Faculty of Graduate Studies

Master Thesis in Water and Environmental Engineering

Assessing the Availability and Capability of Local Resources for the Implementation of Sustainable Desalination Project in Palestine

تقييم مدى القدرة والإمكانية للموارد المحلية لتنفيذ مشاريع تحلية مستدامة في فلسطين

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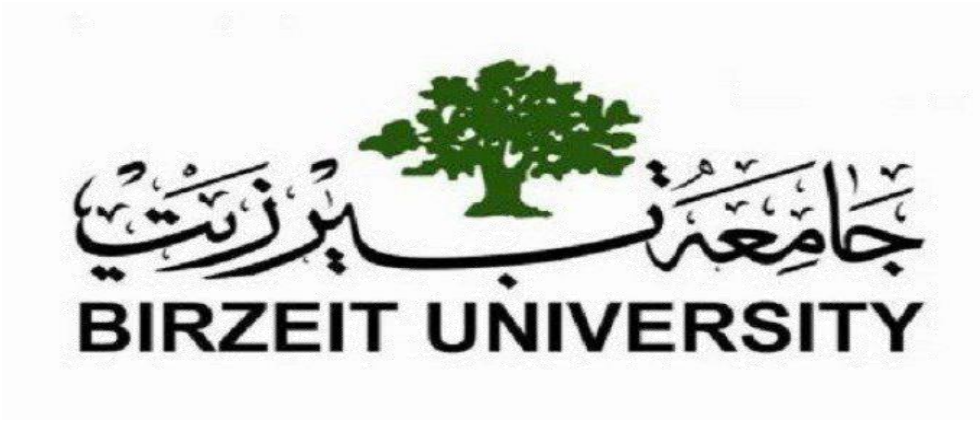

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A Master Thesis Prepared by:

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This thesis was submitted in partial fulfillment of the requirements for the Master's Degree in Water and Environmental Engineering from the Faculty of Graduate Studies, at Birzeit University, Palestine.

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The findings, interpretations and conclusions expressed in this study do not necessarily express the views of Birzeit University, the views of the individual members of the M.Sc. Committee or views of their respective employers.

Date of Defense: 13.06.2020

Dedication

To my beloved homeland, Palestine which I hope to be free from the Israeli occupation soon, in Sha Allah.

Acknowledgement

During my study trip, I would thank God, Primarily, for all the blessings he has given me and I would like to thank my parents for all kinds of support they gave me. Full of gratitude to my research supervisor Dr. Maher Abu-Madi for his support and follow up from the beginning of the idea to the end of my M.Sc. Special thanks for the members of the examination committee, Prof. Dr. Rashed Al-Sa`ed and Dr. Nidal Mahmoud.

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Summary

Palestinians suffer from water scarcity because of the Israeli occupation's control over natural water sources. Thus, there is a shortage of quantities of water which available to them. In addition, the water quality in some Palestinian areas does not conform to international specifications due to pollution, as in the Gaza Strip, and because of salinity, as in Jericho and the Palestinian Jordan Valley. Accordingly, it became necessary for the Palestinians to search for unconventional sources to increase the quantity of water suitable for drinking or agriculture irrigation with the required specifications. Among these unconventional sources is the desalination of water.

Since the Palestinians' experience is recent in this field compared to other countries, the aim of this research was to assess the availability and capability of local resources for the implementation of sustainable desalination system in Palestine, this research focused on the West Bank region. Through this research, two desalination plants were taken as study cases, both were located in Palestinian Jordan Valley: Marj Najah and Zbeidat. Moreover, a designed questionnaire was used in this study for assessing the water desalination plants in Palestine according to experts and workers in the water sector.

The results have shown that there is a general weakness in the ability to establish sustainable desalination plants in Palestine, in spite of the highly demand for them specifically in the Palestinian Jordan Valley. There is a need to increase the academic interest of desalination by Palestinian universities, to find sufficient local expertise to develop the water sector in Palestine. On the other hand, the Palestinian government should support the private sector companies and involve them in water projects to ensure the sustainability of these projects further on. Finally, similar global models have to be studied to learn how the desalination sector work around the world, such as Jordan which has more than 50 desalination plants in the Jordan Valley.

