Likert scale which is a method to measure the behaviors used in the questionnaires, particularly in the field of statistics. The scale depends on the responses indicate the degree to approve or veto the evaluative analysis of The Economic and social effects of the re-use of treated wastewater in agriculture, based on averages:

Table 3.6: Key correction

Mean	Degree
1.00-2.33	Low
2.34-3.67	moderate
3.68-5.00	high

Chapter Four:

Analyzing the results of the study

4.1 Introduction:

This chapter includes a statistical analysis of the data resulting from the study, in order to answer their questions and hypothesis.

Do you have knowledge of the Palestinian standards on water treatment and reuse?

Table 4.1: Knowledge of the Palestinian standards on water treatment and reuse

The answer	frequency	Percent %
yes	6	20.0
no	24	80.0
Total	30	100.0

According to table 4.2. It shows that farmers have not got the knowledge (80%) haven't a knowledge of the Palestinian standards on water treatment and reuse, therefore only (20%) of them have knowledge of the Palestinian standards on water treatment and reuse. This is explained in the following figure.

The researcher suggest enchasing awareness of reuse treated wastewater, so they will have more benefits of using water for farms, thus reducing pollution and protecting the environment.

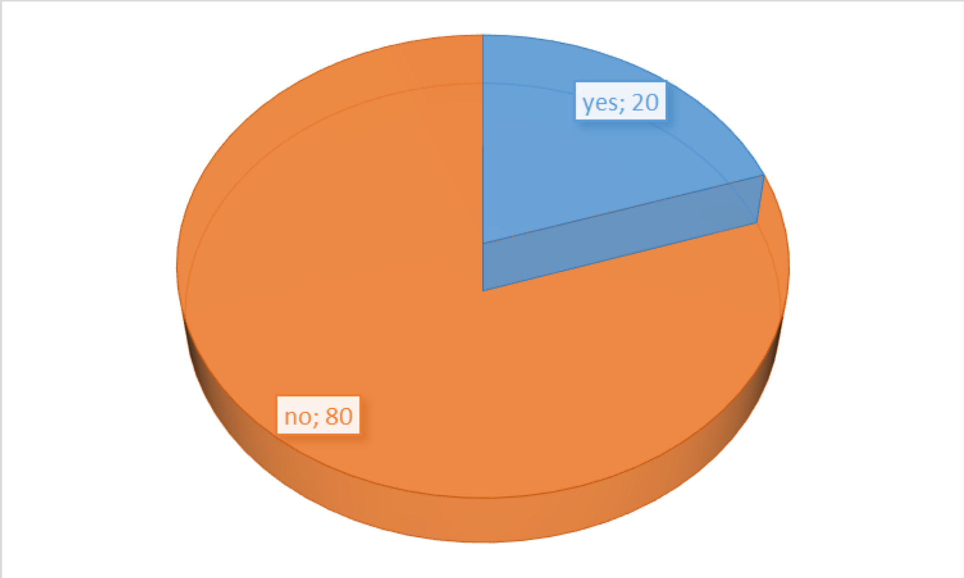


Fig. (4.1): knowledge of the Palestinian standards on water treatment and reuse

Is it possible the production of agricultural crops when irrigated with wastewater treatment and the product would be safe for human use?

Table 4.2: the production of agricultural crops when irrigated with wastewater treatment

The answer	frequency	Percent %
Yes to all crops	7	23.3
Yes, many of the crops	19	63.4
no	4	13.3
Total	30	100.0

Table 4.3 shows that (23.3%) believes that the production of agricultural crops when irrigated with wastewater treatment and the product would be safe for human use to all crops, (63.4%) believes its safe for human use for many of the crops, finally (13.3%) believes that its not safe for human use. As shown in the following figure.

The researcher believes that wastewater is safe to all crops "this according to the literature reviewed by the researcher in many countries using wastewater in irrigating ".However ,government intervention needed in increasing awareness in having more sessions about wastewater benefits.

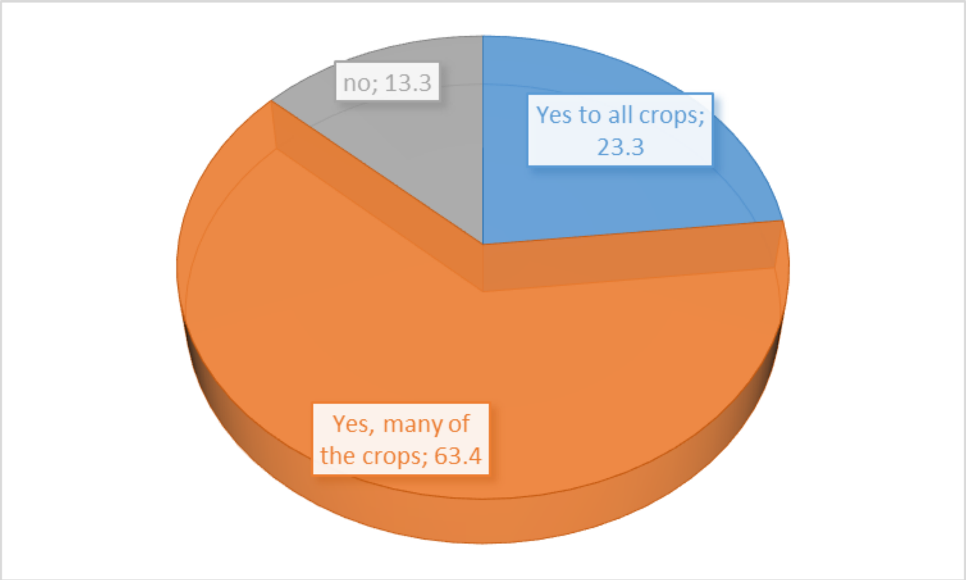


Fig. (4.2): the production of agricultural crops when irrigated with wastewater treatment

Are you willing to use treated wastewater if available in adequate quantities?

Table 4.3: willing to use treated wastewater if available in adequate quantities

The answer	frequency	Percent %
yes	17	56.6
no	5	16.7
yes, provided	8	26.7
Total	30	100.0

The previous table found that (56.6%) are willing to use treated wastewater, (16.7%) are not willing to use treated wastewater, (26.7%) are willing to use treated wastewater under conditions. As shown in the following figure.

The researcher thinks that some conditions if met with wastewater treatment will make more farmers accepting the idea of willing to use wastewater for their crops. this will increase production and enhance crops quality.

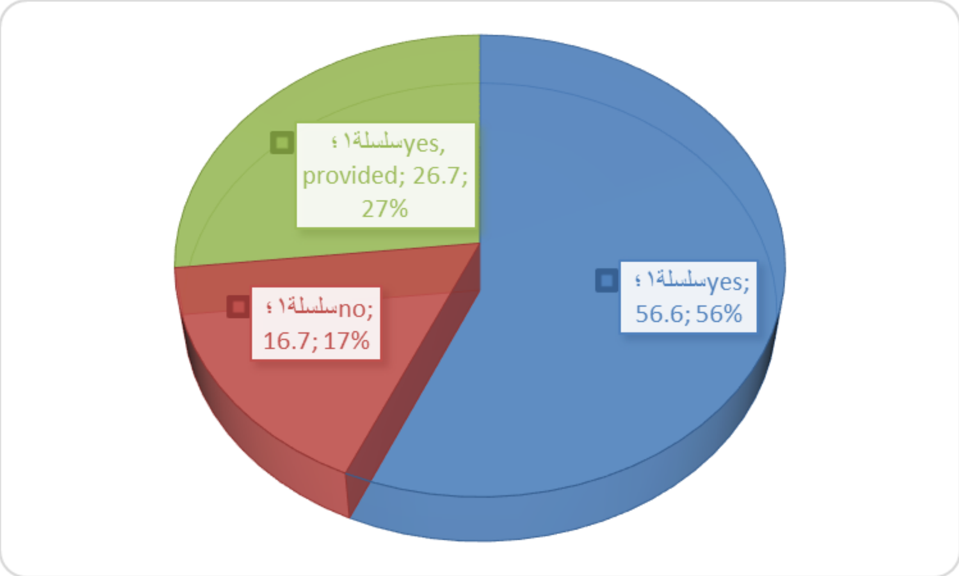


Fig. (4.3): willing to use treated wastewater if available in adequate quantities

