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M.Sc. Program in Water and Environmental Science

M.Sc.Thesis

The Role of Public Awareness Towards Sustainable Use of Treated Wastewater in Agricultural Irrigation

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Supervised by:

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Abstract

Water, an important natural resource in Palestine, requires adequate management practice aiming at efficient use and distribution. Treated wastewater reuse with acceptable quality plays a crucial role as an additional water source considering groundwater protection and conservation.

Lack of public awareness is one of the major issues behind the limited success of wide spread of treated wastewater use in agriculture. The main objective of this study was to investigate the impact of public awareness towards sustainable use of treated wastewater in agricultural sector.

The search methodology applied was two folds: conduction of technical workshops for three targeted group Students, women and farmers in Anza, Beit Dajan and West Bani Zaid in west bank, and distribution of questionnaires. The SPSS data obtained from previous baseline studies were compared with those after workshops conduction. The researcher found that about 9١% 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 where the workshops was promote and increase their willingness to reusing treated wastewater for agriculture.

The research concludes that training and public awareness programs must be conducted to raise the knowldgment about the wastewater treated uses in order to ensure the sustainability of WWTP, and wastewater-related topics have to be

introduced throughout school curriculum in Palestine to be learned for the students in all school grades.

الخلاصة

تعتبر المياه من أهم المصادر الطبيعية في فلسطين والتي تحتاج إلى إدارتها بطريقة سليمة تهدف الى استخدامها وتوزيعها بشكل فعال. وتعتبر المياه العادمة المعالجة ذات جودة مقبولة من المصادر المهمة والتي تلعب دور كبير في الحفاظ على المياه الجوفية وحمايتها.

إن قلة برامج التوعية البيئية حول أهمية المياه العادمة المعالجة وطرق استخدامها على سبيل المثال في الزراعة تعد من أهم الأسباب وراء فشل العديد من محطات المعالجة للمياه العادمة والتي تؤدي إلى اندثار هذه المحطات وعدم الاستفادة منها بالشكل المطلوب. لذا كان الهدف الرئيسي من هذه الدراسة، معرفة اثر ودور التوعية العامة نحو الاستخدام المستدام للمياه العادمة المعالجة في الزراعة.

تم تطبيق منهجية البحث على مرحلتين: الأولى عقد ورشات عمل فنية لجميع الفئات المستهدفة في البحث من طلاب ،نساء و مزارعين في القرى الثلاث المستهدفة: بيت دجن،عنزة و بني زيد الغربية. والمرحلة الثانية توزيع الاستبيانات على الفئات المستهدفة بعد الانتهاء من ورشات العمل.

من خلال مقارنة النتائج التي تم الحصول عليها قبل عقد ورشات العمل للفئات المستهدفة مع النتائج التي حصلنا عليها بعد عقد ورشات العمل والتي تم تحليل النتائج في الحالتين على البرنامج الإحصائي، وجد الباحث ان حوالي ٩١% من الطلاب اظهروا معرفتهم بتعريف المياه العادمة بعد عقد ورشات العمل في حين إن ٨٨% من الطلاب اظهروا معرفتهم قبل إجراء ورشات العمل. كما وجد الباحث ان غالبية

المزارعين توافق وتدعم فكرة بناء محطات معالجة مياه الصرف الصحي في قراهم حيث تم من خلال ورش العمل تعزيز وزيادة رغبتهم في إعادة استخدام مياه الصرف الصحي المعالجة لأغراض الزراعة.

وتخلص الدراسة إلى ضرورة إجراء برامج التوعية والتدريب العامة لرفع درجة المعرفة والثقافة لدى مختلف شرائح المجتمع حول أهمية معالجة المياه العادمة وضرورة استخدامها في عدة مجالات من اجل ضمان استمرارية ونجاح هذه المشاريع التنموية في القرى الفلسطينية، بالإضافة إلى ضرورة إدخال مواضيع تناقش المياه العادمة ومعالجتها واستخدامها في المناهج الدراسية للطلاب في جميع المراحل العمرية في فلسطين.

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LIST OF ABBREVIATIONS

AL	Aerated Lagoon
AS	Activated Sludge
AWC	Arab Water Council
EQA	Environmental Quality Authority
FAO	Food and Agriculture Organization
GCC	Gulf Corporative Council
JWU	Jerusalem Water Undertaken
MDGs	Millennium Development Goals
NIS	New Israeli Sheqel
PARC	Palestinian Agriculture Relief Committee
PCBS	Palestinian Central Bureau of Statistics
PNA	Palestinian National Authority
PSI	Palestinian Standards Institute
PWA	Palestinian Water Authority
SPSS	Statistical Package for the Social Sciences
TF	Trickling Filter
WC	Water Cycle
WESI	Water and Environmental Studies Institute
WHO	World Health Organization
WWTP	Wastewater Treatment Plant
ACWUA	Arab Countries Water Utility Association

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Chapter One: Introduction

1.1 Introduction

Water consists of 70% of the whole universe and 85% of our bodies is water as well. Water is becoming a very critical issue in today's politics; as Palestinians we can feel it day after day since water is becoming a very scarce resource in our country and becomes more critical when we look at our special case due to the Israeli occupation. This may explain why the Israelis have requested to delay the discussion of this issue as part of the final negotiations.

This is also supported by the latest drop in the rain fall rates in our region in the last decades; the last year might be an exceptional case. Palestine relies heavily on agriculture as a main input to the economy; agriculture is estimated to be 1,114 million USD (Ministry of Agriculture, 2006/2007); which makes the reliance on water more and demanding and by time the cost per cubic meter of water used for irrigation is increasing dramatically.

Water, an important natural resource in Palestine, requires adequate management practice aiming at efficient use and distribution. Treated wastewater reuse with acceptable quality plays a crucial role as an additional water source considering groundwater protection and conservation.

Wastewater treatment is considered as important matter that attracts the attention of governmental and non-governmental institutes due to the fact that sanitation services contribute to the reduction of disease propagation in addition to the pollution avoidance of surface and groundwater (Abu Madi and Al-Sa'ed, 2009).

Many Non-governmental organizations provide technical and financial service and they spend a lot of money and time to identify the most effective solution in Palestine to improve the drinking water and wastewater treatment reuse (Al-Sa'ed, 2000).

The agriculture sector is one of the major contributors to the economy in Palestine and it is the greatest water consumer (65% of the available water) in Palestine. Free access to water can reduce food insecurity and enhance the economic development in Palestine (Al-Sa'ed *et al.*, 2012). The growing demand of Palestinian communities for food and fresh water require to encourage the reuse of recycled wastewater in agriculture to protect the fresh water (Abu Madi *et al.*, 2008). To protect the quality of reused wastewater and environment, the Palestinian Authority set many standards and regulations (PSI, 2012), which are monitored and controlled from different ministries and relevant institutions in Palestine.

Public awareness becomes one of the major elements in Palestine to encourage the stakeholders and communities to use the treated wastewater to achieve food security (Abu Jaish, 2011).

Knowledge and awareness about wastewater reuse in agriculture is still limited. Awareness, education, and dissemination of results from other experiences are needed to help change attitudes, and it is suggested to create efficient factors to encourage the use of recycled wastewater instead of fresh water like increasing the price of water used for irrigation Palestine (Al-Sa'ed *et al*., 2008).

1.2 Research Problem

The supply and management of water resources remain a key priority for Palestinian Government to increase water availability, so the only option needed to manage our resources efficiently is by searching and developing other resources than ground water. Wastewater treatment project now is the available resource to reduce consumption of the ground water.

The unaccepted idea for connecting to the sewer network in West Bani Zaid is one of the major problems of the research. Wastewater treatment plant was established in West Bani Zaid since 2006 by Palestinian Hydrology Group (PHG), the plant was designed to receive 80m^3/ day, only 31 houses and one school are connected to the system, the amount of wastewater that currently reach the plant is estimated at only 15 m^3/day, at a rate which is not exceeding 20% of the design rate(PHG, 2011).

Raise connection rate to the central sewer system will be increase the flow rate of the wastewater to reach the suitable flow rate which reflects positively on the operation of WWTP and on the amount of treated wastewater to be used for agriculture.

WWTP in Anza and Beit Dajan is under established so the objective of the research is improving food security conditions through the promotion of the reuse of the treated wastewater for agricultural purposes.

1.3 Aim and Objectives

The specific goals of this research study are the following:

- Enhancement of the public acceptance and raise connection rate to central sewer network.
- Investigate the impact of public awareness towards sustainable use of treated wastewater in agricultural sector.
- Using treated wastewat in agricultural irrigation, even for biomass production of trees for landscape development, and recreation; since world water shortage has pushed many communities to find alternative and new sources of water.

1.4 Importance of the Study

The importance of the research is 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, after explaining the importance of wastewater reuse by making workshop because it is very useful and important and the usefulness of this study is reflected in:

- Measuring the performance of the wastewater treatment and reuse after public awareness in the targeted areas.
- This study would help to improve the public awareness toward wastewater treatment and reuse in the targeted areas.

- Improve food security conditions through the promotion of the reuse of the treated effluents for agricultural purposes in targeted areas in West Bank.
- Improve the Public awareness to increase cknowledge and acceptance for treated wastewater reuse in agricultural irrigation.
- To clarify the importance of treated wastewater reuse to save the fresh water for domestic use.

1.5 Research Questions

What is the role of public awareness towards wastewater treatment and reuse issue after conducting the workshops?

What are the effects of the knowledge, attitude, and practices of the community towards water quality, water disinfection, wastewater treatment, and wastewater reuse after conducting the workshops?

What is the role of public awareness towards wastewater treatment and reuse on Socio-economical situations after conducting the workshops?

Are there any significant differences in the study variables (district, gender, age, and targeted areas) on the role of public awareness towards wastewater treatment and reuse in the selected areas?

1.6 Research Methodology

This study mainly relied on the following methodology:

- Reviewed and analyzed existing literatures and publications on the concept of " the role of Public awareness towards wastewater treatment and reuse"

Conducted workshops about wastewater treatment and reuse issues for the selected area. The field work in targeted areas finished within (16) weeks resulted in interviewing (645) questionnaires each visit took (3-4)hours.

- Distributed questionnaire survey to the representative sample of the population of the study.

1.7 Thesis Outlines

The thesis is organized in five chapters. Chapter one includes the introduction, research problem, research importance, and research methodology. Chapter two discusses the theoretical framework, literature review and the previous studies which are related to the research. Chapter three discusses the research methodology including population, sample, data collection methods, and statistical methods used. Chapter four discusses the study results in answering the study questions and testing the hypothesis. The results of the study discussion and the researcher recommendations are presented accordingly in Chapter five.

Chapter 2: Literature Review

2.1 Introduction

The wastewater treatment does not depend only on its economic and environmental feasibility, but mainly on the support of the public, who, ultimately, pay for, and might be affected by the reuse. Irrespective of scientific and engineering based considerations, public opposition has the potential to cause wastewater reuse to fail, before, during, or after their execution (Jeffrey and Temple, 1999).

Most of wastewater treatment projects developed in the world is mainly for irrigation purposes (Bahri and Lazarova, 2005). Irrigation is vital in increasing crop yields and receiving a consistent production within agriculture. It is essential to keep the agriculture economically viable in arid and semi-arid areas (Pescod, 1992). Irrigation with reused wastewater gives an additional source of nutrition and enhances agricultural production.

The reuse of treated effluent may bring important advantages such as the production of water suitable for irrigation, the reduction of residual pollution loads discharged in water streams and the reduction of water abstraction volumes for irrigation which constitutes important environmental and economic benefits (do Monte and Albuquerque, 2010).

2.2 Wastewater reuse in Arab countries

In most Arab countries limited water resources pose severe constraints on economic and social development and threaten the livelihood of people. Available surface water is declining and the over-pumping of groundwater, beyond natural

recharge rates, has resulted in lowering the water and causing an increase in groundwater salinity, ground water depletion, and ecological degradation (World Bank, 2009).

Egypt produces about 3.5 billion m^3/year of municipal wastewater, while current treatment capacity is in the range of 1.6 billion m^3/year. An additional treatment capacity of 1.7 billion m^3 is targeted by 2017 (Tawfic, 2008). Although the capacity increase is significant, it will not be sufficient to cope with the future increase in wastewater production from municipal sources and therefore, the untreated loads that will reach water bodies are not expected to decline in the coming years.

The reuse of treated wastewater in the Arab region targets agriculture predominantly, particularly in Tunisia, Syria, and Jordan. Irrigation for landscaping and golf courses is also on the rise in member countries of the Gulf Cooperation Council (GCC) as well as in North Africa (World Bank, 2007).

The major challenge for most Arab countries is to secure access to safe water and clean sanitation. The Arab Water Council (AWC, 2006) estimates a further 83 million need to be supplied with safe water and 96 million are still in need of clean sanitation services in order to meet the Millennium Development Goals (MDGs). The needs of a rising population, estimated at 343.8 million (AOAD, 2009), has put an added pressure on total water withdrawal.

According to the World Health Organization (2005), the Damascus and the Homs wastewater treatment plants in Syria account for more than 98% of all treated wastewater with capacities of 177 million m^3/year and 49 million m^3/year,

respectively. Since then, new wastewater treatment plants under construction may have come on line in other cities such as Allepo and Latakia. According to the World Health Organization (2005), About 177 million cubic meters per year of treated wastewater is reused for irrigating 9000 hectares in Damascus.

In 2001, 310 million m^3 of wastewater were produced in Lebanon by the domestic and industrial sectors (FAO AQUASTAT). In 2006, 4 million m^3 of wastewater were treated and 2 millions m^3 were used for informal irrigation (FAO AQUASTAT). Raw wastewater is also being reused for irrigation in several regions of Lebanon. Such is the case in the Bekaa region where some of the sewers are purposely blocked to allow sewage to be diverted for irrigation. In other regions, wastewater is being discharged in rivers or streams used for irrigation such as in Akkar and Bekaa (Ras El Ain, Zahleh).

Wastewater has been used for irrigation in Jordan for several decades. The inclusion of wastewater reuse in the country's National Water Strategy since 1998 was a signal of placing high priority on the value of reclaimed water. Wastewater represents 10% of Jordan's total water supply (WaDImena, 2008) and up to 85% of its treated wastewater is being reused (MED WWR WG, 2007). It should be noted however that treated wastewater is mixed with freshwater and then used for unrestricted irrigation in the Jordan Valley.

Agriculture plays a major role for reuse in Jordan, Egypt, Yemen, while the United Arab Emirates, Tunisia and Morocco focus on green space irrigation in urban centers and tourist facilities. Groundwater recharge is another option for wastewater reuse and is particularly considered in countries where sea water

intrusion into freshwater aquifers is threatening the already scarce water resources. Recycling for industrial and domestic reuse is another option. Recently, several municipalities facing water shortages consider high-tech wastewater treatment system in modern large housing complexes and high rise buildings to reuse the reclaimed water “in-house” for cooling purposes or toilet flushing.

One promising variation of this approach is greywater recycling. Water from showers and sinks is collected separately and treated in state-of-the-art greywater treatment systems with a disinfection unit. Such systems allow a cost efficient and safe reuse of high quality service water close to the point of generation. This technology is particularly on the rise in Jordan (ACWUA, 2010).

Municipal wastewater reuse is believed to be one potential intervention strategy for developing nonconventional water resources. In most Arab countries, “agriculture is by far the main water consumer, accounting for about 80% of the total water supply in Tunisia and up to 90% in Syria” (AHT Group AG, 2009).

2.3 Wastewater reuse in Palestine

In Palestine, wastewater reuse projects in the West Bank are associated with political obstacles, in addition to financial, social, institutional, and technical constraints. Since Israel considers reused wastewater as part of Palestinian total freshwater allotment, (Samhan, 2008) claimed that reuse of treated wastewater in agricultural application is bound to political issues pertinent to Palestinian water rights. Therefore, he recommended an integrated vision for wastewater reuse including political and institutional framework, water policy, awareness, marketing, and tariffs issues.

The reuse of treated wastewater and water demand management, particularly in irrigated agriculture, are the most recommended alternatives for alleviation of the severe water shortage in Palestine. This is mainly because agriculture dominates the Palestinian water consumption with about 70%, while leaving 30% for domestic and industrial purposes (RAND, 2007). Reuse of treated wastewater in irrigated agriculture would, on one hand, provide additional water supplies and, on the other hand, it would reduce environmental pollution caused by untreated/poorly treated wastewater (Abu-Madi *et al.*, 2008).

2.4 Health impacts and environmental safety

According to (Fatta *et al*., 2005), "concerns for human health and the environment are the most important constraints in the reuse of treated wastewater." It is frequently the case that sewage treatment plants in Arab counties do not operate satisfactorily and, in most cases, treated wastewater discharges exceed the legal and/or hygienically acceptable maxima. This is attributed to the lack of adequately trained staff with the technical skills to operate these plants, as well as the lack of an adequate budget for plant maintenance and operation. Irrigation with inadequately treated wastewater poses serious public health risks, as wastewater is a major source of excreted pathogens - bacteria, viruses, protozoa, and helminthes (worms) that cause gastro-intestinal infections in human beings. "Inappropriate wastewater use poses direct and indirect risks to human health caused by the consumption of polluted crops and fish. Farmers in direct contact with wastewater and contaminated soil are also at risk" (WaDImena, 2008). Reuse of unsuitable wastewater in agriculture may also lead to livestock infections.

The agricultural sector is a major element for a viable Palestinian economy. Therefore, the availability of freshwater is crucial to achieve food security and sustainable life. Despite the fact, the agriculture is the greatest water consumer in Palestine, only around 11% of the total Palestinian agricultural land is irrigated. This is mainly due to the Israeli control over the main Palestinian water sources, climate conditions of the region and mismanagement of irrigation water. The political well and commitment, as well as limited access to available water resources and agricultural land exacerbate the urgent needs for effluent reclamation and recycled water use in Palestine (Al-Sa`ed, 2005). Current installed low-cost onsite treatment systems in rural areas are unsustainable and causing annual environmental degradation, due to overloading, faulty design and implementation, absence of monitoring, maintenance and repair, poor public awareness, lack of administrative and legal control measures (Al-Sa`ed, 2007b, Al-Sa`ed and Mubarak, 2006).