خلاصة

يعاني الفلسطينيون من شح في كميات المياه المتاحة لهم بسبب سيطرة الاحتلال الاسرائيلي على مصادر المياه الطبيعية، وبالاضافة الى ذلك، فان جودة المياه في بعض المناطق الفلسطينية غير مطابقة للمواصفات العالمية بسبب التلوث كما في قطاع غزة وبسبب الملوحة كما في منطقة أريحا وغور الأردن الفلسطيني.

وبناءا على ذلك أصبح من الضروري على الفلسطينيين البحث عن مصادر غير تقليدية لزيادة كمية المياه الصالحة للشرب او الزراعة بالمواصفات المطلوبة. ومن هذه المصادر الغير تقليدية : تحلية المياه.

وبما ان خبرة الفلسطينيين حديثة في هذا المجال مقارنة بالدول الأخر، فان الهدف من البحث تقييم مدى القدرة والامكانية للموارد المحلية لتنفيذ مشاريع تحلية مستدامة في فلسطين، وتم التركيز على منطقة الضفة الغربية، عن طريق البحث في كيفية انشاء محطات تحلية سابقة ومدى مشاركة الفلسطينيين بذلك وتم اختيار محطتين لتحلية المياه في منطقة الاغوار الفلسطينية وهما مرج نعجة وزبيدات. بالاضافة الى نشر وتحليل استبيان خاص على الخبراء والعاملين في قطاع المياه.

تبين من خلال الدراسة أن هناك ضعف عام في قدرة الفلسطينيين على انشاء محطات تحلية مستدامة بالرغم من الحاجة لايجاد محطات تحلية جديدة في المستقبل وتحديدا في منطقة الاغوار الفلسطينية. كذلك هناك حاجة لزيادة الاهتمام الاكاديمي من قبل الجامعات الفلسطينية بموضوع التحلية لايجاد خبرات محلية كافية لتطوير قطاع المياه في فلسطين وايضا على الحكومة الفلسطينية دعم شركات القطاع الخاص واشراكها في مشاريع المياه لضمان استدامة هذه المشاريع بشكل اكبر. واخيرا على الباحثين دراسة نماذج مشابهة عالمية لكيفية تطور قطاع التحلية في اماكن اخرى حول العالم مثل الاردن الشقيق الذي يستخدم ما يزيد عن 50 محطة تحلية بمنطقة غور الاردن.

List of abbreviations

Ads: Adsorption Technology

AOAD: Arab Organization for Agricultural Development

ARIJ: Applied Research Institute–Jerusalem

BWRO: Brackish Water Reverse Osmosis

CAPEX: Capital Expenditure

CRA: Corrosion Resistant Alloys

DAF: Dissolved Air Flotation

ED: Electrodialysis

FO: Forward Osmosis

Frz: Freezing Distillation

G. Hyd: Gas Hydrate

GES: Global Environment Services

HDH: Humidification-Dehumidification Desalination

I. Ex: Ion-Exchange Desalination

LLE: Liquid–Liquid Extraction

MED: Multiple-Effect Distillation

MEDRC: Mediterranean Renewable Energy Centre

MF: Microfiltration

MSF: Multi-Stage Flash Distillation

MVC: Vapor Compression Distillation

NF: Nano-Filtration

OPEX: Operating costs

PV-RO: Photovoltaic Reverse Osmosis

PWA: Palestinian Water Authority

RO: Reverse Osmosis

SD: Solar Distillation

TDS: Total Dissolved Solids

UF: Ultrafiltration

UNDP: United Nation Development Program

VC: Vapor-compression

WF: Water Flux

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Chapter One: Introduction

1.1 Background

Water covers 70% of earth, but only 3% classified as freshwater and just one-third of that is available for our use (WWF, 2018). The world is facing daunting challenges in reducing the huge gap between rising demands for clean water and the supply for freshwater. Rising water demands because of population growth, economic growth, increased water consumption per capita, more stringent health-based regulations and competing demands from a variety of users, coupled with decreasing water supplies because of climate change, extended droughts and contamination, are exacerbating water scarcity in most world regions, especially in developing countries (Jones et al., 2019).