Types of crops that will accept irrigated with treated wastewater:

Table 4.4: Types of crops that will accept irrigated with treated wastewater

Types of crops	The answer	frequency	Percent %
Feed	not agree	17	56.7
	agree	13	43.3
	Total	**30**	**100.0**
Fruit trees	not agree	23	76.7
	agree	7	23.3
	Total	**30**	**100.0**
Additional irrigation olive	not agree	20	66.7
	agree	10	33.3
	Total	**30**	**100.0**
Vegetables if the water quality is good	not agree	17	56.7
	agree	13	43.3
	Total	**30**	**100.0**

The previous table shows that (56.7%) will not accept irrigated feed with treated wastewater, (43.3%) will accept irrigated feed with treated wastewater, (76.7%) will not accept irrigated fruit trees with treated wastewater, (23.3%) will accept irrigated fruit trees with treated wastewater, (66.7%) will not accept irrigated Additional irrigation olive with treated wastewater, (33.3%) will accept irrigated Additional irrigation olive with treated wastewater, (56.7%) will not accept irrigated vegetables if the water quality is good with treated wastewater, (43.3%) will accept irrigated vegetables if the water quality is good with treated wastewater. As shown in the following figures.

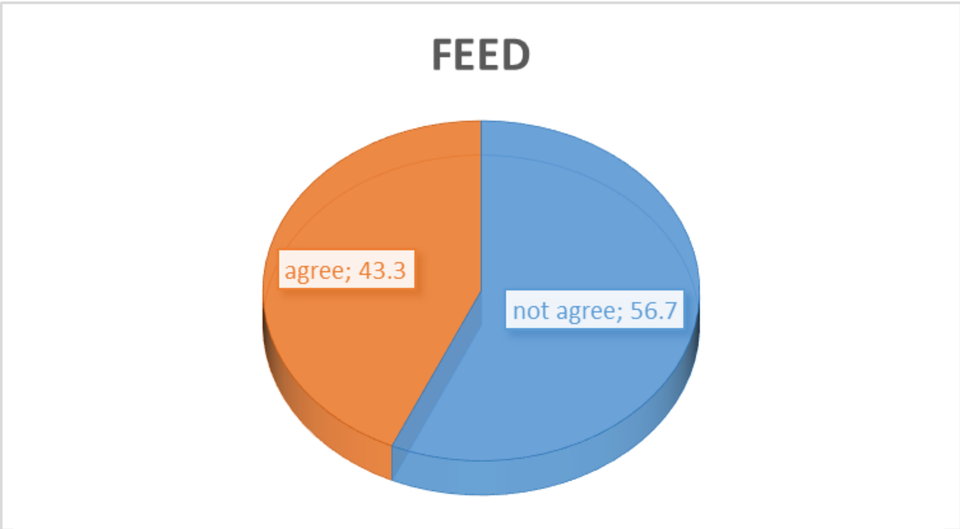


Fig. (4.4): Feed that will accept irrigated with treated wastewater

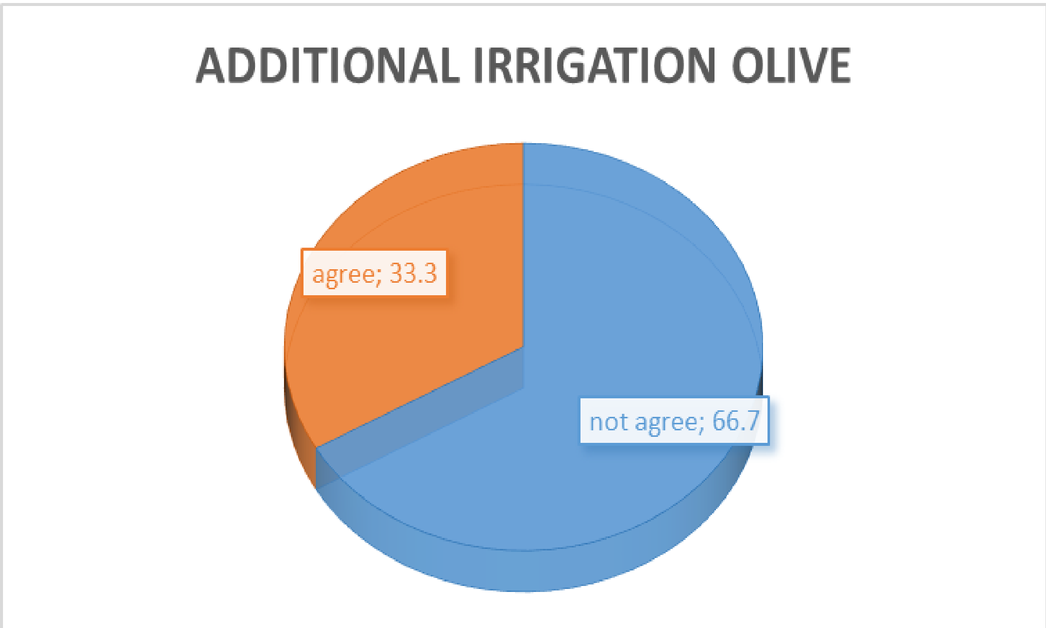


Fig. (4.5): Additional irrigation olive that will accept irrigated with treated wastewater

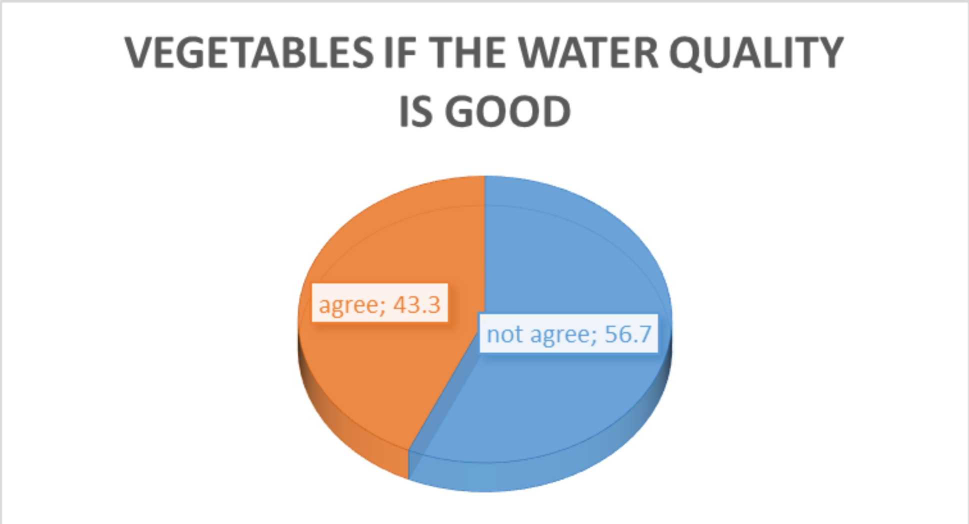


Fig. (4.6): Vegetables if the water quality is good that will accept irrigated with treated wastewater

Fears of re-use of treated wastewater:

Table 4.5: Fears of re-use of treated wastewater

The answer	**frequency**	**Percent %**
Personal Safety	5	16.7
Health risks associated with crops	9	30.0
Lack of marketing	14	46.6
Religious fears or conscience	2	6.7
Total	30	100.0

From the previous table we found that (16.7%) have Fears of re-use of treated wastewater refers to the personal safety, (30.0%) have Fears of re-use of treated wastewater refers to the health risks associated with crops, (46.6%) have Fears of re-use of treated wastewater refers to the lack of marketing. Finally, (6.7%) have Fears of re-use of treated wastewater refers to the religious fears. As shown in the following figure.

Fig. (4.8): Fears of re-use of treated wastewater

If fresh water is not available because of the drought Will you use treated wastewater:

As we see that most farmers fear using wastewater due to marketing issues. This can be solved if farmers feel very safe to use wastewater and have knowledge about marketing requirements and conditions, furthermore, end-users must have the awareness as well of using wastewater as safe to fruit trees and other products.