2.5 Current Status of Wastewater Treatment and Reuse in Palestine.

Severe water shortages and acute water quality problems negatively affect Palestinians livelihood living in the West Bank and Gaza Strip (PWA, 2012). Years of neglect during the occupation from 1967 to 1994 have created severe environmental problems in Palestine. Lack of wastewater treatment plants 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 (MEDAWARE, 2004).

This situation has been mainly caused by several Israeli policies restricting the development of a Palestinian infrastructure. Palestinians have been prohibited from developing wastewater treatment plants that could potentially contain the environmental catastrophe occurring in the West Bank.

Delays the Palestinian projects that is related to Civil Administration, which cause the funders have cut off their funding of numerous Palestinian projects. Israel requires Palestinians to deploy high technical plants that are not even utilized in Israel.

Approved treatment plants are in many cases required to serve the nearby settlements, which is highly problematic due to the large quantities of sewage produced by these settlements and the elevated operational costs.

In urban areas, water is distributed in water networks. However, not all urban areas have collection systems for wastewater. Thus, only some urban areas can be considered for potential wastewater reuse, i.e. the ten cities with collection systems for wastewater and/or urban storm water. At times, untreated wastewater is utilized for irrigating some vegetables. Such utilization is causing severe health effects on the public. Treated wastewater reuse in agriculture is mainly practiced in a small scale in case of a demonstration projects and universities (restricted irrigation), a few demonstration projects are conducted in the West Bank as in Albireh and Ramallah WWTP

2.6 The role of public awareness to increase the reuse of wastewater.

In most countries, public awareness has been small until recently. This has caused delayed investment in wastewater treatment plant.

Factors influencing public acceptance were studied by Ajzen's theory. The application of Ajzen's theory of planned behavior specifically to reuse water proposes that people's willingness to use recycled water is dependent on:

(1) their attitudes towards using the water; (2) their perception of what their significant others think about using recycled water and; (3) their perceived ease or difficulty in using recycled water. Their attitudes towards water reuse are in turn determined by their beliefs about the outcomes of using recycled water and their evaluation of the expected. The same principles underlie their subjective norm and perceived control over the use of recycled water (Ajzens, 2001).

(Zuhair *et al*., 2001) said that public awareness to water shortage will promote reuse options in non-potable purposes and forms a crucial element in achieving a sustainable wastewater reuse scheme, and they suggest raising the public awareness towards the importance of wastewater reuse and the economic benefits should be prior or go in parallel of any planned wastewater reuse facility.

Public awareness efforts based solely on scientific data do not necessarily increase public acceptance of projects. Public policy on wastewater reuse options must include the human dimension since it is the public who will be served by, and pay for, the option. Determinants associated with waste management issues are complex but this does not lessen the importance of fully understanding these concerns if interventions are to be successful. The challenge is to identify public knowledge and perceptions and systematically address concerns through a framework of educational, policy and management strategies (Robinson *et al*., 2005).

2.7 Palestinian Standards in Wastewater

The Palestinian National Authority (PNA) is acting strenuously in the filed of water and wastewater management in terms of legislation, policies and strategies, seeking funds, design and implementation of several projects. The wastewater reuse is regulated by the 1999 Environmental law and by one of the policies of Palestinian Water Authority (PWA). According to the 2002 law No.3 the PWA is responsible for wastewater treatment and reuse the main aim of the PWA is to set polices for solving the problems caused by wastewater and to make use of resultant potential sources through proper planning, design, implementation, and management of the sector, stressing the interdependence of water supply and sanitation services. The policy of PWA regulates the construction of any new treatment plant to be associated with reuse project.

Wastewater treatment and reuse criteria differ from one country to another and even within a given country. Some of the main discrepancies in the criteria are, in part, due to differences in approaches to public health and environmental protection. For a long time, Palestine did not have any specific wastewater regulation; references were usually made to the WHO recommendations or to the neighboring country's standard (for example, Egypt and Jordan).

Recently, Palestinian Standards Institute (PSI) and Environment Quality Authority with coordination of Palestinian ministries and universities has established specific wastewater reuse regulation, PNA organize the wastewater treatment effluent by setting the regulation and standards for physical, chemical

and biological parameters of effluent. Table (2.1) illustrates the standards of technical parameters of effluents according to PSI.

Table 2.1: Effluent guidelines and standards.

Effluent parameters mg/ml	Fodder irrigation		Gardens playground	Industrial crops	Groundwater rechargeable	Landscape
	Dry	Wet				
BOD_5	60	45	40	60	40	60
COD	200	150	150	200	150	200
DO	>0.5	>0.5	>0.5	>0.5	>1.0	>0.5
TDS	1500	1500	1200	1500	1500	50
TSS	50	40	30	50	50	50
PH	6-9	6-9	6-9	6-9	6-9	6-9
NO_3-N	50	50	50	50	15	50

2.8 Previous Studies

(Mahmmoud, 2012) recommended in his evaluation report for west Bani Zaid WWTP that public awareness campaigns must be conducted to raise the connection rate to the sewer system and to enhance the community to reuse the treated wastewater for agricultural irrigation which aims to achieve sustainability of the WWP.

(Al-Sa`ed, 2010) said that reuse of treated wastewater is acceptable by the Palestinian public in rural areas. The public was found to highly support five reuse options; farming, forest irrigation, car washing, constructions, and WC flushing, with less acceptance in reuse for drinking, aquaculture and aquifer recharge

purposes. Integrating the consequences affecting factors behind the public acceptance in three treatment methods, new formulas were developed to measure the public acceptance. The results suggest raising the public awareness towards the importance of wastewater reuse and the economic benefits should be prior or go in parallel of any planned wastewater reuse facility.

(Adilah, 2010) found that the potential of reuse refers to the amount of rural wastewater that is or could be collected and treated and that would possibly add to the national water balance and also the effluent quality needed for each reuse option. Amounts of wastewater generated, treated and reused were calculated for year 2007. Wastewater reuse options were studied using the scenarios of collection suitable for rural areas and water savings under selected reuse options were estimated and discussed. Then, a framework for a national Palestinian strategy for management of rural wastewater was proposed. It is found that 80% of consumed water quantities in Palestinian rural areas are supplied by water networks, 10% from cisterns, and 10% from water vendors.

Study by (Abdel Wahaab, 2010) aimed to investigate the opportunities and challenges to reuse the wastewater reuse in Egypt. Interest in the use of treated wastewater, as a substitute for fresh water in irrigation, has accelerated since 1980. In general, treated wastewater use is of tremendous potential importance for Egypt. The agricultural sector is the highest freshwater consumer, utilizing about 86% of the available supplies. The drainage water from agriculture and the effluents from municipalities and industries are collected, transported and reused by an extensive drainage network which is managed and planned by the Ministry

of Water Resources and Irrigation. Reuse of drainage water has already been practiced at a larger scale during the last decades, whereby water from main drains is pumped into main canals. Reuse of drainage water in the Nile Delta started as early as 1930s. Total number of official reuse pumping stations is 21 stations.

Laws and decrees have been issued including guidelines for mixing drainage water with fresh water, regulations for sewage and industrial effluents, wastewater reuse, cropping patterns, and health protection measures and standards specifications. However, the major problem lies in weak regulatory compliance and enforcement.

Saleh (2009) found that the reuse of treated wastewater can be a source of water for the irrigation of agricultural crops and thus this will lessen the stress on the water resources, increase the agricultural productivity and prevent the pollution of the soil and groundwater. A questionnaire was distributed to analyze the public opinion toward the construction of a wastewater treatment plant and the corresponding reuse of the treated wastewater in agricultural irrigation. Thereafter, a benefit-cost analysis was carried out to estimate the cost of the reuse of the treated wastewater in Tubas area. The study considered five options for wastewater treatment in Tubas area: construction of a treatment plant for the wastewater originating from the north of Tubas, south of Tubas, north of Tubas and Tayaser village, all of Tubas, and all of Tubas and Tayaser village, respectively. The study analyzed three systems for secondary wastewater treatment: activated sludge (AS), trickling filter (TF) and aerated lagoons (AL).

The results of the questionnaire showed that the majority of respondents support the idea of having a wastewater treatment plant in Tubas. The results of the benefit- cost analysis showed that the total costs (US$/m³) for the AS treatments for the five options are: 1.73, 1.93, 1.65, 1.57 and 1.52, respectively in 2010. The total costs (US$/m³) for the TF treatment for the five options are: 1.55, 1.72, 1.47, 1.41 and 1.36, respectively in 2010. The total costs (US$/m³) for the AL treatment for the five options are: 1.39, 1.54, 1.32, 1.27 and 1.24, respectively in 2010.

Shonnar (2007) analyzed and evaluated the current water pricing policies in Ramallah and Al-Bireh District, which do not satisfy the full cost recovery principle. The results analysis revealed that the current tariffs need adjustment and that the proposed variables were significant to willingness of consumers to pay for water and wastewater fees. It can be said that the socio-economic status of residents had no significant impact on their willingness to pay for wastewater or water significantly. However, there were many other determinants that affect consumer willingness to pay for the water services, such as: Knowledge of price paid per cubic meter of water, cost of emptying cesspits for inhabitants who rely on cesspits for sewage collection , availability of water from other sources, and the payment methods used to settle the bills.

Ruma and Sheikh (2009) aimed to discuss reuse of wastewater in urban farming in Katsina City located within a semi-arid setting, relying on rainfed for successful promotion of urban farming is certainly a risky enterprise. Thus, resort to the reuse of wastewater that freely flow in drains within the urban setting of the town is one of the readily available options. Urban farming should not be viewed

as a subsidiary and blighted activity on the urban landscape but rather as an important strategy for developing more productive, viable and sustainable urban habitats. This require promoting urban agriculture within the framework of the country's agricultural and urban development policies, in which emphasis will be placed on incorporating urban agriculture into city plans.

A study by (Barham, 2006) was conducted in order to recognize the procedures used in Albireh sewage treatment plant for purification of wastewater and to evaluate the environmental impact of this station on humans in the surrounding area. The study also aimed at evaluating the possibility for the reuse of treated wastewater for various human uses. The results of the analyzed samples of the current study showed that the treatment station is working in good satisfactory level, proved to be capable through the various working stages to get red of water contaminants, and resulted in re-usable water for use in agricultural cleaning of streets purposes. However, if the last stage was working the yielded water might be even for human usage. Solid wastes are also safe to be used as fertilizers. The treatment plant also carried out experimental work on purified water in order to evaluate the possibility of its re-use. Their results proved that the treatment plant is satisfactory and the purified water can be used for irrigation purposes without constituting any harm or spreading of disease, thus, the treatment plant achieved its two major goals; first to prevent pollution and secondly re-use of treated water that helps in solving water crises in the Palestinian territories.

2.9 Area selected

Anza Village

Anzah is a Palestinian village in the Jenin Governorate in the northern West Bank, located 18 km southwest of Jenin City with altitude of 410 m above sea level. The total area of Anzah, according to PCBS (2007), is about 4,740 Dunums. According to the PCBS (2007), the estimated population is about 2,106 inhabitants in 2012.

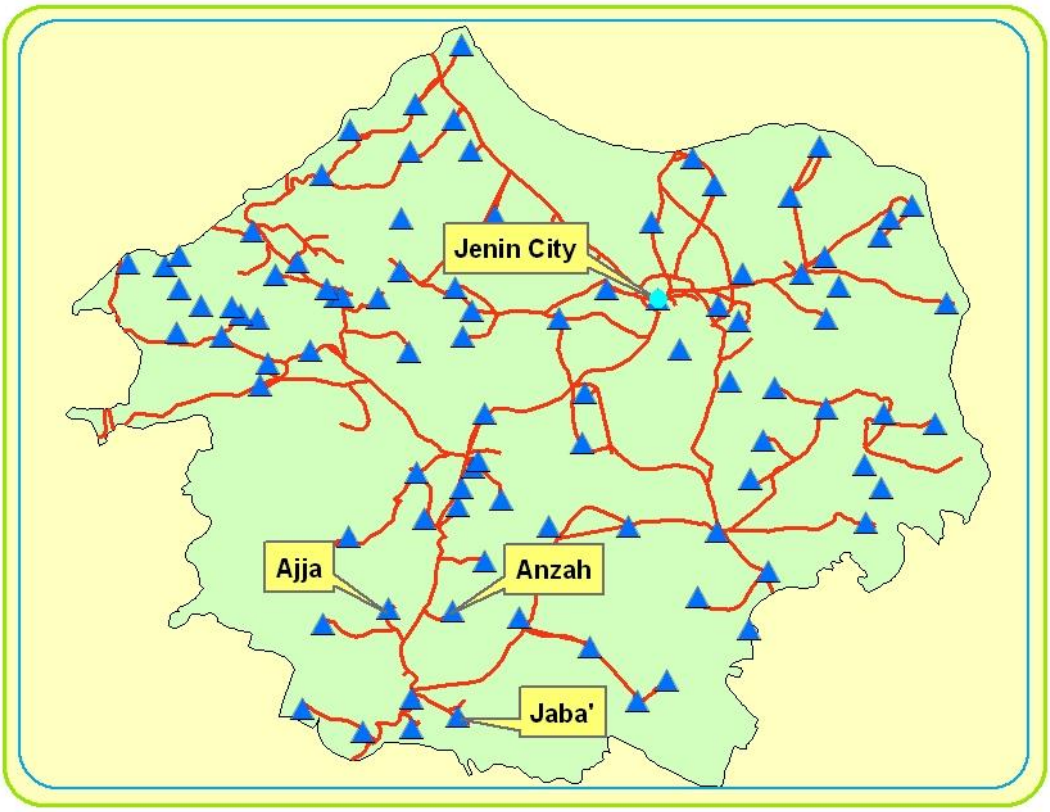


Figure Map of Anzah within Jenin Governorate

Water and Wastewater Situation

Anzah Village depends, for drinking water supply, on Jaba' well which provides the village with about 4,000 to 5,000 m^3 of drinking water per month. The water

continuously pumped from Jaba' well, to a concrete tower at high elevation and distributed through the water network in the village, is restricted to be used only for drinking purposes.

Based on the official records obtained from the village council, the average consumption of water is 48 l/c/d from the network and 41 l/c/d from rainwater harvested in cisterns during winter months. Hence the average consumption of drinking water, from both sources of network and rainwater cisterns, is about 89 l/c/d.

The village is currently using individual sanitation facilities such as cesspits to dispose of wastewater. The frequency of cesspit emptying depends on the cesspit size, geologic formation, water consumption, wastewater generation rates and methods of construction of such cesspits. Evacuation of cesspits is performed using vacuum tankers. Usually the evacuated wastewater is disposed of in the nearby wadis and agricultural lands. The average cost of cesspit evacuation is about 100 NIS per each 6 m^3 tanker load removed.

The computed amount of wastewater generated in the village, based on the population and the water consumption average, is around 135 m^3 in 2010 and 380 m3 in 2035.

Beit Dajan Village

Beit Dajan is a Palestinian village in the Nablus Governorate in the northern West Bank, located 10 km to the east of Nablus City at altitude of 475 to 584 m above sea level. The total area of Beit Dajan, according to PCBS (2007), is about 44,000 Donums. By 2012, the population will be about 3,868 inhabitants PCBS (2007).

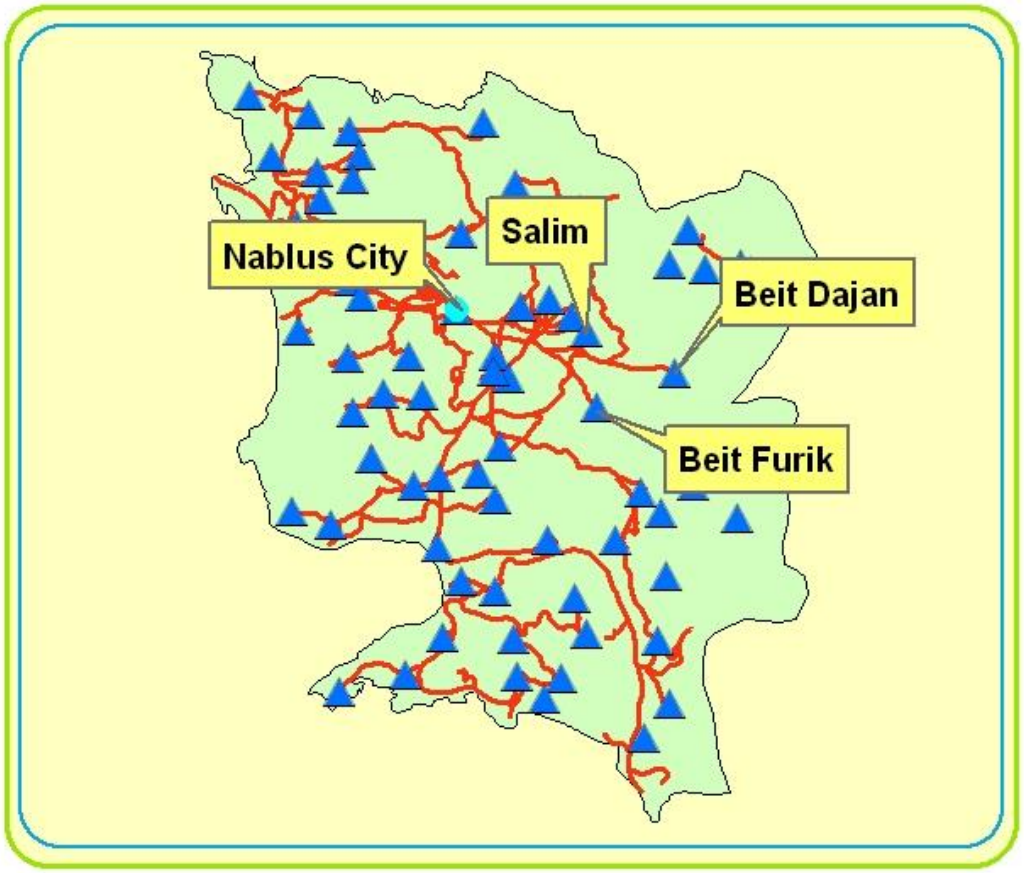


Figure Map of Beit Dajan within Nablus Governorate

Water and Wastewater Situation

Beit Dajan Village depends, for drinking water supply, on Beit Dajan well which provides the village with its needs of drinking water. The water continuously pumped from the well, to a concrete tower at high elevation and distributed through the water network in the village, is restricted to be used only for drinking purposes.