At present, about 3.6 billion people (nearly half the global population) live in areas that are potentially water-scarce at least one month per year, and this population could increase to some 4.8–5.7 billion by 2050 (UN, 2018). These numbers are in direct conflict with Sustainable Development Goal (SDG) number six, which aimed to ensure availability and sustainable management of water and sanitation for all. Also, these statistics showed that "conventional" sources of water are no longer enough to meet human demands in water-scarce areas and Unconventional water resources are supposed to play an important role in narrowing the gap between water supply and water demand (Jones et al., 2019).

Desalination of seawater and highly brackish groundwater is one example of unconventional water resources which estimated to solve the challenge of water scarcity in world (UNU-INWEH, 2019). Nowadays, about 15,906 desalination plants are operational in 177 countries around the world and they produce about 95 mcm per day of desalinated water. About 48% of these desalination plants are found in the MENA region as shown in F*igure 1* (Jones et al., 2019).

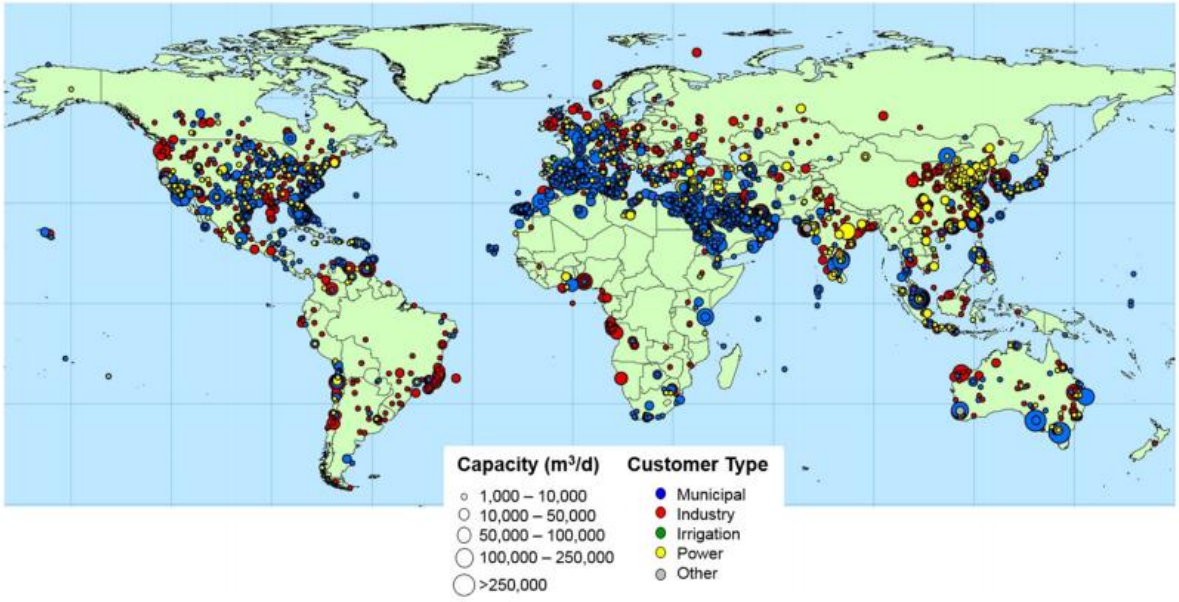

Figure 1 Global distribution of operational desalination facilities and capacities (<1000 m3/day) by sector user of produced water (Jones et al., 2019)

In Palestine, groundwater is considered as the main natural resource that Palestinians depending on, Mountain aquifer (Western aquifer, Northern aquifer, and Eastern aquifer) in the West Bank and Coastal aquifer in Gaza (Fanack after UNEP, 2002). But limited access to water resources because of Israeli occupation caused a severe shortage in water. So, searching for unconventional water resources has become essential to reduce the shortage of water and to reduce the gap between supply and demand on water (PWA, 2011).