Table 4.6: using treated wastewater if fresh water is not available because of the drought

The answer	frequency	Percent %
yes	8	26.7
no	6	20.0
yes, provided	16	53.3
Total	30	100.0

From the previous table we found that (26.7%) agree to use treated wastewater if fresh water is not available because of the drought, (20.0%) not agree to use treated wastewater if fresh water is not available because of the drought, (53.3%) agree with conditions to use treated wastewater if fresh water is not available because of the drought. As shown in the following figure.

The researcher believes that wastewater can be used and its Strong solution if drought happen.

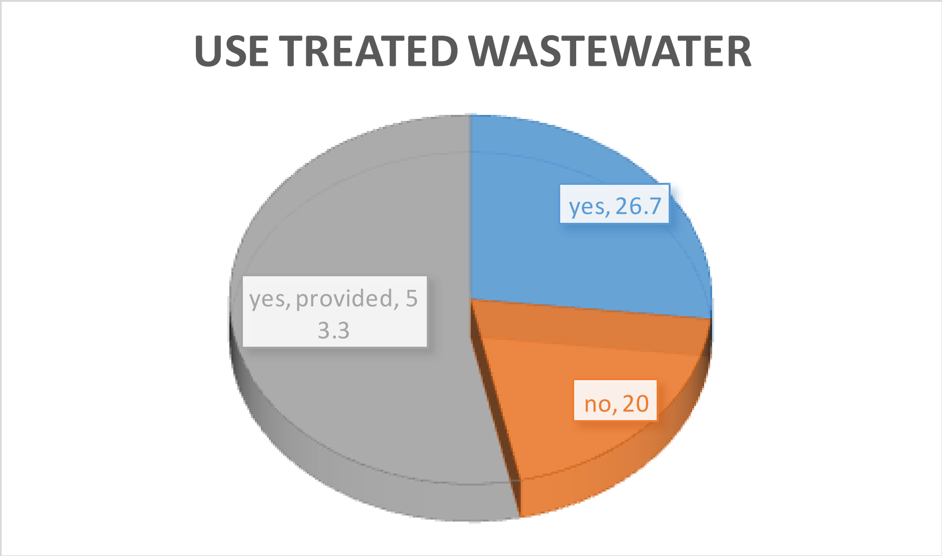


Fig. 4.9: Using treated wastewater if fresh water is not available because of the drought

Your willingness to pay the price of treated wastewater:

Table 4.7: paying the price of treated wastewater

The answer	**frequency**	**Percent %**
nothing	14	46.7
I am willing to pay for a farm pumping costs	16	53.3
Total	30	100.0

From the previous table we found that (46.7%) are not willing to pay the price of treated wastewater, (53.3%) are willing to pay the price of treated wastewater. As shown in the following figure.

The researcher believes if price is less than the fresh water, also encouraging farmers by having less taxes.

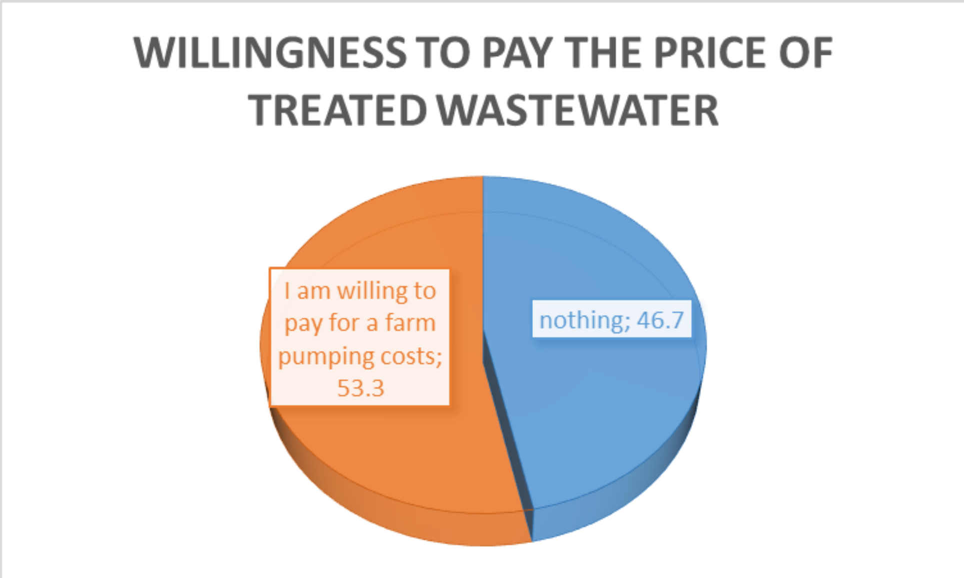


Figure 4.10: paying the price of treated wastewater

What is the solutions to overcome the phenomenon of water scarcity?

Table 4.8: The solutions to overcome the phenomenon of water scarcity

Favorite Solutions	The answer	frequency	Percent %
Rainwater harvesting through ponds and wells	very much better	18	60.1
	significantly better	1	3.3
	moderately better	3	10.0
	low degree better	1	3.3
	lowest better	7	23.3
	Total	30	100.0
The use of treated wastewater	very much better	14	46.7
	significantly better	9	30.0
	moderately better	3	10.0
	low degree better	1	3.3
	lowest better	3	10.0
	Total	30	100.0

Favorite Solutions	The answer	frequency	Percent %
The use of water-saving farming techniques	very much better	8	26.7
	significantly better	7	23.3
	moderately better	10	33.3
	low degree better	4	13.3
	lowest better	1	3.3
	Total	30	100.0
Dependence on rain-fed agriculture is irrigated	very much better	16	53.3
	significantly better	3	10.0
	moderately better	2	6.7
	low degree better	3	10.0
	lowest better	6	20.0
	Total	30	100.0
Reliance on livestock breeding instead of vegetable farming	very much better	12	40.0
	significantly better	2	6.7
	moderately better	3	10.0
	low degree better	4	13.3
	lowest better	9	30.0
	Total	30	100.0

From the previous table we found that (60.1%) thinks that very much better for rainwater harvesting through ponds and wells, (3.3%) thinks that significantly better for rainwater harvesting through ponds and wells, (10.0%) thinks that moderately better for rain water harvesting through ponds and wells, (3.3%) thinks that low degree better for rain water harvesting through ponds and wells, finally, (23.3%) thinks that lowest better for rainwater harvesting through ponds and wells.

About using the treated wastewater, we found that (46.7%) thinks that very much better for using the treated wastewater, (30.0%) thinks that significantly better for using the treated wastewater, (10.0%) thinks that moderately better for using the treated wastewater, (3.3%)

thinks that low degree better for using the treated wastewater, finally, (10.0%) thinks that lowest better for using the treated wastewater.

About the use of water-saving farming techniques, we found that (26.7%) thinks that very much better for zthe use of water-saving farming techniques, (23.3%) thinks that significantly better for the use of water-saving farming techniques, (33.3%) thinks that moderately better for the use of water-saving farming techniques, (13.3%) thinks that low degree better for the use of water-saving farming techniques, finally, (3.3%) thinks that lowest better for the use of water-saving farming techniques.

About dependence on rain-fed agriculture is irrigated, we found that (53.3%) thinks that very much better forthe dependence on rain-fed agriculture is irrigated, (10.0%) thinks that significantly better for the dependence on rain-fed agriculture is irrigated, (6.7%) thinks that moderately better for the dependence on rain-fed agriculture is irrigated, (10.0%) thinks that low degree better for the dependence on rain-fed agriculture is irrigated, finally, (20.0%) thinks that lowest better for the dependence on rain-fed agriculture is irrigated.

About reliance on livestock breeding instead of vegetable farming, we found that (40.0%) thinks that very much better forthe reliance on livestock breeding instead of vegetable farming, (6.7%) thinks that significantly better for the reliance on livestock breeding instead of vegetable farming, (10.0%) thinks that moderately better for the reliance on livestock breeding instead of vegetable farming, (13.3%) thinks that low degree better for the reliance on livestock breeding instead of vegetable farming, finally, (30.0%) thinks that

lowest better for the reliance on livestock breeding instead of vegetable farming**.**

What is the role of using water treatment on the economic and social side?