Based on the official records obtained from the village council, the average consumption of water is 43 l/c/d from the network and 23 l/c/d from rainwater harvested in cisterns during winter months. Hence the average consumption of

drinking water, from both sources of network and rainwater cisterns, is about 66 l/c/d.

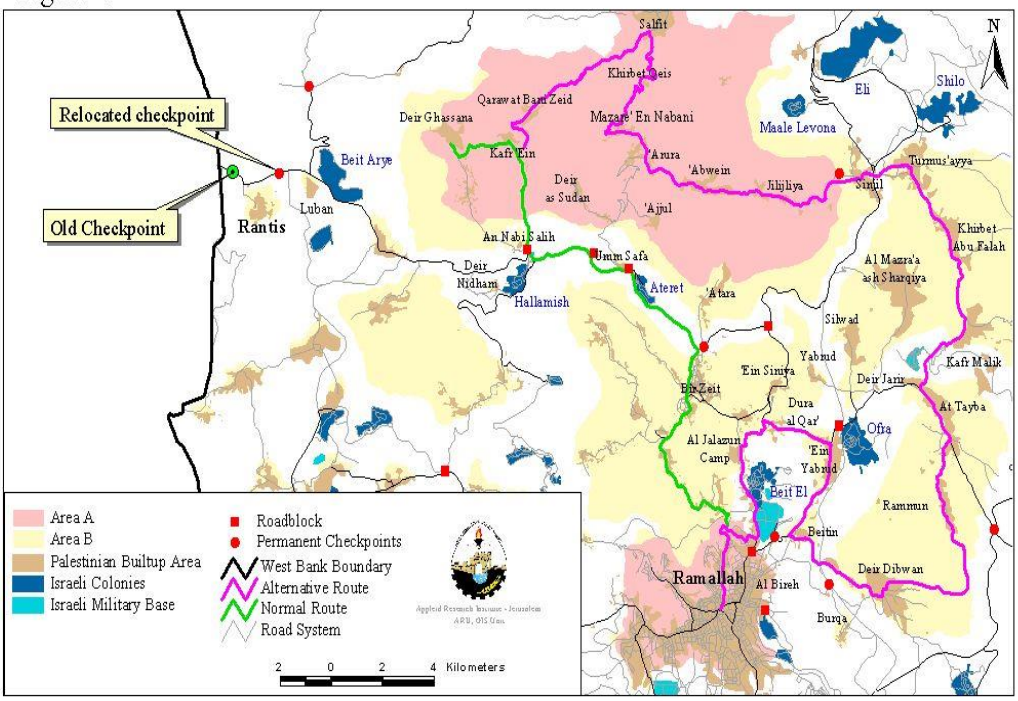
The village is currently using individual sanitation facilities such as cesspits to dispose of wastewater. The frequency of cesspit emptying depends on the cesspit size, geologic formation, water consumption, wastewater generation rates and methods of construction of such cesspits. Evacuation of cesspits is performed using vacuum tankers. Usually the evacuated wastewater is disposed of in the nearby wadis and agricultural lands. The average cost of cesspit evacuation is about 100 NIS per each 6 m^3 tanker load removed.

The computed amount of wastewater generated in the village, based on the population and the water consumption average, is around 218 m^3 in 2010 and 665 m^3 in 2035.

West Bani Zaid Community

West Bani Zaid is a Palestinian community that includes (Beit Reema and Deir Ghassaneh) in the Ramallah and Al-Bireh Governorate in the middle West Bank, located 27 km North –West from Ramallah city. According to the PCBS (2007), the estimated population is about ٦،٢٩٧ inhabitants in 2012.

Figure 4



Water and Wastewater Situation

Bani Zaid WWTP was constructed in 2004, the plant was designed to yield wastewater effluents suitable for direct discharge into the wadis, or reuse in agricultural irrigation under the full capacity of the plant. Till that time few households have been connected to the system and the effluents received are not sufficient and start causing some problems in the system. The plant was designed to receive 80m^3/day, only 31 houses and one school are connected to the system, the amount of wastewater that currently reach the plant is estimated at only 15 m^3/day, at a rate which is not exceeding 20% of the design rate.

The municipality of Western Bani Zaid which is the official body responsible for the operation and maintenance of the treatment plant faced several council changes at the time when PHG handed over the project; this resulted in the lack of

follow up and created problems in the system. In addition to that, the municipality does not have a separate wastewater department, where the operation and maintenance of the plant should be followed up by a specialized technician. The technician who is responsible for the treatment plant was busy with other priorities and dedicated minimum time to the operation and maintenance activities of the plant.

Chapter Three: Methodology

This chapter is devoted to specify the steps and the methodology taken in carrying out the research endeavor.

Study Design

This research is a quantitative design utilizing a survey method in Arabic language. This survey method involves the use of a previous questionnaire designed by Atef Abu Jaish which was prepared by Water and Environment Studies Institute- An-najah National University (WESI) contributing with Palestinian Agriculture Relief Committee (PARC). This study was conducted at 3 targeted areas in North and middle West Bank (Anaza,Beit Dajan and West Bani Zaid).

3.1 Population & Sample of the Study

The population of the study was composed of students, farmers, and households in the targeted areas (Anza, Beit Dajan and West Bani Zaid). Each survey consisted of three questionnaires described as follows:

- The 1st questionnaire was designed and distributed for students in the boys and girls schools from class 9 to 11. The sample of respondents consisted of a total of 496 students.
- The 2nd questionnaire was designed and distributed for direct beneficiaries of 39 farmers who have land in the wastewater treatment plant (WWTP). This sample is about 45.9% of total farmers having land in the WWTP area in Anza and Bet-Dajan villages. Farmers were excluded in Bani Zaid due to

absence of direct farmers in the WWTP according to Western Beni Zaid municipality.

- The 3rd questionnaire was designed and distributed for 108 households of in the targeted areas. Therefore; the total surveyed residents in the targeted areas included 496 students, 39 farmers and 108 householders.

The questionnaire focused on social and economic situation, level of public awareness and practice of the community towards wastewater reuse.

3.2 Students Population

The sample consisted of all of the study population who were (496) students. The researcher managed to distribute the survey to the entire study sample, and he managed to retrieve (422) valid questionnaire, with a response rate of (85.2%). The distribution of the population is according to the Table 3.1:

Table 3. 1 : Distribution of the student population according to targeted areas.

Village Name	#of boys	#of girls	#of responded boys	#of responded girls	%of responded boys	%of responded girls
Anza	63	57	62	50	98.4%	87.7%
Beit Dajan	93	84	63	74	67.7%	89.2%
Western Bani Zaid	88	112	80	93	91%	83%

The population for the first questionnaire was deemed appropriate because the many students were absence during filling the survey; in addition I was exclude 25 questionnaires from the population sample because of uncompleted data.

Table 2.2 shows that about (24%) of the students were from Anza Village, (35.7 %) were from Beit Dajan Village, (40.3%) were from Westren Bani Zaid.

Table 3. 2: Students percentage distribution according to village.

Village Name	Total students Sample (N)	% of the students
Anza	120	24.2
Beit Dajan	177	35.5
Bani Zaid	200	40.3
Total	496	100%

Table 3.3 shows that about (22.6%) of the respondent students were from Anza Village, (27.7 %) were from Beit Dajan Village and (34.9%) were from Western Bani Zaid.

Table 3. 3: Respondent student percentage according to village.

Village Name	Responded students Sample (N)	% of the Students
Anza	112	22.6
Beit Dajan	137	27.7
Bani Zaid	173	34.9
Total	422	85.2

3.3 Farmers

The researcher targeted all the population of farmers who were (85) in Anza and Beit Dajan. The distributions of farmers are 50 from Beit Dajan and 35 form Anza village. The farmers were invited through the local council in the villages through mosque speakers and by phone call for some farmers. The total beneficiaries' who attended the workshop were 39 farmers with a response rate 45.9%. The distribution of the beneficiaries' is according to the Table 3.4.

Table3.4: Respondent beneficiaries farmers percentage according. to village

Village Name	# of beneficiaries Farmers	% of beneficiaries Farmers
Anza	35	41.2
Beit Dajan	50	58.8
Bani Zaid	0	0
Total	85	100%

Table 3.5 shows that about (20%) of the respondent beneficiaries farmers were from Anza Village and (25.9 %) were from Beit Dajan Village. The population for the second questionnaire was deemed appropriate 45.9% from the total beneficiaries' farmers because the many farmers were absence from the workshop due with the olive season and due some other work. Five questionnaires from total 39 questionnaires were personally filled by asking farmers due there are alphabets.

Table 3.5: Distribution beneficiaries farmers percentage according to village.

Village Name	Responded farmers (N)	% of the responded farmers
Anza	17	20
Beit Dajan	22	25.9
Bani Zaid	0	0
Total	39	45.9

3.4 Household distribution and samples

In the part the researcher choose samples randomly from the targeted areas due the difficulty of collecting all the population for workshop. The researcher uses the following statistical equation:

$$\mathbf{n}=\frac{\boldsymbol{K^2NP(1-P)}}{\mathbf{K^2P(1-P)+E^2N}}$$

Where: n= sample size.

K= Confidence level = 1.96

P= Ratio index = 50%

N= Total population size.

E= Error Margin = 9%

By applying the above equation the sample size is 113 household and by treated the sample size from the above equation using the following equation to have a representative sample:

$$\mathrm{n(new)} = \mathrm{n(old)} \div (1 + \frac{\mathrm{n(old)}}{\mathrm{N}})$$

By checking the Palestinian Central Bureau of Statistics, it was revealed that the total number of household in targeted areas is 2630, which means a sample of 108 households should be taken.

Table 3.6 show the distribution of household in targeted areas. The distribution of the randomly household are 18 sample of households from Anza, 25 samples of households from beit Dajan and 65 samples of household form Bani Zaid. Sample was chosen and distributed by simple random sample to the targeted areas (Anza, Beit Dajan and Bani Zaid):

Table 3. 6: Sample size of the household from the village according to above calculations

Village Name	# of household	Sample size
Anza	430	18
Beit Dajan	600	25
Bani Zaid	1600	65
Total	2630	108

3.5 Workshop material

A power point presentation and video presented and the topic discover the water and waste water management system it is focused on the reuse of the effluent for agriculture, the workshops was included many events and stage such as video watching ,WWTP pilot scale which present and explain the stages and the mechanism of the wastewater treatment.

3.6 Field Work

Face-to-face interviews using a structured questionnaire have been conducted to students, beneficiary's farmers and household. The questionnaire collected comprehensive data on a wide range of issues related to the rule of public awareness.

3.7 The Study Fieldwork Procedure

Boys and girls school in Anaza, Beit Dajan and bani Zaid , in additions to the farmers and household in the targeted areas were*:* visited every two days, in each visit doing workshops and distributed questionnaires.

Each interview took (3-4) hours using a structured questionnaire. The field work in targeted areas finished within (16) weeks resulted in interviewing (645) questionnaires.

3.8 Statistical Analysis

Statistical Package for Social Science (SPSS) version 17 was used for data analysis. Various statistical processes were used including means, frequencies, regression were used to determine variation significance. Moreover, factor analysis (principal component analysis) used to determine the most important factors.

3.9 Ethical issues

Permission to conduct this study was obtained from the Palestinian ministry of education in Ramallah for boys and girls schools. In addition, boys and girls school, beneficiary's farmers and household were informed about the purpose of the study before conducting the workshop and the interview and were told that their participation will be voluntary.

Chapter Four: Results Analysis

4.1 Students Questionnaire

After collecting and analysing the data embedded in the students' questionnaire, the following results were obtained:

4.1.1 Knowledge about Water Issues

2.7% of students questioned believed that there is sufficient water available in Palestine and supply exceeds demand while 39.0% believed that water is just sufficient. In the meantime, 54.5% believed that water is insufficient and 3.8% do not know whether water is sufficient or not (table 4.1). 76.3% of students believe that the reason for the water shortage in Palestine is the Israeli Authorities that controls the quantity of water supplied to Palestinians whereas 11.6% believe that the reason is the unwise utilization of water by consumers. Meanwhile 4.1% pointed that water shortage is due to low level of rainfall during winter and 8.1% do not know the reason for that problem.

Table 4. 1: knowledge about water sufficiency

Village name	gender	Water in Palestine			
		Sufficient and more than need	Sufficient	Insufficient	Don't know
Bani Zaid	male	6.1%	58.5%	31.7%	3.7%
	female	1.1%	43.6%	51.1%	4.3%
Anza	male	3.3%	51.7%	40.0%	5.0%
	female	.0%	35.3%	58.8%	5.9%
Beit Dajan	male	4.3%	24.6%	69.6%	1.4%
	female	1.4%	20.3%	75.7%	2.7%
	Total	2.7%	39.0%	54.5%	3.8%

1.2% of students questioned mentioned that there is sufficient water available in the village and supply exceeds demand and 49.5% said that water is just sufficient. Meanwhile 45.3% mentioned that water is insufficient and 4% do not know whether water is sufficient or not.11.5% of students pointed that the reason for the water shortage in the village is the low groundwater well discharge whereas 21.5% said that the reason is the unwise utilization of water by consumers. In the meantime, 15.2% said that this is due to the low capacity of the submerged pump which should be replaced by higher capacity one and 41.2% remarked that the Israeli Authorities does not allow more water discharge from the well while 10.6% do not know why(Table 4.2).

Table 4. 2: Reason of water insufficiency

Village name	gender	if insufficient why				
		Little water discharge of the well	Unwise use	Suction pump small and needs replacement	Israeli control	dont know
Bani Zaid	male	20.6%	17.5%	14.3%	38.1%	9.5%
	female	10.9%	21.8%	7.3%	36.4%	23.6%
Anza	male	3.2%	38.7%	9.7%	41.9%	6.5%
	female	10.7%	21.4%	28.6%	25.0%	14.3%
Beit Dajan	male	7.7%	15.4%	15.4%	61.5%	.0%
	female	16.0%	14.0%	16.0%	44.0%	10.0%
Total		11.5%	21.5%	15.2%	41.2%	10.6%

The results show that students in Beit Dajan have more information's about reasons of water insufficiency than other students in the Anza and West Bani Zaid, and males in all villages show high understanding to the reasons of water insufficiency than females.

Most of the questioned student from the targeted villages have information about water situation in Palestine, based on previous study (Abu Jaish, 2011) carried out in Anza and Beit Dajan found that average of about 30% of the questioned students know that the water in Palestine are insufficient in Palestine, while after attending the workshops in schools that aimed to increase the public awareness found that 54% of the students believe that the water are insufficient.

The researcher found that about 76.3% of students that's said the water are insufficient are due to the control of the Israeli Authorities over water sources in Palestine, this result agrees with the previous studies (Abu Jaish, 2011).

38.6% prefer to drink rainwater harvested in cisterns while 29.5% prefer water from the network. In the meantime, 20.7% do not find any difference between water from cisterns and that from the network and 11.1% do not know which water source is better.

75.2% stated that water chlorination eliminates pathogenic microorganisms while 8.8% stated that chlorination increases these microorganisms and 16.0% do not know the effects of chlorination on microorganisms (Table 4.3).

Table 4. 3: knowledge about use of chlorine.

Village name	gender	Applying chlorine to drinking water will result in		
		Killing microorganisms	Increase microorganisms	Don't know
Bani Zaid	male	59.8%	17.1%	23.2%
	female	67.0%	10.6%	22.3%
Anza	male	80.0%	8.3%	11.7%
	female	78.4%	7.8%	13.7%
Beit Dajan	male	78.3%	8.7%	13.0%
	female	87.8%	.0%	12.2%
Total		75.2%	8.8%	16.0%

The researcher found that the most of students know the role of chlorination applied to drinking water in the network before and after attending the workshop, this is resulted from the education curriculum in the schools in general, and the results show that female know the effect of chlorine in the water network in Beit Dajan and Bani Zaid while in Anza the results relatively close between male and female

4.1.2 Wastewater Treatment and Reuse

6.5% of students defined wastewater as rainwater runoff in wadis while 91.4% defined it as dirt water resulted from using toilet and bathrooms in their homes and 2.1% do not know how to define wastewater (Table 4.4)

57.2% of respondents said that wastewater in their homes is disposed of through cesspits and 27.2% through sewerage system. In the meantime, 9.5% said that they use wastewater for garden irrigation and 1.4% disposes of wastewater in nearby roads and wadis while 4.6% do not know how wastewater is disposed of at their homes.

Table 4. 4: Definition of wastewater

Village name	gender	What does wastewater mean		
		Rainwater runoff	Water resulted from toilet	Don't know
Bani Zaid	male	13.4%	79.3%	7.3%
	female	6.4%	91.5%	2.1%
Anza	male	5.0%	93.3%	1.7%
	female	.0%	100.0%	.0%
Beit Dajan	male	7.2%	91.3%	1.4%
	female	6.8%	93.2%	.0%
Total		6.5%	91.4%	2.1%

The researcher found that about 91.4% of students showed knowledge about wastewater definition, while 88% know about wastewater definition before conducting workshops, which mean that the knowledge about wastewater definition was increased after attending the workshops for students.