According to (PCBS, 2017), the available water for Palestinian in West Bank and Gaza is 375 MCM, obtained from the following sources:

1. 265 MCM from pumped from ground water wells (70% of water)
2. 83 MCM purchase from Israeli company "Mekorot" (22% of water)
3. 23 MCM from Palestinian springs (6% of water)
4. 4 MCM from desalinated drinking water (1% of water)

PWA strategies (2012-2017) were mentioned the desalination as a possible development technique to obtain more quantities of water for different uses.

Figure 2 The Mountain Aquifer and the Coastal Aquifer. Source: Fanack after UNEP, 2002.

1.1.1 Palestinian local situation

Palestine is under Israeli occupation since 1948, 78% of the land was cut off by Israeli military force and the state of Israel was declared. In 1967, Israel has completed the occupation of the rest of the Palestinian land (West Bank, Gaza Strip and the eastern part of Jerusalem) besides some of Arab lands (Golan Heights in Syria, Sinai in Egypt and Shebaa Farms in Lebanon). Posteriorly, Israel-Arab negotiations has been started to achieve Israel's withdrawal from the Arab land occupied in 1967, and between Israel-Palestine Liberation Organization to achieve a Palestinian state over the occupied territories on 1967. Thus, Oslo I, Paris Protocol were signed in 1993, 1994 respectively and Oslo II Agreements in 1994. The provisions of these agreements, which are unjust to the Palestinians, are considered as the cornerstone of understanding the political and economic situation in Palestine.

Article 40 of Annex III the 'Protocol Concerning Civil Affairs' is one of the outputs from Oslo II which mentioned the water issue. The agreement recognizes part of the Palestinian water rights and left the final agreement to the final status negotiations. Besides, the

agreement states that Israel will transfer powers and responsibilities to the Palestinians the in the field of water and wastewater. The future needs of the Palestinians in the West Bank are estimated at 70-80 MCM/yr, v) while the current needs of the Palestinians for fresh water for domestic use are about 28.6 MCM/yr (23.5 MCM/yr for the West Bank and 5.1 MCM/yr for Gaza, during the interim period (MEMO, 2018).

1.1.2 Desalination plants in Palestine

Desalination is one of unconventional method which Palestinian has decided to use in some areas such as Gaza and Jordan Valley. The quality of coastal aquifer in Gaza is poor and it has suffering from salinity and pollution from decades (Abu-Alnaeem et al., 2018). And therefore, thinking of implementation small desalination plants started from 1991 with the first desalination plant which constructed in Gaza for brackish water using RO technology (El Sheikh et al., 2003). Recently, a sea water desalination plant is establishing with capacity reached 20,000 m^3 per day (Unicef, 2019). Salinity problem was clearly appeared in Eastern aquifer almost 30 years (Marie and Vengosh, 2001), and thinking of used desalination in Jericho and the Jordan Valley was started just by 2012 withe the first desalination plant which constructed in Jordan Valley for brackish water using RO technology (Abu Hiaja, 2018)

1.1.3 Desalination in Israel

Water sector has been considered as an essential topic for Israel since its occupation of Palestine. Israel has planned to utilize and control all conventional water resources in the region and to develop unconventional water technologies. Desalination for saline water has been one of the strategic plans in Israel and the master plan for desalination was the main declaration. In 2016, 604 MCM of desalinated water was produced from five main sea water desalination facilities in Israel (Ashkelon, Palmahim, Hadera, Sorek, and Ashdodand) and from other facilities for desalinating salty groundwater (mostly in the Arava). So, approximately 30% of Israel water used in 2016 (2,346 MCM) was desalinated. The amount of desalinated water will be reached to 750 MCM in 2020 According to desalination master plan (Avgar, 2018).

Israel is considered as the 7th largest desalination user by capacity in the world after Saudi Arabia, the United States, UAE, Australia, China, Kuwait (Advisian, 2018).

1.2 Problem Definition

The water scarcity in Palestine necessitate searching for unconventional water resources, and the Palestinian experience in desalination is existed for only a short time compared

with other countries in the region and the world. Desalination is often considered as an expensive alternative for securing additional water supplies. The total costs of desalination can be broken down into investment costs (including design, implementation, equipment and materials) and operational costs (including energy, skilled personnel, spare parts, and others). The poor experience of Palestine in desalination, especially in the west bank, necessitates searching for the current Palestinians capabilities In order to optimize the use of them.