To answer the previous question was extracted means and standard deviations, the role of using water treatment on the economic and social side, so as shown in Table 4.9.

Table (4.9): Means, standard deviations, percentages of the role of using water treatment on the economic and social side, in order of importance.

Paragraphs		Mean	Std. deviation	Percentage %	Degree of using wastewater
q6	The use of treated water leads to the reclamation of more land.	4.10	0.66	82.0	high
q4	The use of treated water reduces expenditure on water supply.	3.90	0.61	78.0	high
q3	The use of treated water leads to savings in agricultural production costs.	3.87	0.94	77.3	high
q5	The use of treated water reduces the expenditure on livestock feed.	3.80	0.76	76.0	high
q10	Wastewater use provides job opportunities for the unemployed.	3.67	1.03	73.3	moderate
q9	Wastewater use provides opportunities to improve monthly income.	3.43	0.97	68.7	moderate
q7	The use of wastewater reduces expenditure on food commodities.	3.43	1.04	68.7	moderate
q1	Use of treated water saves water bills.	3.30	1.24	66.0	moderate
q2	Use of treated water leads to savings in the cost of fertilizer use.	3.17	1.23	63.3	moderate
q8	The use of wastewater provides for the supply of commodities.	3.07	0.78	61.3	moderate
	Total Degree	**3.57**	**0.93**	**71.5**	**moderate**

It is clear from the above table that the role of using water treatment on the economic and social sidewere moderate, where the averages ranged between (3.07-4.10).The highest response paragraph according to the relative mean is as follows:

In paragraph (6),the relative mean equals (4.10)with percentage (82.0%) which states (The use of treated water leads to the reclamation of more land.).

And the lowest response according to the relative mean is as follows:

In paragraph (8) the relative mean equals (3.07)with percentage (61.3%) which states (The use of wastewater provides for the supply of commodities.).

Second question: what is the acceptability of the use and payment?

To answer the previous question was extracted means and standard deviations, the acceptability of the use and payment, so as shown in Table 4.10.

Table (4.10): Means, standard deviations, percentages ofthe acceptability of the use and payment, in order of importance.

Paragraphs		Mean	Std. deviation	Percentage %	Degree of acceptability
q16	The most appropriate use of treated wastewater is the irrigation of public parks.	4.30	0.75	86.0	high
q15	The most appropriate use of treated wastewater is the fire area.	4.13	0.97	82.7	high
q17	The most appropriate use of treated wastewater is agricultural use.	4.03	0.96	80.7	high
q11	The most appropriate use of treated wastewater is the construction field.	3.90	0.84	78.0	high
q19	The components of treated wastewater increase crop productivity.	3.80	1.19	76.0	high
q12	The most appropriate use of treated wastewater is the field of industry.	3.63	0.76	72.7	moderate
q21	Your opinion on the authority's tendency to reuse treated water in the agricultural sector.	3.53	1.17	70.7	moderate
q18	You are willing to contribute to the expenses of sewage treatment.	3.30	0.79	66.0	moderate
q14	The most appropriate use of treated wastewater is the car wash area.	2.67	0.71	53.3	moderate
q13	The most appropriate use of treated wastewater is the area of home use.	2.63	1.35	52.7	moderate
q20	Wastewater treatment components are harmful to crop production.	2.17	0.99	43.3	moderate
	Total Degree	**3.46**	**0.95**	**69.3**	moderate

It is clear from the above table that the acceptability of the use and payment were moderate, where the averages ranged between (2.17-4.30). The highest response paragraph according to the relative mean is as follows:

In paragraph (16), the relative mean equals (4.30) with percentage (86.0%) which states (The most appropriate use of treated wastewater is the irrigation of public parks.).

And the lowest response according to the relative mean is as follows:

In paragraph (20) the relative mean equals (2.17) with percentage (43.3%) which states (Wastewater treatment components are harmful to crop production.).

2.4Testing of hypotheses:

The first hypothesis: There are no statistically significant differences at the level of (α0.05≤) in Socio-economic impacts of reusing treated wastewater in agriculture purposes in governorate of Hebron (Nuba village)due to the number of family members.

The researcher used Kruskal Wallis Test to measure the statistical differences between the groupsin Socio-economic impacts of reusing treated wastewater in agriculture purposes in governorate of Hebron (Nuba village)due to the number of family members. Table () shows this:

Table (4.11): Kruskal-Wallis H Test to measure the statistical differences between the groups in Socio-economic impacts of reusing treated wastewater in agriculture purposes in governorate of Hebron (Nuba village) due to the number of family members

Kruskal-Wallis H Test						
Field	**Number of family members**	**N**	**Mean Rank**	**df**	**chi-square ()**	**AsympSig.**
Measuring the role of using water treatment on the economic and social side	less than 5 members	10	14.55	2	0.212	0.900
	5-10 members	11	16.27			
	10 members and more	9	15.61			
	Total	30	------			
Measure the acceptability of the use and payment	less than 5 members	10	12.85	2	1.449	0.484
	5-10 members	11	17.05			
	10 members and more	9	16.56			
	Total	30	------			
Tot	less than 5 members	10	14.55	2	0.270	0.874
	5-10 members	11	16.50			
	10 members and more	9	15.33			
	Total	30	------			

The previous table shows that there are no statistically significant differences at $\alpha \leq 0.05$ in statisticaldifferences between the groups in the Socio-economic impacts of reusing treated wastewater in agriculture purposes in governorate of Hebron (Nuba village) due to the number of family members, where the statistical significance > 0.05 which is not statistically significant, and thus accept the null hypothesis.

The 2nd hypothesis: There are no statistically significant differences at the level of ($0.05\alpha \leq$) in the Socio-economic impacts of reusing treated wastewater in agriculture purposes in governorate of Hebron (Nuba village) due to the age.

The researcher used Kruskal Wallis Test to measure the statisticaldifferences between the groups in the Socio-economic impacts of reusing treated wastewater in agriculture purposes in governorate of Hebron (Nuba village) due to the age. Table () shows this:

Table (4.12): Kruskal-Wallis H Test to measure the statistical differences between the groups in the Socio-economic impacts of reusing treated wastewater in agriculture purposes in governorate of Hebron (Nuba village) due to the age

Kruskal-Wallis H Test						
Field	**age**	**N**	**Mean Rank**	**df**	**chi-square ()**	**Asymp Sig.**
Measuring the role of using water treatment on the economic and social side	18-30 years	5	14.80	2	4.87	0.088
	30-45 year	14	12.29			
	46 year and more	11	19.91			
	Total	**30**	-----			
Measure the acceptability of the use and payment	18-30 years	5	17.90	2	0.70	0.704
	30-45 year	14	15.75			
	46 year and more	11	14.09			
	Total	**30**	-----			
Tot	18-30 years	5	14.40	2	0.59	0.745
	30-45 year	14	14.64			
	46 year and more	11	17.09			
	Total	**30**	-----			

The previous table shows that there are no statistically significant differences at $\alpha \leq 0.05$ in statistical differences between the groups in the Socio-economic impacts of reusing treated wastewater in agriculture purposes in governorate of Hebron (Nuba village)due to the age, where the statistical significance > 0.05 which is not statistically significant, and thus accept the null hypothesis.

The 3rd hypothesis: There are no statistically significant differences at the level of (0.05α ≤) in the Socio-economic impacts of reusing treated wastewater in agriculture purposes in governorate of Hebron (Nuba village) due to the level of education.

The researcher used Mann-Whitney Test to measure the statistical differences between the groups in the Socio-economic impacts of reusing treated wastewater in agriculture purposes in governorate of Hebron (Nuba village)due to the level of education. Table () shows this:

Table (4.13): Mann-Whitney Test to measure the statistical differences between the groups in the Socio-economic impacts of reusing treated wastewater in agriculture purposes in governorate of Hebron (Nuba village) due to the level of education

Field	Educational level	N	Mean Rank	Sum of Ranks	U	Z	Asymp. Sig.
Measuring the role of using water treatment on the economic and social side	Less level of middle school	15	16.53	248.00	97.00	-0.657	0.511
	Level of secondary education and above	15	14.47	217.00			
Measure the acceptability of the use and payment	Less level of middle school	15	15.80	237.00	108.00	-0.192	0.848
	Level of secondary education and above	15	15.20	228.00			
Total degree	Less level of middle school	15	16.40	246.00	99.00	-0.569	0.569
	Level of secondary education and above	15	14.60	219.00			

The previous table shows that there are no statistically significant differences at $\alpha \leq 0.05$ in statistical differences between the groups in the Socio-economic impacts of reusing treated wastewater in agriculture purposes in governorate of Hebron (Nuba village)due to the level of education, where the statistical significance > 0.05 which is not statistically significant, and thus accept the null hypothesis.