20.3% of students mentioned that negative effect of cesspit is due to that wastewater from the cesspit infiltrates into drinking water cistern causing diseases while 9.5% said that wastewater overflows, when the cesspit is full, to the roads causing bad smells. Meanwhile 9.4% stated that evacuation of the cesspit costs much money and 54.5% agreed for all previous negative effects and 6.2% do not know which harms the cesspits might cause (Table 4.5). 7% of respondents declared that their water cisterns were contaminated due to cesspits in their houses and 10% due to cesspits of their neighbors. Meanwhile 31.3% heard about contamination occurred in one of the village cisterns not in their own cistern while 51.7% did not hear about such problem.

Table 4. 5: Negative impacts of cesspits

Village name	gender	Negative impacts of cesspits				Don't know
		Seepage to water cisterns	Flooding and causing bad smell	Evacuation cost	All mentioned reasons	
Bani Zaid	Male	26.8%	17.1%	22.0%	26.8%	7.3%
	Female	12.8%	10.6%	8.5%	58.5%	9.6%
Anza	Male	26.7%	8.3%	1.7%	56.7%	6.7%
	Female	17.6%	5.9%	5.9%	70.6%	.0%
Beit Dajan	Male	24.6%	5.8%	8.7%	55.1%	5.8%
	female	13.5%	9.5%	9.5%	59.5%	8.1%
Total		20.3%	9.5%	9.4%	54.5%	6.2%

98.6% of the questioned students agreed to connect their homes to sewerage network while 10.6 % refused. 9.5% of those students who agreed to connect their

houses to sewerage system attributed that to sewerage network which does not allow wastewater to infiltrate into drinking water cisterns and 9.3% said that no bad smells will be perceived from sewerage networks. Meanwhile 10.7% remarked that wastewater from networks could be used for irrigation and 14.1% remarked that wastewater can protect groundwater from pollution and 56.4% attributed their agreement to all previous reasons (Table 4.6).

Table 4. 6: Reasons for preference of WW network.

Village name	Gender	The advantages of connecting the house to the sewerage system				
		doesn't seep to cisterns	No bad smell	Wastewater used for agriculture	protect groundwater from pollution	all mentioned
Bani Zaid	Male	8.7%	15.9%	18.8%	37.7%	18.8%
	Female	10.4%	9.1%	3.9%	24.7%	51.9%
Anza	Male	15.1%	11.3%	17.0%	3.8%	52.8%
	Female	6.0%	4.0%	8.0%	2.0%	80.0%
Beit Dajan	Male	15.4%	12.3%	10.8%	10.8%	50.8%
	female	1.4%	2.9%	5.7%	5.7%	84.3%
Total		9.5%	9.3%	10.7%	14.1%	56.4%

89.7% of respondents stated that they heard about wastewater treatment process while 10.3% did not hear about that. 76.6% of those students who heard about wastewater treatment pointed that treatment is just eliminating of sediments from wastewater whereas 12.5% stated that it is applying chlorine to wastewater. In the meanwhile 10,9% did not know how this treatment is processed (Table 4.7).

Table 4. 7: Definition of WW treatment.

Village name	gender	Wastewater treatment definition		
		Eliminating sediments from water	Applying chlorine to water	Don't know
Bani Zaid	male	61.8%	29.4%	8.8%
	female	67.5%	7.5%	25.0%
Anza	male	77.2%	8.8%	14.0%
	female	92.0%	6.0%	2.0%
Beit Dajan	male	76.9%	7.7%	15.4%
	female	84.5%	15.5%	.0%
Total		76.6%	12.5%	10.9%

66.8% of students pointed that using treated wastewater for irrigation is necessary and acceptable meanwhile 33.2% mentioned that it is unnecessary and unacceptable (Table 4.8). 13.3% of those who rejected the use of treated wastewater for irrigation attributed that to enough water available and 43% believed that it is unsafe while 21.9% for its bad smell and 13.2% unacceptable from social point of view. 2% of respondents believed that it is forbidden by the Islamic laws and 6.6% because it is not acceptable from most of the people.

Table 4. 8: Acceptance of using WW for irrigation.

Village name	gender	Reusing treated wastewater acceptable and necessary	
		Yes	No
Bani Zaid	Male	50.6%	49.4%
	female	58.1%	41.9%
Anza	Male	74.6%	25.4%
	female	66.7%	33.3%
Beit Dajan	Male	69.6%	30.4%
	female	81.1%	18.9%
Total		66.8%	33.2%

14.6% of students pointed that treated wastewater could be used for drinking purposes and 74.9% for irrigation. Meanwhile 10.4% believed that it is not possible to use it for any purpose as it is forbidden by the Islamic laws (Table 4.9).11.5% of respondents stated that raw wastewater could be used for irrigation without treatment while 69.8% said that it could be used for irrigation only after treatment. Meanwhile 7.3% believed that it is not allowed at all to be used for irrigation and 11.5% do not know how wastewater could be used for irrigation.

Table 4. 9: Attitude about ways of reusing WW.

Village name	gender	Using of Treated wastewater for		
		Drinking	Agriculture	Don't know
Bani Zaid	male	32.1%	39.7%	28.2%
	female	18.3%	79.6%	2.2%
Anza	male	10.2%	76.3%	13.6%
	female	2.0%	92.2%	5.9%
Beit Dajan	Male	15.9%	76.8%	7.2%
	Female	9.5%	85.1%	5.4%
Total		14.6%	74.9%	10.4%

65.4% of students said that treatment of wastewater produces sediments which could be used as fertilizers and 12.9% said that the resulted sediments could not be used for anything whereas 21.7% do not know anything about the resulted matter.

33.6% of respondents prefer to use available treated wastewater to irrigate woodland and 18.1% to irrigate fruit trees. In the meantime, 8% prefer to use treated wastewater to irrigate vegetables eaten without cocking, 4.6% to irrigate

vegetables eaten after cocking and 5.6% to irrigate fodders. 22.3% of respondents said that available treated wastewater could be used for irrigating all trees and vegetables previously mentioned while 7.6% believed that they will not use it at all.

34% of the questioned students refused to eat any agricultural products irrigated with treated wastewater as they negatively affect health and 11.7% because they believed that such products are religiously dirty. Meanwhile 36.2% said that they will eat these products as they do not affect health and such products are not religiously rejected while 18.1% remarked that they will eat these products only if no other products are available. 21.5% of students said that among advantages of reusing treated wastewater is reducing water crisis, 10.9% mentioned that it transforms unirrigated land to irrigated and 5.7% pointed that treated wastewater increases the family income when reused for irrigation. In the meantime, 49.9% agreed on all previously opinions while 12% do not know any advantages of reusing treated wastewater (Table 4.10).

Table 4. 10: Advantages of using treated WW for irrigation

Village name	gender	Advantages of reusing treated wastewater for agriculture				
		Mitigate water crises	Transform unirrigated land to irrigated one	Increase the family income	All mentioned	Don't know any of these advantages
Bani Zaid	male	31.2%	15.6%	14.3%	16.9%	22.1%
	female	24.7%	9.7%	2.2%	35.5%	28.0%
Anza	male	22.0%	10.2%	6.8%	50.8%	10.2%
	female	15.7%	5.9%	.0%	76.5%	2.0%
Beit Dajan	male	21.7%	14.5%	4.3%	53.6%	5.8%
	female	13.5%	9.5%	6.8%	66.2%	4.1%
Total		21.5%	10.9%	5.7%	49.9%	12.0%

In General the results show in most of questions that the female have more idea and understanding for the workshops subjects than male in three selected area Anza,Beit Dajan and West Ban Zaid.

4.2 Household Questionnaire

After collecting and analyzing the data embedded in the questionnaire from the households, the following results were obtained:

4.2.1 Social Issues

6.2% of household were under 25 years, 53.1% of household were between 25-35 years, 24.4% of household were 36-45 years, and 16.4% of household are above 45 years. 3.9% of household were analphabet, 17.7% of households were educated to the elementary stage level, 12.9% to the secondary stage level, 10.9% have diploma, and 54.5% have bachelor degree level or above.

4.2.2 Water Issues

94.1% of households rely exclusively on the water network to meet their water needs, whereas only 1% relies on water cisterns, 3% rely on tankers and 2% rely from other sources.

41.2% of households emphasized that water from the network is supplied continuously and rarely disconnected. In the meantime, 30.4% said that it is frequently disconnected and 27.4% said that water is mostly disconnected.

18.4% of households monthly average of water consumption was 0-10 m3, 26.5% of households the monthly average consumption was 11-20 m^3, 33.7% was 21-30 m^3 and 21.4% more than 30 m^3.

51.5% of the questioned households have water cisterns to store harvested rainwater during winter. 40% of the questioned households have black water separated from the grey water.

4.2.3 Wastewater Treatment and Reuse

49% of households pointed that they dispose of wastewater via infiltration cesspits, 24.5% via confined cesspits, 5.9% via irrigated the garden and 20.6% via public sewerage system.

8.8% of the households questioned prefer to disposing of wastewater in unconfined cesspit, 3.9% prefer to disposing in confined cesspit, 20.6% prefer in onsite treatment unit and 66.7% prefer to connect their houses with the proposed sewerage network (Figure 4.1). 95.1% of householders understand what wastewater treatment means (Figure 4.2).

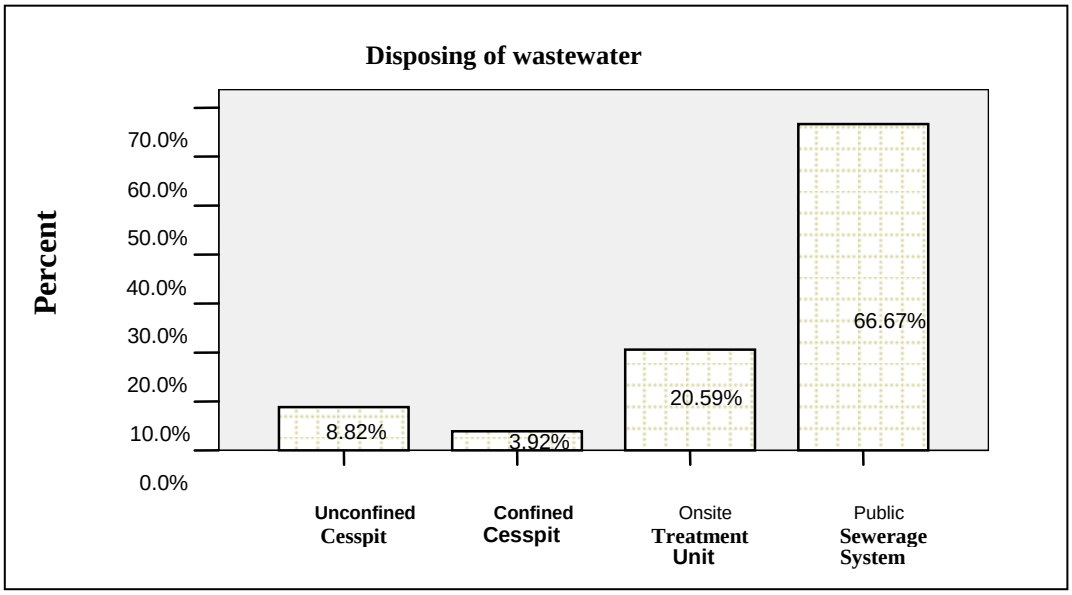


Figure 4. 1: Methods prefer for wastewater disposing.

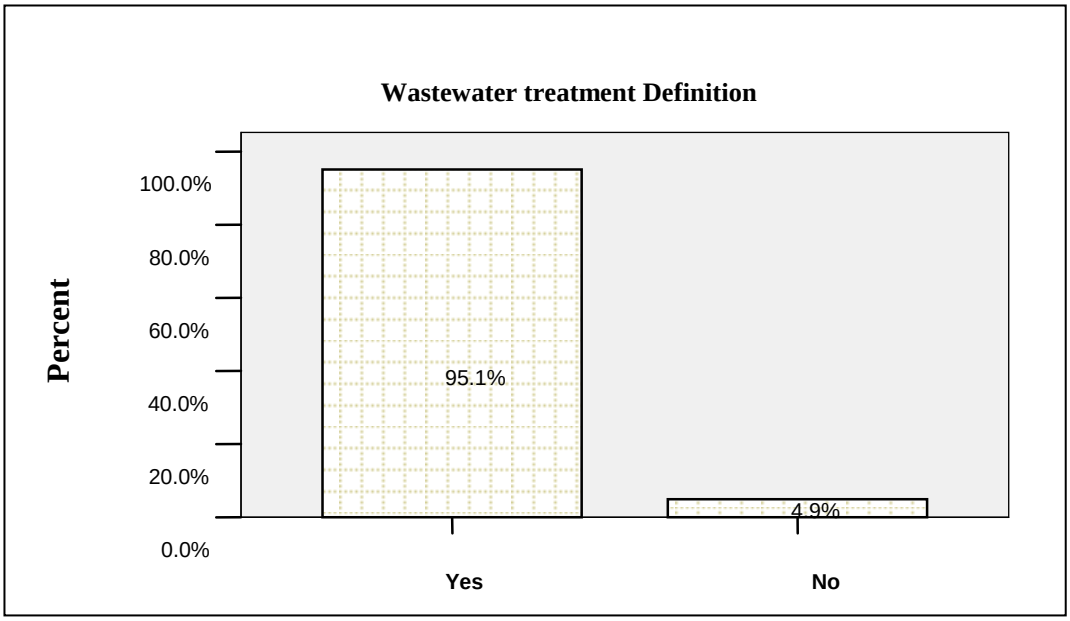


Figure 4. 2: Wastewater treatment meaning

91.9% of those who understand the meaning of wastewater treatment agreed to treat wastewater out flowing from their houses (Figure 4.3).

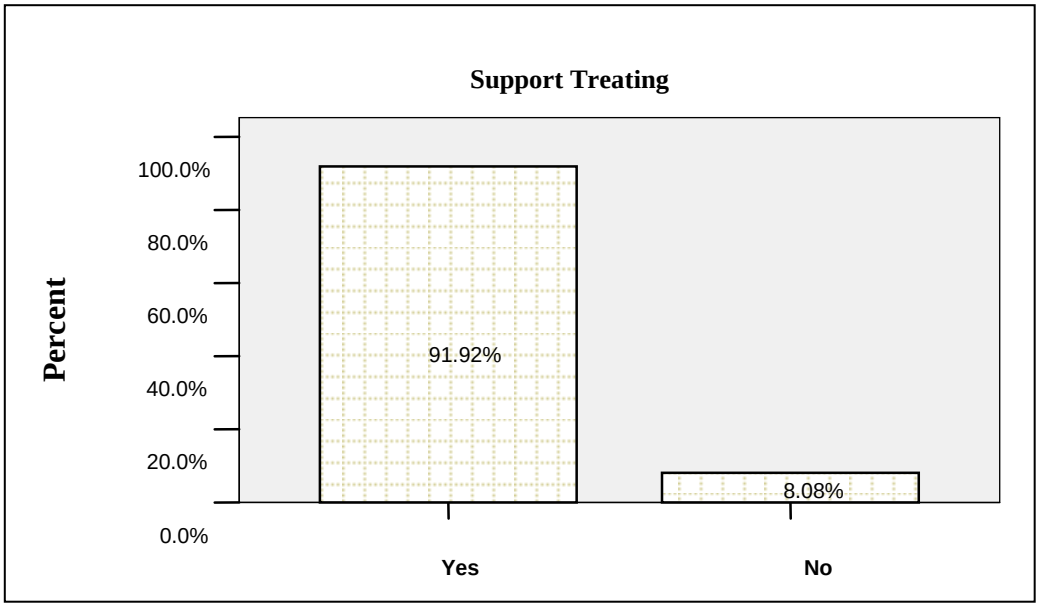


Figure 4. 3: Supporting wastewater treatment.

14.7% of households remarked that they feel bad smell from using the infiltration cesspit, 13.7% feel the existence of insects, 39.2% feel bad smell and existence of insects at the same time, while 32.4 % pointed that they do not feel about that at all.

54.6% of questioned households don't evacuate the cesspit in the year, 30.9% evacuate more than three times per year, 7.2% evacuate once per year, 5.2% evacuate twice per year and 2% evacuate three times per year.

26.8% of households believe that the cesspit evacuation cost is little, 27.8% believe that cost is reasonable, while 45.4% believe that cost is high (Figure 4.4).

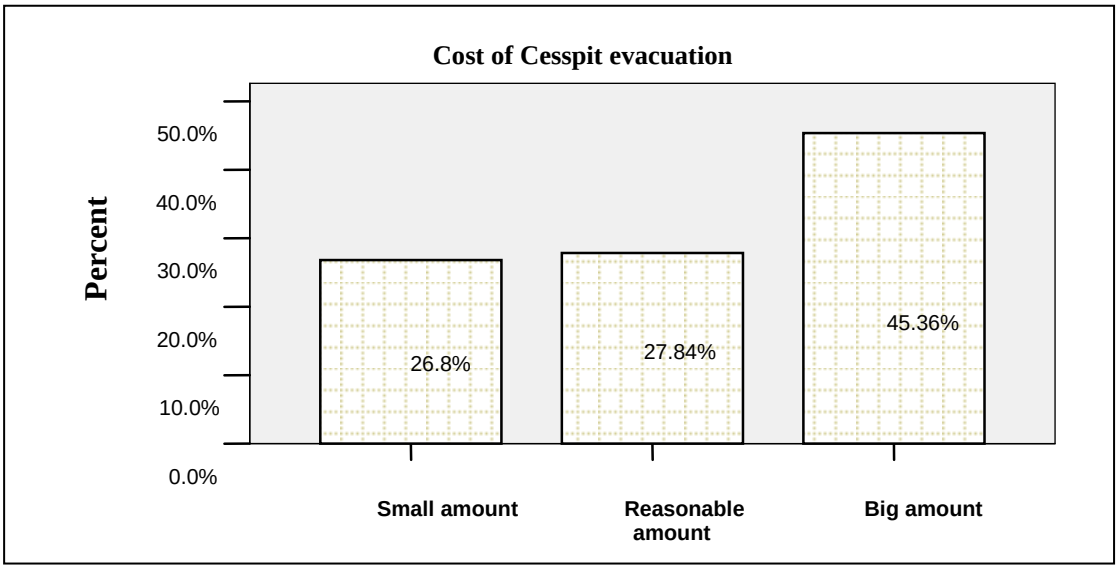


Figure 4. 4: Attitude about cost of cesspit evacuation.

12.7% of households believe that problems generated during wastewater evacuation are only smell and insects, 2.9% pointed that the only problem is the evacuation cost, 3.9% attributed water contamination to evacuation process, while 80.4% emphasized that smell, insects, and cost are all together real problems generated during cesspit evacuation (Figure 4.5).

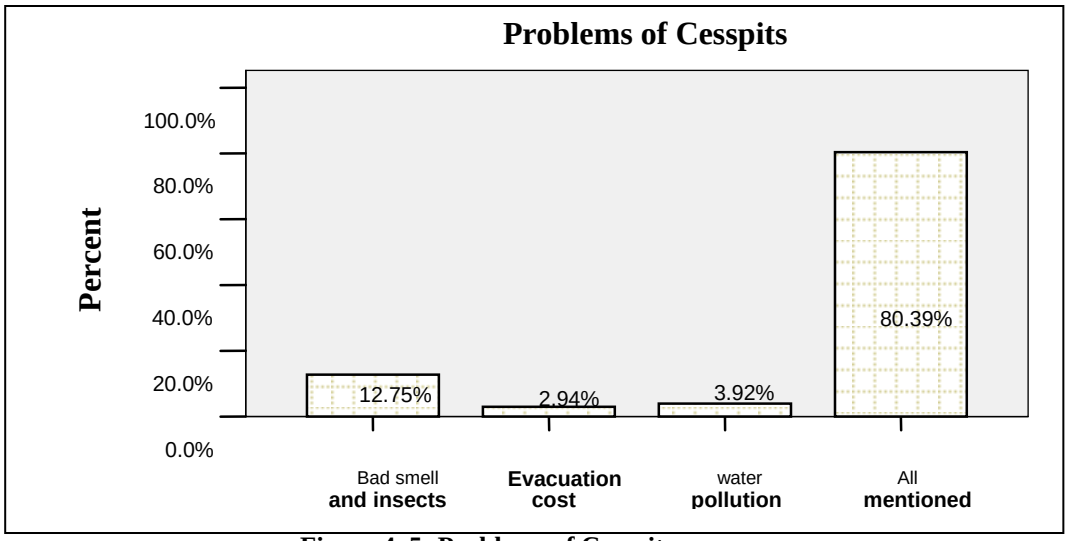


Figure 4. 5: Problems of Cesspits

2.9% of households remarked that the main disadvantage of using infiltration cesspits is its construction cost, 6.7% its overflowing, 3.9% seepage to water cisterns, and 1% seepage to springs and groundwater wells. In the mean time, 82.2% believe that all previously mentioned are real disadvantages.

98% of households supported the idea of constructing a WWTP in the village (Figure 4.6)

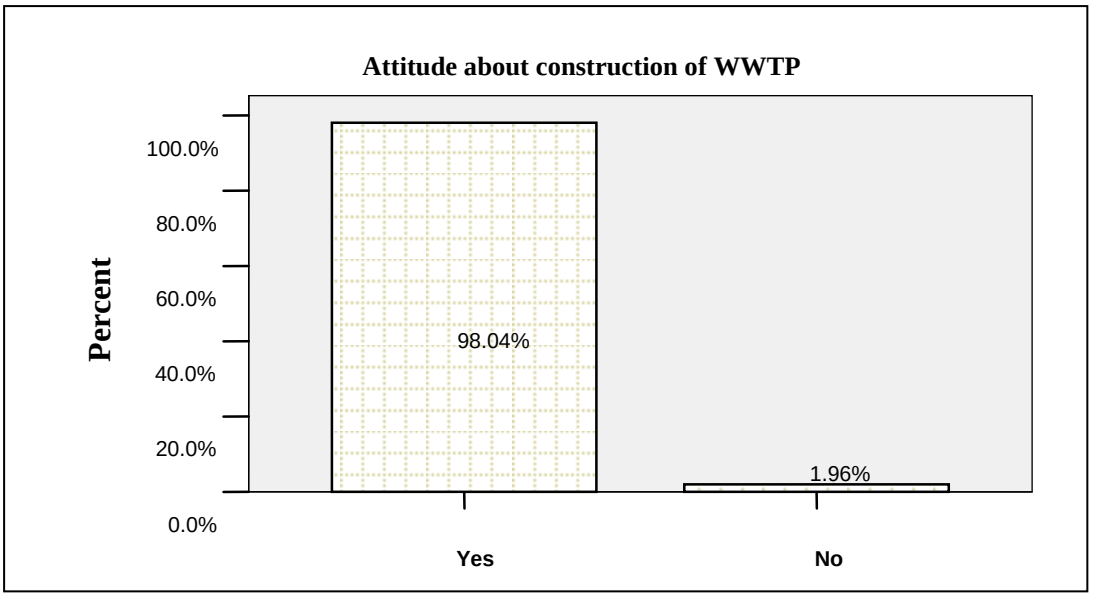


Figure 4. 6: Attitude about construction of WWTP

93.1% of households expressed their willingness to pay money contribution for the construction of the wastewater sewerage network and treatment system, whereas 6.9% refused to pay (Figure 4.7).

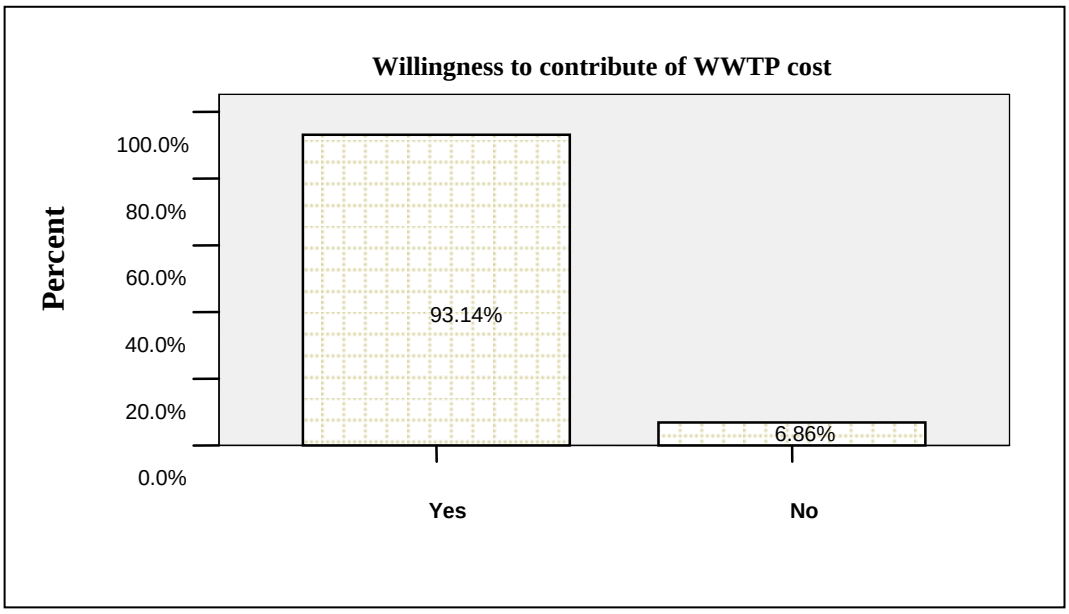


Figure 4. 7: Willingness to contribute of WWTP cost

97.1% expressed their willingness to pay monthly fees for wastewater services after connecting their houses to sewerage network, whereas 2.9% rejected that (Figure 4.8).

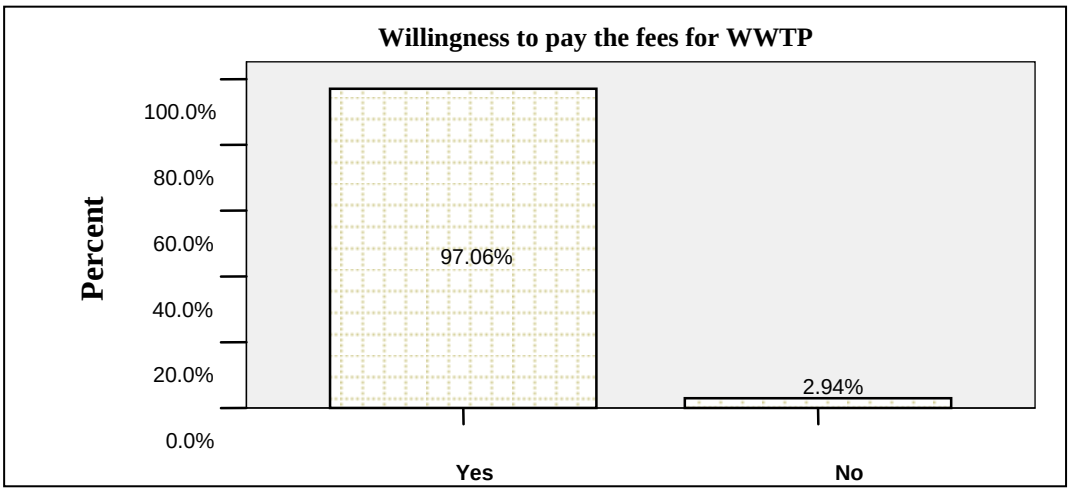


Figure 4. 8: Willingness to pay the fees for WWTP after connecting

62.8% of households prefer to add the wastewater monthly services cost to the monthly water bill according to the amount of water consumed during that month, meanwhile 37.2% prefer to add a fixed amount of money to each monthly water bill.92.2% of households expressed their agreement to reuse the treated wastewater to irrigate their lands, while 7.8% refused that (Figure 4.9).

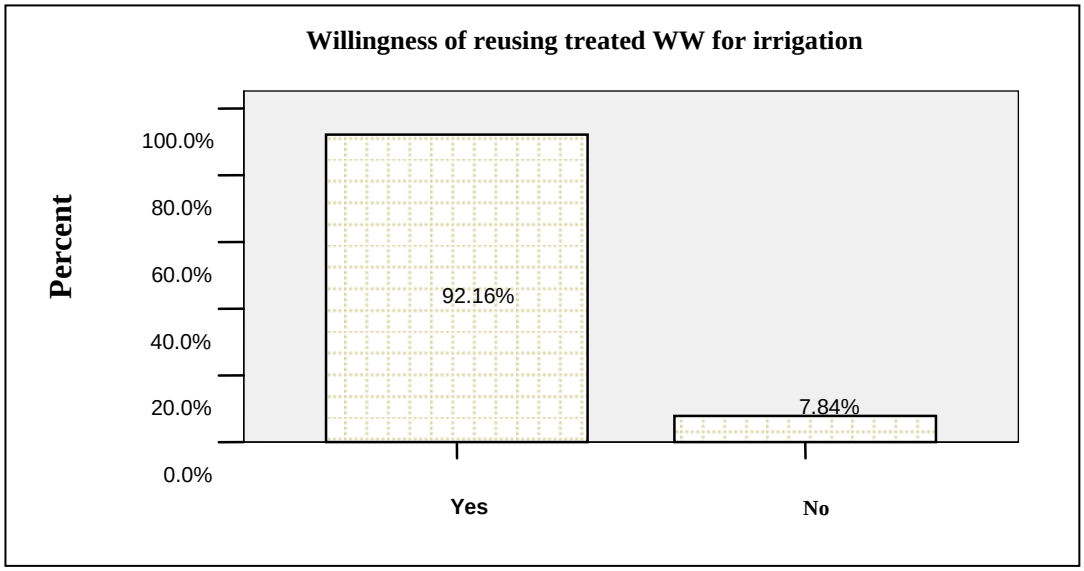


Figure 4. 9: Willingness of reusing treated WW for irrigation

85.2% of households will work in agriculture if their land was reclaimed and irrigated by treated wastewater while 14.8% will not do that (Figure 4.10).

Figure 4. 10: Willingness of working in land after reclamation

70.6% of households consider reusing of wastewater for irrigation is acceptable and necessary; meanwhile 29.4% rejected that (Figure 4.11).

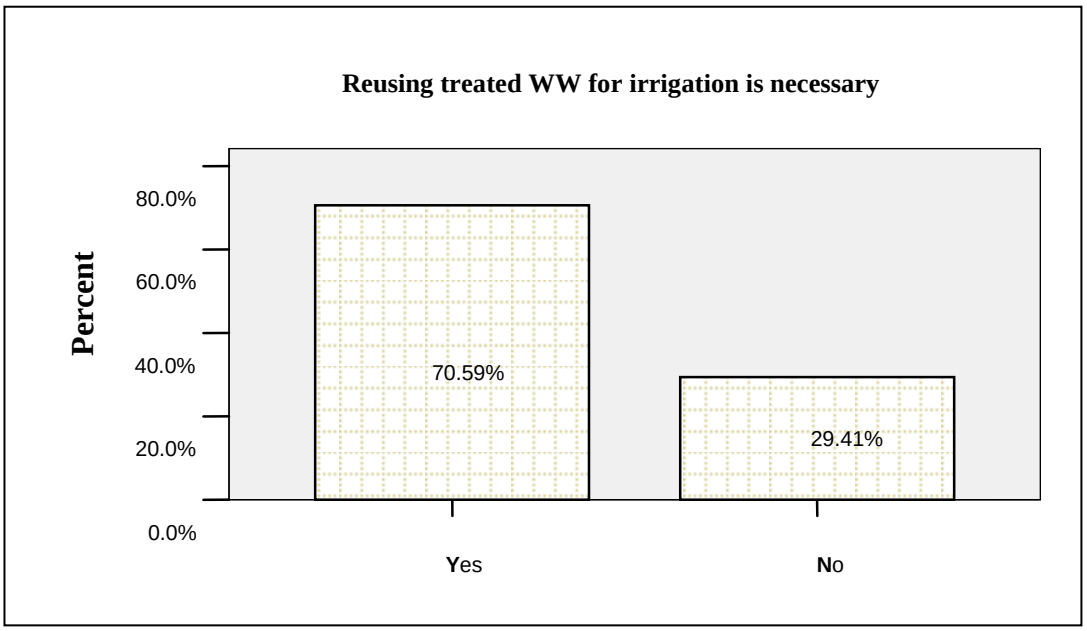


Figure 4. 11: Reusing treated WW for irrigation is necessary and acceptable.

64.3% of households who support reusing of treated wastewater for irrigation attributed that to water insufficiency, 27.1% to its cheaper price, and 1.4% to its safety (Figure 4.12).

52.5% of households who did not accept reusing wastewater for irrigation attributed that to its risky, 15.0% to its bad smell, 22.5% to social reasons, and 7.5% to religious reasons and 2.5 to water sufficiency.

71.6% of households have garden in their houses and 89.1% of the questioned households have used grey water for irrigation and 10.9% don’t use the grey water.

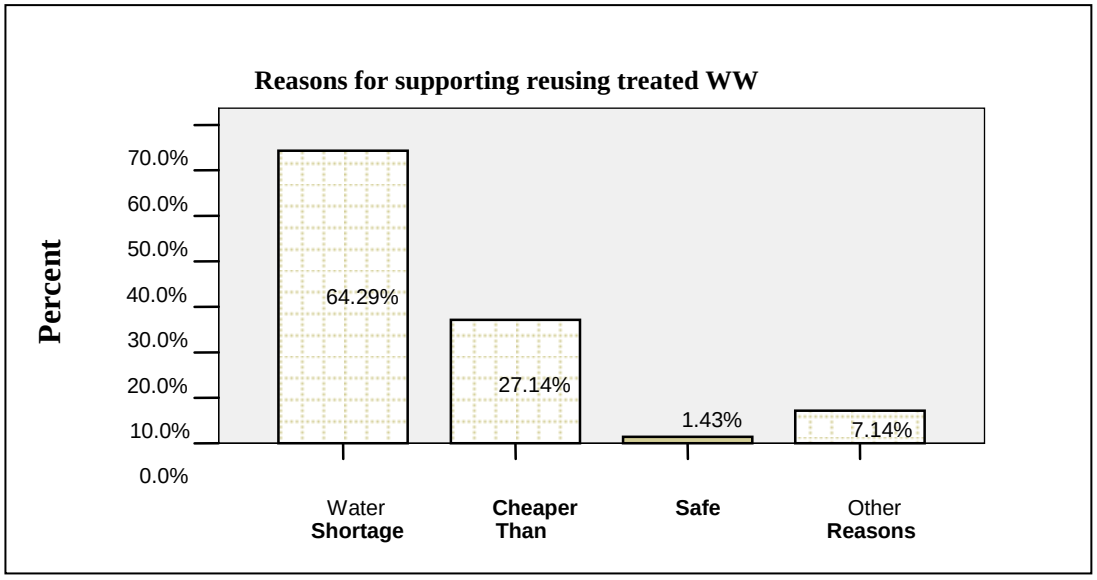


Figure 4. 12: Reasons for supporting reusing treated WW for irrigation.

4.3 Farmers Questionnaire

After collecting and analyzing the data embedded in the farmers' questionnaire, the following results were obtained:

4.3.1 Socio-Economic Issues

It was found that the age average of farmers surveyed was 57.6 years. All farmers sampled were males and all were married as well.

10.5% of farmers were analphapatic, 46.3% of farmers were educated to the elementary stage level, 25.4% to the secondary stage level and 17.9% have bachelor degree level or above.

The average of the household size was 8.9 persons. The monthly income average was found to be 1982 NIS.

97.8% of farmers reported that lands they are cultivating are their own where 2.2 of farmers reported that lands they are cultivating are sponsored.

The average of all area of land owned by the farmer was 52.2 dunums.

The average of area of land owned by the farmer, which is suitable for agriculture, was 11.8 dunums.

The average of area of land owned by the farmer, which is unsuitable for agriculture, was 39.5 dunums. The average of area of land owned by the farmer, which is already cultivated, was 11.7 dunums. 94.8% of the cultivated area, owned by the farmer, was rain fed land and 5.2% was irrigated.