The 4th hypothesis: There are no statistically significant differences at the level of (0.05α ≤) in the Socio-economic impacts of reusing treated wastewater in agriculture purposes in governorate of Hebron (Nuba village) due to the nature of the work being done.

The researcher used Kruskal Wallis Test to measure the statistical differences between the groups in the Socio-economic impacts of reusing treated wastewater in agriculture purposes in governorate of Hebron (Nuba village)due to the nature of the work being done. Table () shows this:

Table (4.14): Kruskal-Wallis H Test to measure the statistical differences between the groups in the Socio-economic impacts of reusing treated wastewater in agriculture purposes in governorate of Hebron (Nuba village) due to the nature of the work being done

Kruskal-Wallis H Test						
Field	**the nature of the work being done**	**N**	**Mean Rank**	**df**	**chi-square (**	**Asymp Sig.**
Measuring the role of using water treatment on the economic and social side	agriculture	11	15.64	2	0.006	0.997
	building	9	15.50			
	trade	10	15.35			
	Total	**30**	-----			
Measure the acceptability of the use and payment	agriculture	11	13.45	2	1.012	0.603
	building	9	17.00			
	trade	10	16.40			
	Total	**30**	-----			
Total degree	agriculture	11	16.14	2	0.135	0.935
	building	9	15.56			
	trade	10	14.75			
	Total	**30**	-----			

The previous table shows that there are no statistically significant differences at α≤0.05 in statisticaldifferences between the groups in the economic and social effects of the re-use of treated wastewater in agriculture due to the nature of the work being done, where the statistical significance > 0.05 which is not statistically significant, and thus accept the null hypothesis.

The 5th hypothesis: There are no statistically significant differences at the level of (0.05α ≤) in the Socio-economic impacts of reusing treated wastewater in agriculture purposes in governorate of Hebron (Nuba village) due to the average monthly family income.

The researcher used Mann-Whitney Test to measure the statistical differences between the groups in the Socio-economic impacts of reusing treated wastewater in agriculture purposes in governorate of Hebron (Nuba village)due to the average monthly family income. Table (4.15) shows this:

Table (4.15): Mann-Whitney Test to measure the statistical differences between the groups in the Socio-economic impacts of reusing treated wastewater in agriculture purposes in governorate of Hebron (Nuba village) due to the average monthly family income

Field	average monthly family income	N	Mean Rank	Sum of Ranks	U	Z	Asymp. Sig.
Measuring the role of using water treatment on the economic and social side	1000-2000 Sh.	12	18.58	223.00	71.00	-1.601	0.109
	more than 2000 Sh.	18	13.44	242.00			
Measure the acceptability of the use and payment	1000-2000 Sh.	12	15.67	188.00	106.00	-0.087	0.931
	more than 2000 Sh.	18	15.39	277.00			
Total degree	1000-2000 Sh.	12	17.75	213.00	81.00	-1.161	0.245
	more than 2000 Sh.	18	14.00	252.00			

The previous table shows that there are no statistically significant differences at α≤0.05 in statistical differences between the groups in the Socio-economic impacts of reusing treated wastewater in agriculture purposes in governorate of Hebron (Nuba village)due to the average monthly family income, where the statistical significance > 0.05 which is not statistically significant, and thus accept the null hypothesis.

The 6th hypothesis: There are no statistically significant differences at the level of (0.05α ≤) in the Socio-economic impacts of reusing treated wastewater in agriculture purposes in governorate of Hebron (Nuba village) due to the experience in agriculture.

The researcher used Kruskal Wallis Test to measure the statistical differences between the groups in the Socio-economic impacts of reusing treated wastewater in agriculture purposes in governorate of Hebron (Nuba village)due to the experience in agriculture. Table (16) shows this:

Table (4.16): Kruskal-Wallis H Test to measure the statistical differences between the groups in the Socio-economic impacts of reusing treated wastewater in agriculture purposes in governorate of Hebron (Nuba village) due to the experience in agriculture

Kruskal-Wallis H Test						
Field	**the experience in agriculture**	**N**	**Mean Rank**	**df**	**chi-square ()**	**Asymp Sig.**
Measuring the role of using water treatment on the economic and social side	more than 10 year	17	16.71	2	1.149	0.563
	5-10 year	7	15.29			
	less than 5 year	6	12.33			
	Total	**30**	-----			
Measure the acceptability of the use and payment	more than 10 year	17	13.94	2	2.412	0.299
	5-10 year	7	15.21			
	less than 5 year	6	20.25			
	Total	**30**	-----			
Total degree	more than 10 year	17	16.26	2	1.003	0.606
	5-10 year	7	16.36			
	less than 5 year	6	12.33			
	Total	**30**	-----			

The previous table shows that there are no statistically significant differences at α≤0.05 in statistical differences between the groups in the economic and social effects of the re-use of treated wastewater in agriculture due to the experience in agriculture, where the statistical significance > 0.05 which is not statistically significant, and thus accept the null hypothesis.

The 7th hypothesis: There are no statistically significant differences at the level of (α ≤ 0.05) in the Socio-economic impacts of reusing treated wastewater in agriculture purposes in governorate of Hebron (Nuba village) due to the number of family members who work in agriculture.

The researcher used Mann-Whitney Test to measure the statistical differences between the groups in the Socio-economic impacts of reusing treated wastewater in agriculture purposes in governorate of Hebron (Nuba village) due to the number of family members who work in agriculture. Table (4.17) shows this:

Table (4.17): Mann-Whitney Test to measure the statistical differences between the groups in the Socio-economic impacts of reusing treated wastewater in agriculture purposes in governorate of Hebron (Nuba village) due to the number of family members who work in agriculture

Field	number of family members who work in agriculture	N	Mean Rank	Sum of Ranks	U	Z	Asymp. Sig.
Measuring the role of using water treatment on the economic and social side	one person	20	17.08	341.50	68.50	-1.417	0.157
	two or more persons	10	12.35	123.50			
Measure the acceptability of the use and payment	one person	20	16.83	336.50	73.50	-1.197	0.248
	two or more persons	10	12.85	128.50			
Total degree	one person	20	16.78	335.50	74.50	-1.140	0.267
	two or more persons	10	12.95	129.50			

The previous table shows that there are no statistically significant differences at α≤0.05 in statistical differences between the groups in the Socio-economic impacts of reusing treated wastewater in agriculture purposes in governorate of Hebron (Nuba village)due to the number of family members who work in agriculture, where the statistical significance > 0.05 which is not statistically significant, and thus accept the null hypothesis.

The 8thhypothesis: There are no statistically significant differences at the level of (0.05α ≤) in the Socio-economic impacts of reusing treated wastewater in agriculture purposes in governorate of Hebron (Nuba village) due to the percentage of agriculture in the monthly income of the family.

The researcher used Mann-Whitney Test to measure the statistical differences between the groups in the Socio-economic impacts of reusing treated wastewater in agriculture purposes in governorate of Hebron (Nuba village)due to the percentage of agriculture in the monthly income of the family. Table (4.18) shows this:

Table (4.18): Mann-Whitney Test to measure the statistical differences between the groups in the Socio-economic impacts of reusing treated wastewater in agriculture purposes in governorate of Hebron (Nuba village) due to the percentage of agriculture in the monthly income of the family

Field	the percentage of agriculture in the monthly income of the family	N	Mean Rank	Sum of Ranks	U	Z	Asymp. Sig.
Measuring the role of using water treatment on the economic and social side	less than 50%	22	15.02	330.50	77.50	-0.503	0.615
	more than an equal 50%	8	16.81	134.50			
Measure the acceptability of the use and payment	less than 50%	22	17.20	378.50	50.50	-1.806	0.071
	more than an equal 50%	8	10.81	86.50			
Total degree	less than 50%	22	16.41	361.00	68.00	-0.953	0.341

Field	the percentage of agriculture in the monthly income of the family	N	Mean Rank	Sum of Ranks	U	Z	Asymp . Sig.
	more than an equal 50%	8	13.00	104.00			

The previous table shows that there are no statistically significant differences at α≤0.05 in statistical differences between the groups in the Socio-economic impacts of reusing treated wastewater in agriculture purposes in governorate of Hebron (Nuba village)due to the percentage of agriculture in the monthly income of the family, where the statistical significance > 0.05 which is not statistically significant, and thus accept the null hypothesis.