61.1% of the rain fed irrigated area was cultivated with wheat while 5.6% was cultivated with barley, 5.5% was cultivated with vegetables and 27.8% was cultivated with other crops. 25% The available irrigated area is irrigated by network,25% by groundwater and 50% by other sources.

The average price of water used for irrigation was 4 NIS/m^3. The average of annual income of the farmer from agricultural activities was 2034 NIS.

30.8% of farmers sell their agricultural products in the market, 64.1% consumed by family, and 5.1% use them for other purposes.

The average of area of land owned by the farmer nearby the proposed WWTP site was 7.5 dunums.

4.3.2 Wastewater Treatment and Reuse

92.3% 0f farmers supported the idea of constructing a WWTP in the village where 7.7% refused the idea.

10.3% of farmers pointed that the objective of treating wastewater was saving water for irrigation, 5.1% protecting the environment, and 79.5% for all mentioned reasons and 5.1% doesn't achieve anything (Figure 4.13).

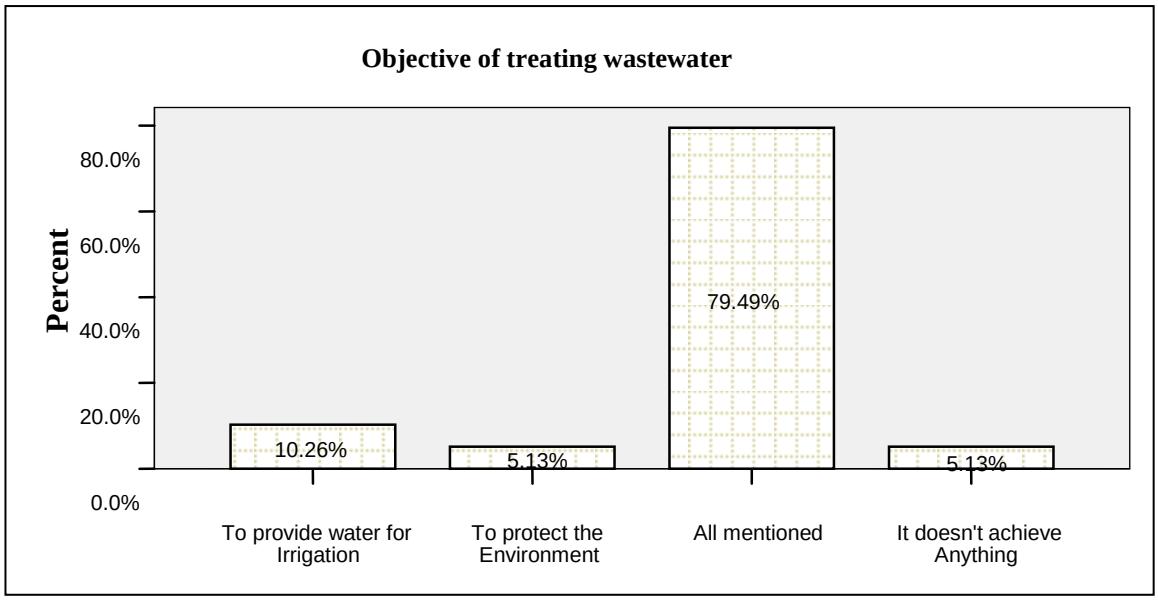


Figure 4. 13: Main objectives of treating WW.

28.2% of farmers believe that harms from using untreated wastewater for irrigation were attributed to health hazards, 5.1% tocontamination of environmental harms,5.1% to agricultural harms and 61.6% to all possible risks, health, environmental, agricultural, soil, groundwater, and economic (Figure 4.14)

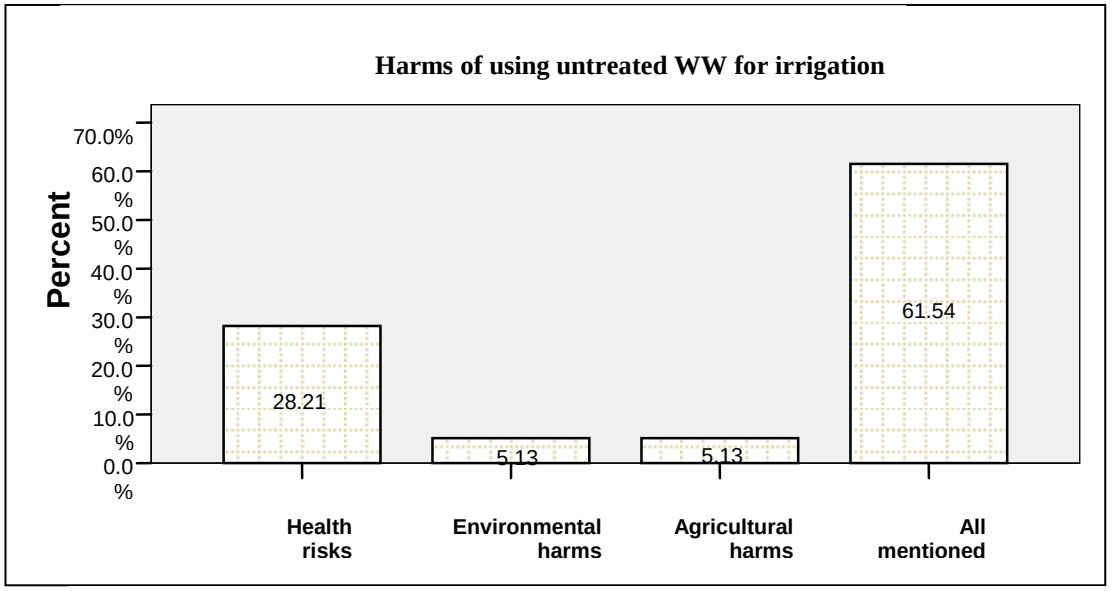


Figure 4. 14 :Expected harms of using untreated WW for irrigation

18.9% of the farmers remarked that their acceptance of reusing the treated wastewater for irrigation was associated with providing more water , 5.4% their acceptance associated with price of treated wastewater less than potable water,5.4 their acceptance associated with Acceptability of public to purchase products irrigated by treated wastewater,5.4% their acceptance associated with Concern of health risks,2.7% their acceptance associated with acceptability of public the unconditional use of treated wastewater, and 62.2% their acceptance was associated with all previously mentioned reasons.

59.5% of farmers had been targeted by public awareness programs about reusing treated wastewater for irrigation while 40.5% had not (Figure 4.15).

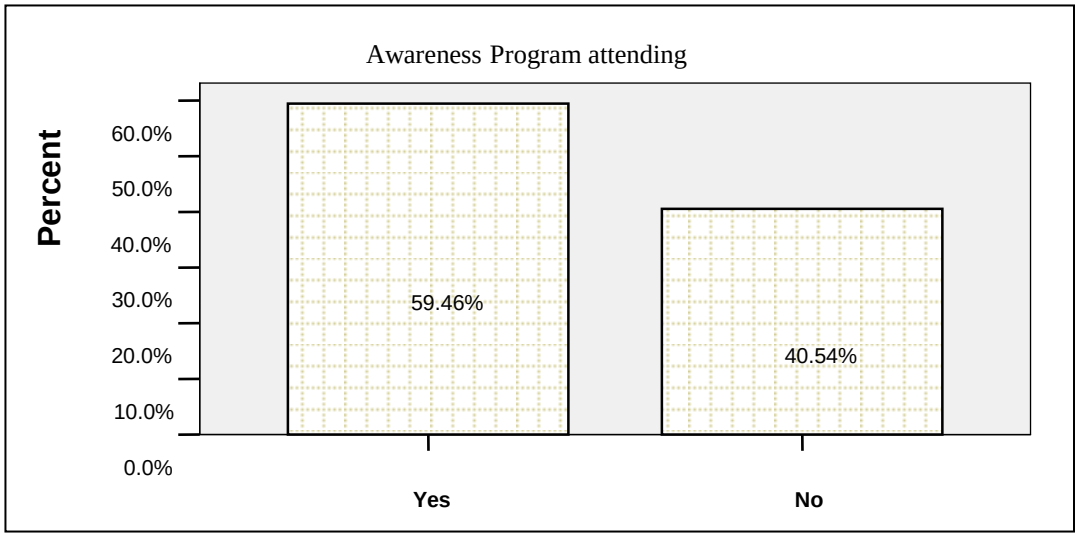


Figure 4. 15: Farmers targeted by awareness programs

97.3% of farmers know that wastewater disposed of in cesspits will be collected and treated in a WWTP where 2.7 didn't know about it.

All of farmers said that they are happy to have such project and they support.

97.3% of farmers know what does treatment of wastewater mean where 2.7 didn't know (Figure 4.16).

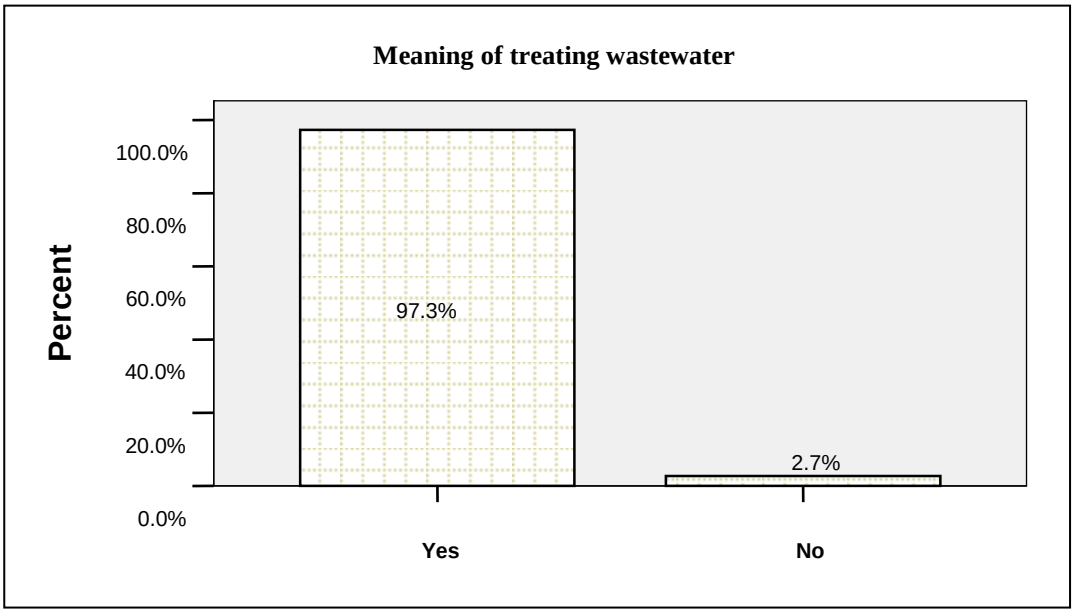


Figure 4. 16: Meaning of wastewater treatment.

78.4 % of farmers are cultivating their lands nearby the proposed WWTP site.

19.4 % of farmers cultivating their lands nearby the proposed WWTP site pointed that they plant fruit trees, and 80.6% plant grains (Figure 4.17).

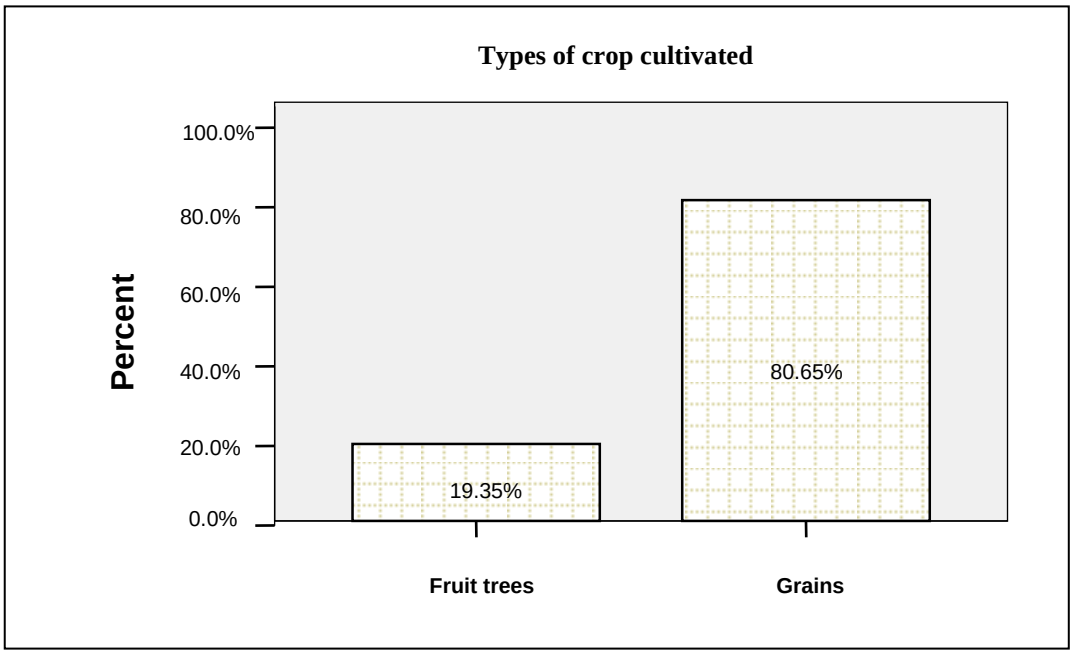


Figure 4. 17: Types of crop cultivated in land nearby WWTP

The average of annual income of the farmer, from utilizing the land nearby the WWTP proposed site, was 1,162 NIS. 94.6% 0f farmers are willing to reuse the treated wastewater for irrigation (Figure 4.18).

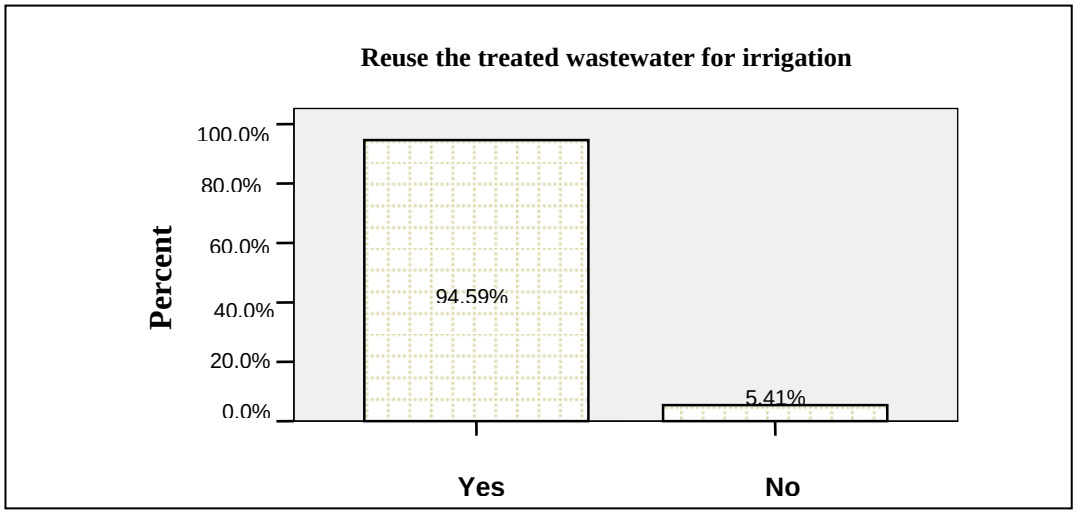


Figure 4. 18: Willingness to reuse treated WW.

16.2% of the questioned farmers pointed that, after the construction of the WWTP, will construct greenhouses to plant various types of vegetables, and 83.8% will plant fruit trees (Figure 4.19).

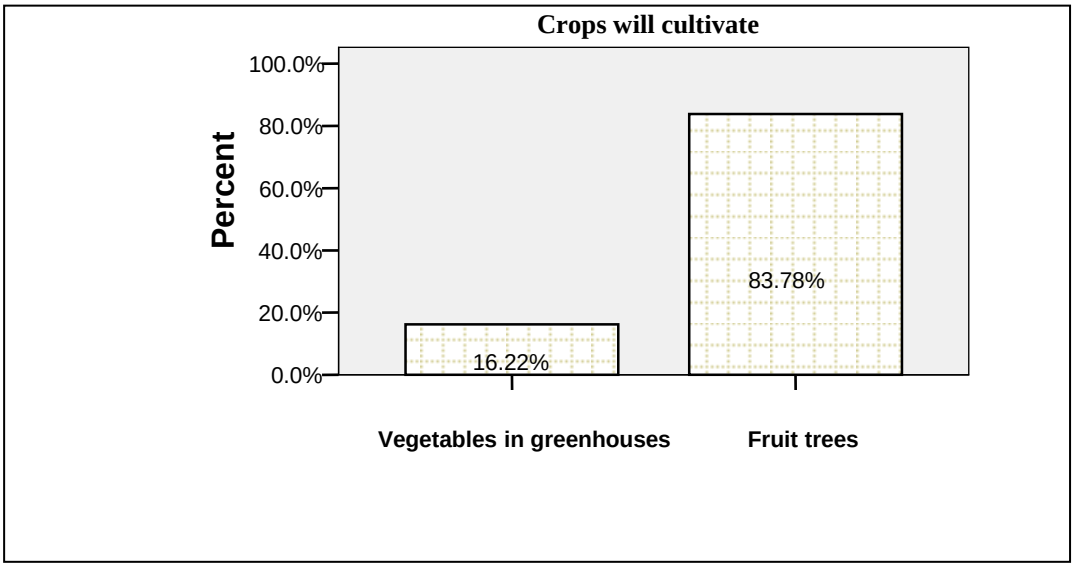


Figure 4. 19: Crops to be cultivated nearby the WWTP site.

94.6% of farmers emphasized that they will eat from products, from their land, irrigated by treated wastewater while 5.4% refused (Figure 4.20).

Figure 4. 20: Attitude about eating products irrigated by treated WW

All those who refused to eat from products irrigated by treated wastewater attributed that to all mentioned reasons (Psychological, Social, Health and Religious) reasons.16.2% of farmers consider the treated wastewater as disgusting while 83.8% do not have the same attitude (Figure 4.21).

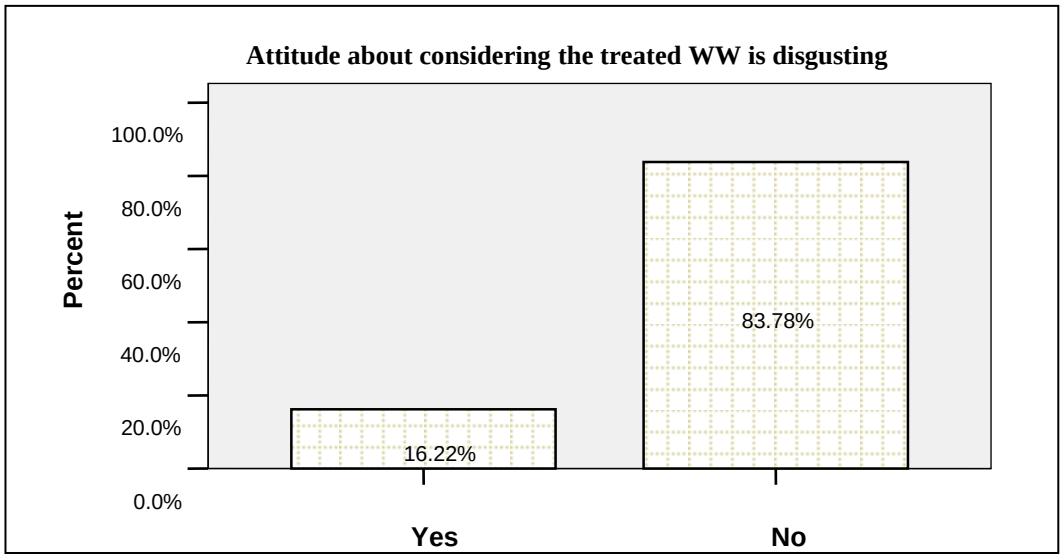


Figure 4. 21: Attitude about considering the treated WW is disgusting

29.7% of farmers accept using the generated sludge to fertilize fruit trees only and 27.3% to fertilize both fruit trees and vegetables while 29.7% accept to use it to fertilize woodland only where 13.5% don't accept using sludge.

94.6% of farmers consider cultivating of their land nearby the WWTP will create work opportunities for them and their families to improve their economic conditions whereas 5.4% do not have the same view. 78.4% of the questioned farmers have sufficient experience in the irrigated agriculture while 21.6% do not have.

86.5% of farmers agreed to contribute to pay for the cost of the project, and 80% of those preconditioned payment to be proportional to the area owned there, while 13.5% refused that completely.

91.4% agreed to pay for the amount of treated wastewater used by them with a price of no more than 1.1NIS/m^3 whereas 8.6% refused that.

28.6% of farmers believe that constructing of the WWTP will significantly increase the value of the nearby lands while 5.7% believe that the value may slightly increase. In the meantime, 8.6% believe that the value may slightly decrease while 14.3% believe that the land value will significantly decrease. However, 42.8% of the questioned farmers believe that the value of land will not change (Figure 4.22).

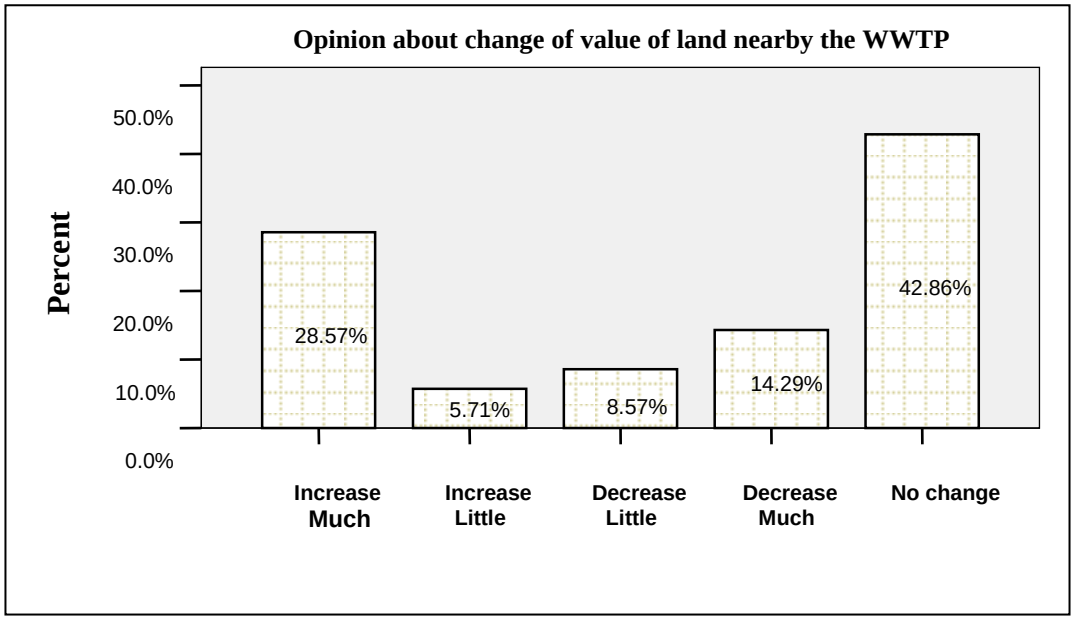


Figure 4. 22: Opinion about change of value of land nearby the WWTP

21.6% of farmers remarked that, after constructing the WWTP, they will themselves practice farming and 73% will practice farming with other members of the family, whereas 5.4% said that they will hire workers.

83.8 of farmers focused on the necessity for routine laboratory testing of the treated wastewater to determine its suitability for irrigation where 16.3% it didn't nessecerly.

86.5% of the farmers expressed their knowledge that most of local agricultural products as well as those imported from Israel are being irrigated by treated wastewater while 13.5% denied that they know. 48.7% of the latter group emphasized that, after they know, they will stop purchasing and consuming such products.

26.3% of the farmers need explanation and proof that treated wastewater not harmful where 73.7% didn't need after the workshops and public awareness campaigns.

2.7% of the farmers will sell the products irrigated by treated wastewater in their village while 97.3% will sell these products in the central vegetable market.

86.5% of the farmers like to have instructions with regard to irrigated agriculture practices. Where 13.5% didn't need instructions.

83.8% of farmers will reuse treated wastewater for irrigation if the potable water not available while 16.2% will not reuse it.

Chapter Five: Conclusions and Recommendations

5.1 Conclusions

In General, according to the results obtained from this study and compared with the previous study results (Abu Jaish, 2011), the researcher found that public awareness campaigns and workshops conducted for the targeted group's students, farmers and women raised the level of the information's and awareness about the importance of the wastewater treated and reuse for agricultural irrigation.

The researcher believes that these public awareness campaigns contribute on the sustainability of the WWTP projects and reuse of the treated wastewater for irrigation.

The researcher found that the most respondent students said that the wastewater in their home is disposed through cesspits and they agree in high respondent that the cesspits have many negative impacts that affect the surrounding environment and they agree and support connecting their houses to the proposed sewerage network and the most of them believe that there is a positive impact of the sewerage network.

The researcher found that about 90% of students heard about wastewater treatment process, while 85% know about wastewater treatment process before conducting workshops, which mean that the knowledge about wastewater treatment process was increased after attending the workshops for students and about 76% of them said that the wastewater treatment is the eliminating of sediments from wastewater while 68% of them said the same definition before conducting the workshops.

Most percentage of students considers reusing of treated wastewater for irrigation acceptable and necessary. Those who do not accept reusing of treated wastewater attribute that mainly to unsafe for health and bad smell concerns. The majority of students prefer to reuse the treated wastewater to irrigate woodland and fruit trees only. They are aware about advantages of reusing wastewater for irrigation, in general.

Most of the households dispose of wastewater through confined or unconfined cesspits and at the same time most of them prefer to dispose of their wastewater through connecting their houses with the sewerage system. The majority of households know what treatment of wastewater means and hence they support treating wastewater out flowing from their houses.

The majority of households are aware about the different disadvantages of disposing of wastewater via cesspits and almost all support the idea of constructing a WWTP. Consequently, the majority of households have the willingness to financially contribute to construct the WWTP and at the same time to pay the wastewater fees after constructing the WWTP. About tow third of householders prefer to pay these fees according to their water consumption and to be added to the monthly water bill, whereas the other one thirds prefer to pay a monthly fixed amount.

Most of households consider reusing of treated wastewater for irrigation acceptable and necessary and this attitude is mainly because of the shortage of water availability, and most of them have the acceptability to work in agriculture if their land was reclaimed and irrigated by treated wastewater. Those who have

negative attitude with respect to reusing of treated wastewater for irrigation attributed that to its risky and social reasons. In other study, before attending the workshops, about two thirds of households consider reusing of treated wastewater for irrigation acceptable and necessary.

The monthly average income of the farmers is about 1,982 NIS and the annual average income from cultivating their land in the village is about 2,034 NIS. Most of the land they are cultivating is their own. Almost all of the owned land is rain fed as no water resources are available for irrigation purposes. More than half of crops produced in the village are consumed by the family and the remaining is sold in the market.

The majority of farmers agrees and supports the idea of constructing a WWTP in their villages to gain all advantages of treating wastewater. Farmers, in general, are aware about the importance of treating wastewater and about the disadvantages of using infiltration cesspits to dispose of wastewater after conducting public awareness programs about reusing wastewater for irrigation. The training courses with regard to reusing wastewater for irrigation was promote and increase their willingness to reusing wastewater for agriculture and these results are agreed with the previous study.

Most farmers who plant field crops such as wheat in the land nearby the WWTP will, after constructing the WWTP, change the pattern of agriculture to plant fruit trees instead such as almond, apricot and plum trees in addition to olive trees and vegetables in greenhouses, while in the previous study about half of the farmers 55% said they will use the treated wastewater for fruit trees and about third of the

farmers said they will plant uncovered vegetables and construct greenhouse. The public awareness workshops highlight on the specifications of the effluent reuse for agriculture especially for trees.

The majority of farmers are likely to eat products irrigated by treated wastewater as they consider the treated wastewater clean, safe and not disgusting. Those who rejected that attributed their rejection mainly to psychological reasons in addition to health, religious, and social reasons. This result agrees approximately with the previous studies where about 88% of the farmers are likely to eat products while 94.5% of the farmers are likely to eat the products irrigated by treated wastewater in this research.

Farmers will use the generated sludge for fertilizing fruit trees, vegetables and wooden land, if the use of sludge. About two thirds of the farmers consider that cultivating their land nearby the WWTP site will create work opportunities for the family members and in turn will significantly increase their economic conditions.

The majority of farmers expressed their willingness to financially contribute to the project but one third of them will contribute only if the amount of contribution is proportional to the area owned by the farmer. About one third of the farmers believe that land value nearby the WWTP will increase while less than half of them believe farmers believe that the value of land will not change

The majority of farmers express their need for raising public awareness with regard to the safety and cleanliness of the treated wastewater. However, once a Fatwa in this regard is issued, this will encourage the trend towards reusing the treated wastewater.

(Table 5.1) shows a plain comparison with figures between previous study results and the results obtained. In general all results obtained in this study show either an increase in percents or agreed with the results in the previous study.

Table 5 .1: Illustrate a figure comparison for the results.

Questions	Before Workshops	After workshops
Students		
Wastewater definition	88%	91.4%
Insufficient are due to the control of the Israeli Authorities	79.5	76.3%
Wastewater treatment definition	68%	76%
Treated wastewater reuse for irrigation necessary	66.6%	66.8%
Wastewater produces sediments which could be used as fertilizers	48.2%	65.4%
Water situation in Palestine is insufficient	30%	54%
Households		
Willingness to pay the fees for WWTP	81.9%	97.1%
Treatment of wastewater means and hence they support treating wastewater out flowing from their houses.	79.5%	95.1%
Willingness to contribute of WWTP cost	86.7%	93.1%
Willingness of reusing treated WW for irrigation	75.8%	92.2%
Farmers		
Willingness to reuse the treated wastewater for irrigation	95%	97%
Eat the products irrigated by treated wastewater	88%	94.5%

5.2 Recommendations

The recommendations of this study are the following:

- Public awareness campaign must have the priority in the strategic plan for any WWTP to achieve the economic benefits from WWTP.
- Conducting training and public awareness programs targeting students at schools, householders, and farmers must be conducted to raise the knowlgment and culture and to achieve the sustainability for the wastewater treatment plant.
- The school curriculums have to be including Wastewater-related topics to be learned for the students in all school grades.
- The sustainability and successful of the WWTP and reuse of treated wastewater for agricultural irrigation is related with the public awareness and training course not for consumers only, but for the technical team who responsible for the operating and maintainace of the WWP
- We need to empower human and institutional capacities in local education organizations in the development community.
- The researcher believes that these public awareness campaigns contribute on the sustainability of the WWTP projects and reuse of the treated wastewater for irrigation.

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Appendixes

1. **Students Questionnaires**

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BIRZEIT UNIVERSITY

سلطة المياه الفلسطينية
PALESTINIAN WATER AUTHORITY

الموقع:

عمر الطالب..... الجنس ١ - ذكر ٢ - أنثى ***الصف.....***

إستبانة الطلاب

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(١) معلومات حول المياه

q1- المياه في فلسطين:

١- متوفرة وتزيد عن الحاجة ٢- متوفرة ٣-غير متوفرة ٤ - لا أعرف

q2- إذا كانت غير متوفرة فما الأسباب؟

١- تحكم السلطات الإسرائيلية في كميتها ٢- الاستخدام المفرط و غير الرشيد

٣- قلة هطول الأمطار في الشتاء ٤- لا أعرف

q3- المياه في قريتك:

١- متوفرة وتزيد عن الحاجة ٢- متوفرة ٣-غير متوفرة ٤ - لا أعرف

q4- **إذا كانت غير متوفرة فما الأسباب؟**

١- إنتاج البئر الارتوازي قليل

٢ - الاستخدام المفرط وغير الرشيد للمياه

٣- مضخة سحب الماء من البئر الارتوازي صغيرة وتحتاج تبديل

٤- الإسرائيليون لا يسمحون بسحب الماء بكميات أكثر من ذلك ٥- لا أعرف

q5- **صلاحية المياه للشرب تكون أفضل:**

١- إذا كانت من البئر المنزلي (الحاووز) ٢- من شبكة توزيع المياه

٣-البئر المنزلي والشبكة نفس الشيء ٤- لا أعرف

q6- **إضافة الكلور إلى مياه الشرب:**

١- يؤدي إلى قتل الميكروبات المسببة للأمراض

٢- يؤدي إلى زيادة الميكروبات المسببة للأمراض

٣- لا أعرف.

(٢) معلومات حول المياه العادمة

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q7- ما معنى المياه العادمة؟

١- مياه الأمطار التي تجري في الوديان ولا نستفيد منها.

٢- المياه الناتجة عن المراحيض والمغاسل.

٣- لا أعرف.

q8- كيف يتم التخلص من المياه الناتجة عن المراحيض والمغاسل في منزلكم، أين تذهب؟

١- الحفرة الامتصاصية

٢- شبكة المجاري العامة

٣- ري الحديقة المنزلية

٤- الشارع أو الأودية المجاورة

٥- لا أعرف

q9- ما هي برأيك أضرار الحفرة الامتصاصية في المنازل؟

١- تتسرب للآبار المنزلية فتلوثها وتسبب الأمراض

٢- تفيض في الشارع عند الامتلاء وتسبب الروائح الكريهة

٣- نسحبها عند الامتلاء بواسطة الصهريج وهذا يكلف كثيرا

٤- جميع العيوب السابقة

٥- لا أعرف

q10- هل حدث تلوث للبئر في منزلكم بسبب الحفرة الامتصاصية الخاصة بكم أو الخاصة بمنزل الجيران؟

١- نعم، حدث من الحفرة الامتصاصية في منزلنا

٢- نعم، حدث ولكن من الحفرة الامتصاصية في منزل الجيران

٣- سمعت أن ذلك قد حدث للبئر الخاص بأحد سكان القرية وليس في منزلنا

٤- لم اسمع عن مثل هذا التلوث

q11- هل أنت مع فكرة شبك منزل العائلة بشبكة صرف صحي:

١- نعم ٢- لا (لماذا..) (انتقل إلى q13)

q12- **إذا كان الجواب نعم فما هي فائدة ربط منزلنا بشبكة صرف صحي:**

١ - مياه شبكة الصرف الصحي لا تتسرب إلى الآبار المنزلية

٢- لأن مياه شبكة الصرف الصحي لا ينتج عنها روائح كريهة في المنزل

٣- مياه شبكة الصرف الصحي يمكن استخدامها في الزراعة بعد معالجتها.

٤- تحمي المياه الجوفية من التلوث.