4.3 The results of the interview:

1- What are the economic dimensions of reuse of treated water in agriculture?

a. Enhancing food security.
b. Contribution to water security.
c. Increase the area of the agricultural sector. GDP.
d. Safe disposal of wastewater, which reduces the incidence of diseases.

2- Are wastewater treatment and reuse projects economically feasible?

Yes, feasible compared to the yield of rained and irrigated agriculture, and the comparison between the price of fresh water and treated water. As well as they contain nutrients that the plant needs and provide fertilizer.

3- How can we increase the benefits and accept the costs associated with treatment and reuse plans?

- Use renewable energy patterns.
- Reuse treated water in agriculture and ensure farmers pay.
- Conversion of sludge to sludge and sale.
- To have more privatized project in order to operate and maintain the plants ,so this will generate profits in the future and offers sustainability ,profits

4- **Do you think that restrictions on the use of fresh water help to use wastewater in agriculture?**

Yes, where the farmer is looking for alternatives and other sources of water, especially in light of the scarcity of water in Palestine.

5- **Is there monitoring and controlling of reclaimed water quality (salts, heavy metals, etc.)?**

The majority believes that monitoring and control on paper only, as there are no laboratories working within the specifications, and no regulations for implementation.

6- **Is there a relationship between the level of education and the a 3cceptance of the use of wastewater in agriculture?**

The majority responded that there was a direct relationship. So that if the level of education increased acceptance of the use of treated water, while some believe that this is linked to the needs of the farmer and not the level of education relationship.

7- **What are the factors used to encourage reuse?**

- Building confidence among farmers about the quality of treated water.
- The price of treated water must be less than the price of fresh water.
- Conducting meetings and seminars to inform farmers about the use of treated water.
- Extension of networks and delivery of agricultural land.

8- **Do you think that the operation and maintenance of municipalities is sufficient? If not enough what do you suggest?**

Not enough, but the project can be privatized or partnership with private companies. Maintenance can also be done through private companies and farmers pay for will pay the real costs of transporting treated water to their farms

9- **Do you think that the standards and regulations do not work well and do not serve the Palestinian Authority's directions for reuse or is there an imbalance in distribution and treatment?**

Systems are good but lack implementation and follow-up, and the criteria must take into account the classification of crop lists: seedlings, trees ... accept primary treatment, secondary and tertiary treatment , for example there is no need to triple treatment in cotton cultivation.

10- What are the practices and techniques for creating an efficient, safe and economically viable environment for projects and reuse of treated water?

- Underwater irrigation and focus on feed in the first stage and forest trees and then move to fruit trees and seed production.
- Create an institutional legal framework to regulate and issue licenses and create a tariff for this.
- Establish the Water Users Association that socially responsible for reuse .

Chapter Five: Resuls and Recommendations

5.1 Results and Discussion :

Treated wastewater is considered as a new source of non-conventional water sources that can be used in irrigating agricultural crops and human uses. The scarcity of water which the Palestinian territories suffers from is as a result of the control of the occupation on water sources. This made a need and urgent necessity to intensify wastewater treatment projects and reuse them in agricultural production and irrigating public gardens and parks.

Economic and social dimensions play an important role in the desire of the rural population in the West Bank to accept the reuse of treated wastewater in agricultural production which has relation to environmental awareness and the population understanding of wastewater treatment systems and their use. This study was based on distributing a questionnaire which raise questions which discuss the reuse of rerated wastewater agricultural production accordingly. The sample consists of 30 farmers from the village of Nuba to the south of Hebron, in the West Bank, was selected as a treatment unit in addition to conducting personal interviews.

After studying the need of the Palestinian market, it was turned out that the crops that can be encouraged and generate economic benefits are the fodder and fruits, where it is found that there is a gap in fodder by 80% and about 50% in fruits. The study recommended the expanding of the agricultural areas for fruits by 10 thousand Donums per year. And there are some fruits that we must concentrate on such as apples, mangoes and avocados, where the deficit is 780,000 tons, so we can fill a large part of the deficit of mango and avocado in a short time from 5_7 years.

The study found that the State of Palestine has about 100 million cubic meters of wastewater that can be utilized and there is a possibility to use it in irrigating 50-70 thousand Donums and this will this reduces the deficit ratio in agricultural water 20-30% until the year of 2020.

The results of the study showed that 80% of the population of the study did not know the Palestinian criteria for reusing as 63.4% think that many crops can be produced safely for human use , but for the use of the treated water,56.6% feel like using it while the rest refuses the desire to use it even conditionally.

The study also showed that 53.3% are willing to pay for treated wastewater in agriculture, while 64.6% believe that fears of using them are fears related to poor marketing ,but the pathological and religious ones aren't the main reason.

The results also showed that the solutions to overcome water scarcity according to the study population were as the following:

collecting rainwater through ponds and wells, using treated water, using modern agriculture techniques, relying on irrigated rain fed agriculture. 82% of the sample of the study sees that the use of treated water in agriculture will lead to the reclamation of new lands and will reduce the expenditure on water bill and reduce the expenditure on the supply of food commodities and animal fodder . In addition, 63.6 considers that the use of treated water will lead to the reduction in expenditure on the use of fertilizers as the treated water contains the nutrients needed for the plant.

As to the nature of the use, it came as the following :

- Using treated water to irrigate public gardens , to extinguish fires, then

- In agricultural use and contractions as well as others.

The results of the study included the analysis of the social dimensions of the study for the area of study and the impact of these various variables on the extent to which the population accept the reuse of treated wastewater. The results show that there is no close relationship between the acceptance of the population to reuse the treated water , the number of family members and the age and educational level. In addition , the results of the analysis showed no close relationship between income, and the number of beneficiary families and the acceptance of the reuse of treated wastewater in agriculture.

This study summarizes that in the current water crisis, the reuse of wastewater produced in the Palestinian countryside must taken into consideration. Therefore, efforts should be intensified among institutions concerned with the management of wastewater for the establishment of stations and the operating of the stations at the community level to treat wastewater in most rural areas in the West Bank.

The study stipulated for the success of the experiment that creating a permanent and integrated program to encourage the private sector to invest in treated water and in agriculture and to carry out an integrated awareness campaign for the public and farmers and to work in an integrated and coherent institutional and legal manner as well as reliance on motivational policies at the political level that include cooperative societies and the private sector. Many sources estimate these quantities can be used to irrigate approximately 150,000 Donums, which will save 20-30% of the demand on water for agricultural purposes in the West Bank in the year of 2020.

Due to the modernity of this sector in the Palestinian territories and despite the presence of a significant legal and legislative framework, institutional frameworks at the community level (municipalities and local governments) still needs to be developed.

5.2 Conclusions:

The researcher found according to the given data analyzed in the previous chapter that most farmers are willing to use treated waste water if treated according to special conditions that will not harm human health and less rick to their crops; however, most of the data found out that farmers are less educated about waste water treatment techniques and think it can be dangerous to their products so, they will not be able to market their products if end users know that the products were irrigated by treated waste water.

This contradicts the literature review that we have in this study as most of the countries encourage farmers using treated waste water as this will decrease health issues within the society.

The results also concluded that farmers and the Palestinian society are less aware of the real benefits of using such water; according to most literatures; the use of treated waste water will decrease pollution and have better crops due to great fertility; in addition, the increasing of agricultural irrigated land; moreover, this will enhance the product quality and quantity.

The study showed that most farmers are willing to use treated waste water if produced in large quantity at competitive prices; hence, less taxes on treated waste water is an effective way to urge farmers to use it.

The results concluded most farmers accept the idea of using treated waste water on different kinds of crops; such as feeds, fruit trees, olives and vegetables, a high percentage agreed to use it on vegetables; however, most literatures advised not to use it on vegetables on the first place unless it treated tertiary. This shows that most farmers have less education on how to use treated waste water. In this regards the government shall have some serious awareness sessions, seminars to educate farmers and people on the concept of treated waste water.

The research showed a significant relationship between farmers and price of treated waste water; as most farmers agreed that treated waste water should be available at cheap prices as this will help them to use it more. The literature revealed that the cost of treated waste water is about 1 – 1.5 NIS per cubic meter; on the other hand, the cost of regular cubic meter is 1.00 NIS. Thus it does achieve sustainable treatment plants, efforts should be done in reducing operation cost with accepted quality of water.

5.3 Recommendations:

1. To achieve high sustainability of reused plants, government intervention needed to spread the awareness of the use of treated waste water, before proceeding of opening such plants.
2. This idea of reuse plants must be accepted by the society in the first place, this can be done by educating the society by doing seminars on how to decrease diseases and protect the environment.
3. Start to reallocate pure water from treated wastewater without acknowledging water rights according to time schedule in a 5-10 year plan, which will decrease the use of fresh water in irrigation to a %10.
4. Support the expansions (supporting the infrastructure and agricultural projects) in planting feeds and fruits, which usually costs amounts of money when importing especially avocado, mango and other fruits.
5. give a priority to agricultural land and farmers who are willing to use treated wastewater in irrigation.
6. making finical incentives to integrate the private sector in the use of treated wastewater (both; small and large businesses).
7. perform laws to restrict the use of fresh water in irrigation which can be substituted by treated water.
8. Conduct a detailed survey study in all directorates , taking into consideration the farmers experience, the climate and the local markets need.
9. Expand in scientific studies in both economics and agriculture.
10. 8. Conduct a study on revenues to expanding on Palm cultivation and converting Palm cultivation using of treated water in irrigating .

11. Based on the previous and according to local and regional standards it has been preferable to cultivate that grain and fruit crops in the Valley area and fruits in mountainous lands.

12. The need to complete the legal and institutional arrangements referred to in this study, which is stipulated by the new water law.

13. The importance on holding awareness campaigns for farmers, community and law makers to address the importance of using treated water safely .

14. Focusing on increasing profit cubic meter by decreasing lost and increasing efficiency in agriculture.

15. Encouraging scientific research in water, soil and farming.

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ملحق رقم (1): استبيان لبيان الآثار الاقتصادية والاجتماعية لإعادة استخدام مياه الصرف الصحي المعالجة في الزراعة 129

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ملحق رقم (1): استبيان لبيان الآثار الاقتصادية والاجتماعية لإعادة استخدام مياه الصرف الصحي المعالجة في الزراعة .

المواطن: الكريم / المواطنة الكريمة.

تحية طيبة و بعد,,,,,

يقوم الباحث بأجراء بحث حول " الآثار الاقتصادية والاجتماعية لإعادة استخدام مياه الصرف الصحي المعالجة في الزراعة " و هذا البحث هو متطلب علمي لنيل درجة الماجستير, مسار بناء المؤسسات في معهد التنمية المستدامة – جامعة القدس.

لذا أهيب بكم تخصيص بضع دقائق و تكرم بالاطلاع على محاور الاستلانة و الإجابة عن كل فقرة أو سؤال حسب ما ترونه واقعيا.

مع العلم أن الاستبانة ستستخدم لأغراض البحث العلمي فقط و ستعامل بكل سرية, و يؤكد الطالب الباحث على اخذ أرائكم بالجدية التي تستحق, كما يمكنكم الاطلاع على النتائج بعد اكتمال البحث العلمي.

مع بالغ الاحترام و التقدير,,,

الطالب /وسام عمرو

يرجى اختيار أحد الإجابات لكل عبارة مذكورة أدناه من خلال وضع علامة في المكان الذي يعبر عن رأيك .

الجزء الأول: المعلومات الديموغرافية:

المعلومات الديموغرافية/ عامة :	
1/1	عدد افراد الاسرة : 1) 2أقل من 5 أفراد 2) 5- 10 افراد 3) 10 افراد فأكثر.
2/1	العمر : 1) 18-30 سنوات 2) 30 - 45 سنوات 3) 45- 60 4) 60 فأكثر
3/1	الجنس : 1) ذكر 2) أنثى
4/1	المستوى التعليمي: 1. أمي 2. اعدادي 3. ثانوي 4. جامعي .
5/1	ما هو طبيعة العمل الذي تقوم به : 1) الزراعة 2) الصناعة 3) البناء 4) التجارة 5) غير ذلك
6/1	متوسط الدخل الشهري للأسرة : 1) 500- 1000 شيكل 2) 1000- 2000 3) أكثر من 2000
7/1	الخبرة بالزراعة : 1) أكثر من 10 سنوات 2) من 5- 10 سنوات 3) أقل من سنوات
8/1	عدد أفراد الأسرة الذين يشتغلون بالزراعة ....
9/1	النسبة المئوية للزراعة في الدخل الشهري للعائلة :...........................
10/1	هل تتوفر مياه للري بكميات مناسبة :أ) نعم ب) لا

الجزء الثاني: الموقف من إعادة الاستخدام والدفع

أولا: هل لديك معرفة بالمعايير الفلسطينية بشأن معالجة المياه وإعادة استخدامها

1) نعم 2) لا

ثانيا : هل من الممكن إنتاج محاصيل زراعية عندما تروى بالمياه العادمة المعالجة والمنتج سيكون آمنا للإستخدام البشري ؟

1) نعم لجميع المحاصيل 2) نعم لكثير من المحاصيل 3) لا

رابعا: هل أنت على استعداد لاستخدام المياه العادمة المعالجة اذا توفرت بكميات مناسبة ؟

1) نعم 2) لا 3) نعم بشروط

خامسا: أنواع المحاصيل التي سوف تقبل ريها بالمياه العادمة المعالجة ؟

1- العلف 2- أشجار الفاكهة 3- ري إضافي للزيتون 4- الخضراوات اذا كانت جودة المياه جيدة

سادسا : المخاوف من إعادة استخدام المياه العادمة المعالجة

1- السلامة الشخصية 2- المخاطر الصحية المرتبطة بالمحاصيل 3- مشاكل عدم التسويق 4- مخاوف دينية

سابعا : اذا لم يتوفر الماء العذب بسبب الجفاف هل ستستخدم المياه العادمة المعالجة ؟

1) نعم 2) لا 3) نعم بشروط

ثامنا : استعدادك لدفع ثمن المياه العادمة المعالجة

1- لا شيء 2- مستعد لدفع تكاليف الضخ للمزرعة

الجزء الثالث: قياس دور استخدام المياه المعالجة على الجانب الاقتصادي و الاجتماعي.