٥- كل ما ذكر.

q13- هل سمعت بمعالجة مياه شبكة الصرف الصحي:

١- نعم ٢- لا (أنتقل إلى q15)

q14- **إذا كان الجواب نعم، معالجة مياه الصرف الصحي هي:**

١- إزالة الملوثات من هذه المياه

٢- إضافة كلور إلى هذه المياه ٣- لا أعرف

q15- هل تعتبر ري المزروعات بمياه الصرف الصحي المعالجة مقبولة و ضرورية

١- نعم (انتقل إلى q17) ٢- لا

q16- **إذا كان الجواب لا، ما هي أهم الأسباب لعدم استعمال المياه العادمة المعالجة**

١- وفرة المياه ٢- غير آمنة صحيا ٣- روائح كريهة ٤- غير مقبولة اجتماعيا

٥- محرمة في الشريعة الإسلامية ٦- غير ذلك

q17- برأيك بعد معالجة مياه شبكة الصرف الصحي فإنه:

١- يمكن استخدامها للشرب ٢- يمكن استخدامها للزراعة

٣- لا يمكن استخدامها في أي شيء

q18- ما هو الأفضل برأيك عند استخدام مياه الصرف الصحي لري المزروعات:

١- استخدامه كما هي دون معالجة ٢- استخدامها بعد المعالجة

٣- لا يجوز استخدامها ٤- لا أعرف

q19- بعد معالجة مياه شبكة الصرف الصحي:

١- تنتج رواسب يمكن استخدامها كسماد

٢- تنتج رواسب ولا يمكن استخدامها في شيء ٣- لا أعرف

q20- إذا توفرت مياه صرف صحي معالجة للزراعة فانا أفضل استخدامها لري:

١- الأشجار الحرجية ٢- الأشجار المثمرة ٣-الخضروات التي تؤكل دون طبخ

٤-الخضروات التي تؤكل بعد الطبخ ٥- فقط علف الحيوانات كالبرسيم ٦- كل ما ذكر

٧- لن استخدمها مطلقا.

q21- إذا علمت أن المنتجات الزراعية التي اشتريتها كانت مروية بمياه صرف صحي معالجة فإنني:

١- أرفض تناولها مطلقا لأنها تضر بالصحة

٢- أرفض تناولها مطلقا لأنها نجسة من الناحية الدينية

٣- أتناولها لأنها لا تضر بالصحة ولا تتعارض مع التعاليم الدينية

٤- أتناولها فقط إذا لم يوجد بديل من الخضروات مروي بمياه عادية

q22- من مزايا استخدام المياه المعالجة للزراعة:

١- يخفف من أزمة المياه

٢- تحول الأرض البعل إلى ارض مروية

٣- يزيد من دخل الأسرة عند استخدامها لري المزروعات

٤- كل ما سبق

٥- لا أعرف مزايا استخدام مياه الصرف الصحي المعالجة

2. Households questionnaires

الموقع:_____

إستبانة ربات البيوت

١. **العمر:**

ا- اقل من ٢٥ سنة. ب- ٢٥- ٣٥ سنة. ج- ٣٦- ٤٥ سنة. د- اكبر من ٤٥ سنة.

٢. **المؤهل العلمي:**

ا. أمي ب. أساسي ج. ثانوي د. دبلوم هـ. بكالوريوس فأعلى.

٣. **مصدر مياه الشرب في المنزل:**

أ- شبكة عامة ب- آبار جمع ج- تنكات د- أخرى حدد..

٤. **هل يتم قطع المياه عن منزلك:**

أ- غالبا ب- بشكل متكرر ج- نادرا .

٥. **معدل الاستهلاك الشهري للمياه بالنسبة للأسرة: (م^3)**

أ- ٠-١٠ ب- ١١-٢٠ ج- ٢١-٣٠ د- اكثر من ٣٠ .

٦. **هل يوجد بئر جمع في المنزل:**

أ- نعم ب- لا .

٧. **هل المياه السوداء (المرحاض) مفصولة عن المياه الرمادية (المطبخ والحمام (الدش)):**

أ- نعم ب- لا .

٨. **كيف تتخلص من المياه العادمة في منزلكم؟**

أ- حفرة امتصاصية منفذة ب- حفرة صماء ج- أتركها تسيل في الشارع د- ري الحديقة المنزلية هـ- من خلال محطة معالجة منزلية و- شبكة المجاري العامة.

٩. ما هي الطريقة التي تفضل أن تتخلص بها من المياه العادمة؟

أ- حفرة امتصاصية منفذة ب- حفرة صماء

ج- وحدة معالجة منزلية د- ربط المنزل بشبكة صرف صحي

١٠. هل تعرف ما معنى معالجة المياه العادمة؟

أ- نعم ب- لا

١١. إذا كانت الإجابة نعم، هل تؤيد معالجة المياه العادمة الخارجة من منزلك؟

أ- نعم ب- لا

١٢. هل تشعر بروائح كريهة أو تواجد حشرات في منزلك نتيجة استخدام الحفرة الامتصاصية في التخلص من المياه العادمة ؟

أ- اشعر بروائح كريهة ب- اشعر بتواجد حشرات ج- أ+ ب د- لا اشعر بذلك مطلقا.

١٣. كم مرة تفرغ الحفرة الامتصاصية سنويا: (مرة)

١٤. كم يكلفك سنويا عملية تفريغ الحفرة الامتصاصية: (شيكل)

١٥. كيف تقيم التكلفة المصروفة على نضح المياه العادمة:

أ- قليل ب-معقول ج- عالي.

١٦. ما هي أهم المشاكل المصاحبة لعملية التخلص من مياه المجاري:

أ- الرائحة والحشرات ب- تكلفة النضح ج- تلوث المياه د- كل ما ذكر.

١٧. هل تعلم ما هي أهم عيوب استخدام الحفرة الامتصاصية ؟

أ- مكلفة ماديا ب- تفيض وتسبب مكرهة صحية ج-قد تتسرب إلى ابار الجيران فتلوثها

هـ - تلوث المياه الجوفية و- تأخذ مساحة من المنزل ز- جميع ما ذكر.

١٨. هل أنت مع فكرة إنشاء محطة معالجة للمياه العادمة:

أ- نعم ب- لا

١٩. هل عندك الاستعداد دفع مساهمة مالية نقدية لتوسيع شبكة المجاري و محطة تنقية المياه العادمة في البلدية.

ا- نعم ب- لا

٢٠. هل لديك الاستعداد لدفع رسوم شهرية للبلدية/المجلس القروي مقابل خدمات الصرف الصحي بعد وصل منزلك بشبكة المجاري:

أ- نعم ب- لا

٢١. ما هي الآلية التي تفضليها للدفع:

أ- إضافة نسبة على سعر مياه الشرب المستهلكة ب- إضافة مبلغ مقطوع شهرياً .

٢٢. إذا ما توفرت إمكانية لاستصلاح بعض الأراضي وريها هل ستقومين بتشجيع الاسرة بالعمل في الزراعة.

أ- نعم ب- لا

٢٣. في حالة توفر مياه عادمه معالجة هل لديك استعداد لاستعمالها في زراعة أرضك

أ- نعم ب- لا

٢٤. هل تعتبر ري المزروعات بالمياه العادمة السوداء أو الرمادية المعالجة مقبولة و ضرورية

أ- نعم ب- لا .

٢٥. إذا كان الجواب نعم، فما الأسباب؟

أ- نقص المياه ب-أرخص من المياه العذبة ج-آمنة د-غير ذلك

٢٦. إذا كان الجواب لا، ما هي أهم الأسباب لعدم استعمال المياه العادمة المعالجة.(يمكنك اختيار اكثر من اجابة).

أ- وفرة المياه ب- غير آمنة ب- ذات روائح كريهة ج- غير مقبولة اجتماعيا

د- محرمة في الشريعة الإسلامية.

٢٧. هل لديك حديقة منزلية مزروعة حول منزلك

أ- نعم ب- لا .

٢٨. إذا كان الجواب نعم، فهل تستخدم المياه الرمادية الناتجة من منزلك في ري

أ- الأشجار ب- الخضروات المزروعة في الحديقة .

٢٩. هل تؤيد أم تعارض توسيع شبكة المجاري

أ- أؤيد ب- أعارض.

3. Farmers questionnaires

Austrian Development Cooperation

جامعة بيرزيت BIRZEIT UNIVERSITY

سلطة المياه الفلسطينية PALESTINIAN WATER AUTHORITY

V1 الموقع: ١ - بيت دجن ٢ - عنزة

إستبانة المزارعين

أولا: المعلومات الشخصية:

١- عمر المزارع: (سنة)

٢- الجنس: ١. ذكر ٢. أنثى

٣- الحالة الزواجية: ١. أعزب ٢. متزوج ٣. مطلق ٤. أرمل

٤- الحالة التعليمية: ١. أمي ٢. أساسي ٣. ثانوي ٤. جامعي

٥- عدد أفراد الأسرة: (فرد)

٦- الدخل الشهري: (شيكل)

٧- ملكية الأرض: ١. مالك ٢. مستأجر ٣. ضامن

٨- مساحة الأرض الكلية التي تمتلكها: (دونم)

٩- مساحة الأرض الكلية التي تمتلكها والقابلة للزراعة: (دونم)

١٠-مساحة الأرض الكلية التي تمتلكها والغير قابلة للزراعة: (دونم)

١١-مساحة الأرض المزروعة: (دونم)

١٢-هل الأرض المزروعة: ١. بعلية ٢. مروية٣. كلاهما

١٣-إذا كانت الأرض المزروعة بعلية ما هو نوع المزروعات

١. قمح ٢. شعير ٣. خضروات ٤. أخ

١٤-إذا كانت الأرض المزروعة مروية، ما هو مصدر المياه المستخدمة للري

١. مياه من الشبكة ٢. بئر جوفي ٣. مياه الينابيع ٤. مصادر أخرى ٥. مياه عادمه

١٥-سعر كوب المياه المستخدم لأغراض الري: (شيكل)

١٦-متوسط كمية المياه المستخدمة لأغراض الر في مزرعتك: (م^3/دونم)

١٧-ماذا تفعل بالمحصول الزراعي:

١. يباع في الأسواق ٢. استهلاك ذاتي ٣. يباع لأغراض الصناعة ٤. أخرى

١٨-الدخل السنوي من الزراعة: (شيكل)

١٩-مساحة الأرض المملوكة في منطقة المشروع: (دونم)

ثانيا: معلومات عامة حول مياه الصرف الصحي

٢٠- هل أنت مع فكرة إنشاء محطة معالجة للمياه العادمة: ١. نعم ٢. لا

٢١- برأيك، ما هو الهدف من معالجة المياه العادمة:

١. لتوفير مياه الري ٢. لتجنب المخاطر الصحية ٣. للحفاظ على البيئة

٤. لأسباب اقتصادية ٥. كل ما ذكر ٦. لا يحقق شيء

٢٢- برأيك، ما هي الأضرار المتوقعة من استخدام مياه عادمه غير معالجة لأغراض الري

١. مخاطر صحية ٢. مخاطر بيئية ٣. أضرار زراعية ٤. أضرار للتربة

٥. أضرار للمياه الجوفية ٦. أضرار اقتصادية ٧. كل ما ذكر

٢٣- أي من الأسباب التالية تؤثر على تقبلك لفكرة استخدام المياه العادمة المعالجة لأغراض الري:

١. لتوفر المياه ٢. سعر المياه العادمة المعالجة مقارنة بالمياه العذبة

٣. تقبل الناس لشراء المحاصيل المروية بالمياه المعالجة ٤. التخوف من مخاطر صحية

٥. تقبل الاستخدام غير المشروط للمياه لأغراض الري ٦. كل ما ذكر

٢٤- هل سبق وزرت مزرعة تروى بمياه عادمه معالجة

١. نعم ٢. لا

٢٥- هل استهدفت ببرامج بيئية توعوية حول إعادة استخدام المياه المعالجة في الري في السابق

١. نعم ٢. لا

٢٦- هل تعاني منطقتك من نقص في المياه:

١. نعم ٢. لا

٢٧- هل تعلم أن مياه الصرف الصحي التي تذهب إلى الحفرة الامتصاصية حاليا في منزلك سيتم نقلها من خلال شبكة إلى محطة لمعالجة هذه المياه قرب القرية؟

١. نعم ٢. لا

٢٨- هل أنت مرتاح لتنفيذ هذا المشروع وموافق عليه؟

١. نعم ٢. لا

٢٩- هل تعرف ما معنى معالجة المياه العادمة؟

١. نعم ٢. لا

٣٠- إذا كانت الإجابة نعم، هل تؤيد معالجة المياه العادمة الخارجة من منزلك؟

١. نعم ٢. لا

٣١- في الوقت الحاضر هل تقوم بزراعة الأرض في المنطقة القريبة من محطة معالجة مياه الصرف الصحي؟

١. نعم ٢. لا

٣٢- إذا كانت الإجابة نعم ما هو نوع المحصول الذي تزرعه حاليا؟

١. أشجار مثمرة ٢. حبوب ٣. خضروات

٣٣- ما مقدار الدخل السنوي الذي تحصل عليه من جراء استغلالك لهذه الأرض القريبة من موقع المحطة .شيكل؟

٣٤- عندما سيتم إنشاء محطة المعالجة هل ترغب باستخدام المياه المعالجة في الري؟

١. نعم ٢. لا

٣٥- إذا كانت الإجابة لا لماذا؟ (اختر الإجابة الأكثر ملائمة)

١. من ناحية نفسية ٢. لأسباب اجتماعية ٣. لأسباب صحية ٤. لأسباب دينية

٥. اعتبر أن العمل بهذه المياه نجس ولا يجوز ذلك ٦. اعتبر أني أغش نفسي وكذلك الذين سيأكلون من هذه المنتجات ٥. لكل هذه الأسباب السابقة الذكر

٣٦- ما هي المحاصيل التي يمكن أن تزرعها من خلال المياه المعالجة في هذه الأرض؟

١. خضروات مكشوفة ٢. بيوت بلاستيكية ٣. أشجار مثمرة

٣٧- هل ستأكل من منتجات هذه الأرض بعد ريها بالمياه المعالجة؟

١. نعم ٢. لا

٣٨- إذا كانت الإجابة لا فلماذا؟ (اختر الإجابة الأكثر ملائمة)

١. من ناحية نفسية ٢. لأسباب اجتماعية ٣. لأسباب صحية

٤. لأسباب دينية ٥. لكل هذه الأسباب السابقة الذكر

٣٩- هل تعتبر أن المياه العادمة بعد معالجتها نجسة ومقززة؟

١. نعم ٢. لا

٤٠- هل تقبل باستخدام الرواسب الناتجة من معالجة مياه المجاري في:

١. تسميد الأشجار المثمرة فقط ٢. تسميد الخضروات فقط

٣. تسميد الأشجار المثمرة والخضروات 4. تسميد الأشجار الحرجية فقط 5. لا اقبل باستخدامها مطلقاً

٤١- هل تعتبر أن استخدامك للأرض الزراعية حول محطة التنقية سيوفر فرص عمل لك ولأسرتك ويرفع من المستوى الاقتصادي لأسرتك ؟

١. نعم ٢. لا

٤٢- هل لديك خبرة في الزراعة المروية؟

١. نعم ٢. لا

٤٣- هل توافق إذا ما مر خط لمشروع المياه المعالجة من أرضك؟

١. نعم ٢. لا

٤٤- هل توافق على دفع جزء من تكلفة المشروع كرسوم للمجلس القروي؟

١. نعم ٢. لا

٤٥- إذا كانت الإجابة نعم، هل تشترط أن تكون الرسوم حسب مساحة الأرض؟

١. نعم ٢. لا

٤٦- هل توافق على دفع ثمن بسيط (ثمن ورمزي) للمياه العادمة التي ستستخدمها في الزراعة (للمجلس القروي)؟

١. نعم ٢. لا

٤٧- إذا كانت الإجابة نعم، ما هو السعر المناسب لكوب المياه المعالجة لاستخدامها في أغراض الري:

(شيكل/م^3))

٤٨- هل تعتقد أن إقامة محطة المعالجة قرب الأرض التي تمتلكها سيرفع من ثمن هذه الأرض؟

١. سيرتفع كثيرا ٢- سيرتفع قليلا ٣. سينخفض الثمن قليلا

٤. سينخفض الثمن كثيرا ٥- لا، سيبقى على ما هو عليه

٤٩- هل الأرض التي تمتلكها حول المنطقة التي ستقام فيها محطة المعالجة بحاجة إلى استصلاح؟

١. نعم ٢. لا

٥٠- إذا كانت الإجابة نعم هل أنت على استعداد لاستصلاح هذه الأرض؟

١. نعم ولدي الإمكانات لذلك ٢. نعم ولكن لا يوجد الإمكانات اللازمة ٣. لا أقوم بذلك

٥١- إذا ما تمت مساعدتك ماليا لاستصلاح هذه الأرض هل ستقوم بذلك؟

١. نعم ٢. لا

٥٢- إذا ما تم قيام المشروع وأردت أن تستخدم المياه المعالجة من سيقوم بالزراعة؟

١. أنا فقط ٢. أنا وبعض أفراد أسرتي ٣. سأقوم باستئجار عمال

٥٣- كم عدد الأشخاص الذين تعتقد بأنهم سيعملون في أرضك بعد ريها بالمياه المعالجة؟

(.عامل)

٥٤- هل ترى أنه من الضروري الفحص المستمر للمياه المعالجة في المختبرات للتأكد من صلاحيتها للري؟

١. نعم ٢. أحيانا ٣. لا ٤.لا أعرف

٥٥- هل تعرف بان معظم الحاصلات الزراعية التي تأتي من إسرائيل أو بعض المناطق الفلسطينية مروية بالمياه المعالجة؟

١. نعم ٢. لا

٥٦- إذا كانت الإجابة لا، وعرفت الآن بأنها تروى من المياه المعالجة، هل ستقوم الآن بالتوقف عن استهلاك هذه المنتجات؟

١. نعم ٢. لا

٥٧- هل ترى بأنك بحاجة إلى شرح وتفسير يثبت عدم الضرر من استخدام المياه المعالجة في ري المزروعات؟

١. نعم ٢. لا

٥٨- إذا ما كانت هناك فتوى تبيح استخدام هذه المياه في الزراعة هل توافق على استخدام هذه المياه؟

١. نعم ٢. لا

٥٩- إذا ما قمت باستخدام المياه المعالجة في الزراعة أين ستقوم ببيع المنتجات الزراعية التي تنتجها بشكل رئيسي؟

١. في قريتي ٢. في القرى المجاورة

٣. في سوق الخضار المركزي (الحسبة) ٤. في بقية أجزاء الضفة

٦٠- هل ترغب في الحصول على إرشادات في مجال الزراعة المروية؟

١. نعم ٢. لا

٦١- إذا لم تتوفر المياه العذبة، هل تقبل استخدامها بغض النظر عن السعر.

١. نعم ٢. لا