	قياس دور استخدام المياه المعالجة على الجانب الاقتصادي و الاجتماعي	موافق بشدة	موافق	محايد	غير موافق	غير موافق بشدة
.1	يؤدي استخدام المياه المعالجة الى التوفير في فاتورة المياه.	⑤	④	③	②	①
.2	يؤدي استخدام المياه المعالجة الى التوفير في تكلفة استخدام الاسمدة.	⑤	④	③	②	①
.3	يؤدي استخدام المياه المعالجة الى التوفير في تكاليف الانتاج الزراعي.	⑤	④	③	②	①
.4	يؤدي استخدام المياه المعالجة الى التقليل من الانفاق على التزود بالمياه.	⑤	④	③	②	①
.5	يؤدي استخدام المياه المعالجة الى تقليل الانفاق على اعلاف المواشي	⑤	④	③	②	①
.6	يؤدي استخدام المياه المعالجة لاستصلاح مزيد من الأراضي	⑤	④	③	②	①
.7	يؤدي استخدام المياه العادمة الى تقليل تكاليف الانفاق على السلع الغذائية	⑤	④	③	②	①
.8	يوفر استخدام المياه العادمة مبالغ للتزود بالسلع الاساسية	⑤	④	③	②	①
.9	يوفر استخدام المياه العادمة فرص لتحسين الدخل الشهري	⑤	④	③	②	①
.10	يوفر استخدام المياه العادمة فرص عمل للمتعطلين عن العمل	⑤	④	③	②	①
	قياس مدى التقبل للاستخدام والدفع	موافق بشدة	موافق	محايد	غير موافق	غير موافق بشدة
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.12	الاستخدام الأنسب للمياه العادمة المعالجة هو مجال الصناعة	⑤	④	③	②	①
.13	الاستخدام الأنسب للمياه العادمة المعالجة هو مجال الاستخدام المنزلي	⑤	④	③	②	①
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22.	**اي الحلول تفضل للتغلب على ظاهرة الندرة المائية: (1) الاكثر تفضيلا، (5) الاقل تفضيلا.** تجميع مياه الامطار من خلال البرك و الابار: 1 | 2 | 3 | 4 | 5 استخدام المياه العادمة المعالجة: 1 | 2 | 3 | 4 | 5 استخدام تقنيات الزراعة الموفرة للمياه: 1 | 2 | 3 | 4 | 5 الاعتماد على الزراعة البعلية غير المروية: 1 | 2 | 3 | 4 | 5 الاعتماد على تربية الثروة الحيوانية بدل الزراعة السبانيه: 1 | 2 | 3 | 4 | 5

انتهى الاستبيان

ملحق رقم (2): المقابلة

جامعة القدس

عمادة الدراسات العليا

بناء مؤسسات وتنمية موارد بشرية

تحية طيبة وبعد ,,,,

تهدف هذه الدراسة إلى معرفة الآثار الاقتصادية والاجتماعية لاستخدام مياه الصرف الصحي المعالجة في الزراعة " نوبا كحالة دراسية " وذلك من خلال استطلاع وفحص آراء المزارعين ومجموعة من الخبراء من البلديات والمؤسسات الغير حكومية وكذلك للتعرف على مدى إمكانية التقبل الاجتماعي لاستخدام المياه العادمة المعالجة وإمكانية الدفع للحصول على هذا المياه .

شكرا لتعاونكم ،،،،

الباحث : وسام عمرو

أولا : اجراءات المقابلة :

الإسم :...

مكان العمل :..

المسمى الوظيفي :..

تاريخ المقابلة :..

زمن المقابلة :...

ثانيا : هدف المقابلة : التعرف على الآثار الاقتصادية والاجتماعية وإمكانية التقبل الاجتماعي والدفع للمياه العادمة المعالجة في الزراعة .

ثالثا : أسئلة المقابلة :

1. ما هي الأبعاد الإقتصادية لإعادة استخدام المياه العادمة المعالجة في الزراعة ؟

....
....
....

2. هل مشاريع معالجة مياه الصرف الصحي واعادة استخدامها مجدية اقتصاديا ؟

....
....

كيف يمكن العمل على زيادة الفوائد وتقليل التكاليف المتعلقة بمحطات المعالجة واعادة الاستخدام ؟

....
....

هل ترى بأن فرض القيود على استخدام المياه العذبة يساعد على استخدام مياه الصرف الصحي قي الزراعة ؟

....
....

هل هناك رصد ومراقبة لنوعية المياه المستصلحة (الأملاح , المعادن الثقيلة ....إلخ)؟

....
....

هل يوجد علاقة بين المستوى التعليمي وتقبل استخدام مياه الصرف الصحي قي الزراعة؟

………

………

ما هي العوامل التي تشجع على اعادة الإستخدام ؟

………

………

هل ترى بأن التشغيل والصيانة المتبعة من قبل البلديات كاف ؟ اذا كان لا ماذا تقترح ؟

………

………

هل ترى بان المعايير والأنظمة لا تعمل جيدا ولا تخدم توجهات السلطة الفلسطينية نحو اعادة الإستخدام أم أن هناك خلا في التوزيع والمعالجة ؟

………

………

ما هي الممارسات والتقنيات لخلق بيئة فعالة وآمنة وقابلة للحياة اقتصاديا لمشاريع إعادة استخدام المياه المعالجة ؟

……………………………………………………………………………………………………

……………………………………………………………………………………………………

الملخص

تعتبر المياه العادمة المعالجة مصدرًا جديدًا من مصادر المياه غير التقليدية التي يمكن استخدامها في ري المحاصيل الزراعية وفي الاستخدامات البشرية، إن شح المياه التي تعانيه الأراضي الفلسطينية نتيجة لسيطرة الاحتلال على مصادر المياه، جعل هناك حاجة وضرورة ملحة لتكثيف مشاريع معالجة المياه العادمة وإعادة استخدامها في الإنتاج الزراعي وفي ري الحدائق العامة والمتنزهات.

هدفت الدراسة إلى استكشاف الآثار الاقتصادية والاجتماعية لاستخدام مياه الصرف الصحي المعالجة في الزراعة وكذلك لاستكشاف إمكانية الاستخدام والدفع مقابل استخدام هذه المياه.

اعتمدت الدراسة على إعداد و توزيع استبانه تطرح أسئلة تناقش إعادة استخدام المياه العادمة المعالجة في الإنتاج الزراعي، وبناء عليه تم اختيار عينة بشكل هادف من 30 مزارع من قرية نوبا جنوب الخليل في الضفة الغربية ، بالإضافة إلى إجراء المقابلات الشخصية.

بينت نتائج الدراسة أن ما نسبته 80 % من مجتمع الدراسة ليس لديهم معرفة بالمعايير الفلسطينية لإعادة الإستخدام كذلك يرى ما نسبته 63.4% أنه يمكن انتاج كثير من المحاصيل بشكل آمن للإستخدام البشري أما بخصوص استخدام المياه المعالجة فيرى 56.6% أن يرغبون بالإستخدام في حين أن البقية ترفض أو ترغب باستخدام مشروط.

كذلك بينت الدراسة أن ما نسبته 53.3% لديهم استعداد للدفع مقابل استخدام المساه المعالجة في الزراعة في حين يرى 64.6% أن المخاوف من الإستخدام هي مخاوف متعلقة بضعف التسويق وأن المخاوف المرضية والدينية ليست السبب الرئيس.

كما وضحت النتائج الحلول للتغلب على ندرة المياه حسب مجتمع الدراسة حيث كانت كالآتي : تجميع مياه الأمطار من خلال البرك والآبار ثم استخدام المياه المعالجة,استخدام تقنيات الزراعة الحديثة والاعتماد على الزراعة البعلية غير المروية.

يرى 82% من عينة الدراسة أن استخدام المياه المعالجة في الزراعة سيؤدي إلى استصلاح أراضي جديدة وكذلك سيقلل من الإنفاق على فاتورة المياه وتقليل الإنفاق على التزود بالسلع الغذائية وأعلاف

المواشي كذلك يرى 63.6 بأن استخدام المياه المعالجة سيؤدي إلى التقلل من الإنفاق على استخدام الأسمدة لإحتواء المياه المعالجة على المغذيات اللازمة للنبات.

تضمنت نتائج الدراسة من تحليل الأبعاد الاجتماعية لمنطقة الدراسة وأثر هذه المتغيرات المختلفة على مدى تقبل السكان لإعادة استخدام المياه العادمة المعالجة، تبين النتائج عدم ووجود علاقة وثيقة بين تقبل السكان لإعادة استخدام المياه المعالجة وعدد أفراد الأسرة وكذك العمر والمستوى التعليمي ، كذلك ظهر من نتائج التحليل عدم وجود علاقة وثيقة والدخل، وعدد الأسر المستفيدة، وبين تقبل إعادة استخدام المياه العادمة المعالجة في الزراعة.

تخلص هذه الدراسة إلى أنه في ظل أزمة المياه الحالية يجب النظر إلى إعادة استخدام المياه العادمة المنتجة في الريف الفلسطيني، وعليه يجب تكثيف الجهود بين المؤسسات المعنية بإدارة المياه العادمة من أجل إنشاء محطات وكذلك تشغيل المحطات على مستوى التجمعات السكانية لمعالجة المياه العادمة في معظم المناطق الريفية في الضفة الغربية.