1.3 Research Questions and Objectives

1.3.1 Research Questions

The main question of this research is "How to increase Palestinian participation in water desalination projects, whether in technical matters or in the materials used?" The specific research questions are:

● Do Palestinians have sufficient skills to plan, design, implement, and operate sustainable desalination projects?

●What are the existing gaps in the knowledge of Palestinian professionals regarding desalination?

●What equipment and materials are available locally?

1.3.2 Research Objectives

The appearance of desalination projects in Palestine raises questions about knowledge of Palestinians on the planning, design, implementation, operation and maintenance as well as the management of desalination projects. Similarly, the availability of materials such as equipment, pipes, membranes, and what is needed to be imported. The specific objectives are:

- To study the different components of a successful desalination project.
- To assess the capacity of the Palestinian institutions regarding the planning, design, implementation, operation and maintenance as well as management of desalination projects
- To study the different materials that are used in desalination projects and the level of their local availability.
- To set guideline that ensure the success of desalination projects.

1.4 Methodology

As a first step, the research highlights the brackish water desalinations in the West Bank especially in the Jordan Valley.

The data collected by contacting the managers of these desalination projects and got the information about planning, design, implementation, operation and maintenance process.

The methodology applied includes the following steps:

- Review of the available documents on projects and research regarding desalination in Palestine and the region.
- conduct a survey for assessing the expertise available at the different Palestinian institutions related to desalination projects.
- Analyse the collected data to compile lessons learned and develop key messages, which will be presented in national workshops to all stakeholders.

This research will focus on the Palestinian experience in West Bank and the local resources which can use for the implementation of sustainable desalination plant in the region. The research has chosen two desalination plants as case studies in Marj Na'jah and Al-Zubeidat located in Jordan Valley: Marj Na'jah desalination plant and Al-Zubeidat desalination plant.

1.5 Thesis Outline

Chapter One provides a background on research issues, problem definition, research questions and objectives. Chapter Two reviews the previous studies related to the research topic. Chapter Three describes the study area of the research and the case studies which studied. Chapter Four talks about the methodology that which followed in this research. Chapter Five presents the results and discussion. Chapter six summarizes the main conclusions and recommendations.

Chapter Two: Literature Review

2.1 Desalination and Desalination Technologies

Desalination is a process that aims at removing salts or any other minerals and contaminants from seawater, brackish water, and effluent from WWTPs. It is a common solution to get fresh water for different consumption categories such as domestic, industrial, and agricultural uses (Rahimi et al, 2017). Desalination processes can divide into two technology types: thermal desalination, and membrane technology, also chemically activated methods can be the third type of desalination (Jons et al., 2019 and Youssef et al., 2014). Thermal desalination includes: multi-stage flash distillation (MSF), multiple-effect distillation (MED), vapor compression distillation (MVC), humidification-dehumidification desalination (HDH), solar distillation (SD) and freezing (Frz). Membrane technology includes: reverse osmosis (RO), forward osmosis (FO), electro-dyalysis (ED) and Nano-filtration (NF). Chemically activated desalination systems include ion-exchange desalination (I. Ex), liquid–liquid extraction (LLE) and gas hydrate (G. Hyd) or other precipitation schemes. Recently, adsorption technology (Ads) has been investigated for desalination application as shown in figure 3 (Youssef et al, 2014).

Thermal technologies were early desalination plants predominantly used, prior to the 1980s, 84% of all global desalination water was being produced by MSF and MED technologies. In 2000, the volumes of using RO and MSF systems were approximately equal (Jons et al., 2019). After 2000 the energy saving type reverse osmosis membrane process has rapidly spread (Kurihara, 2019). Nowadays, 69% of the volume of desalination water produced from RO membrane systems (Jons et al., 2019).

2.2 Main challenges in desalination plants

Corrosion, scaling and fouling were the main challenges to desalination plants (Valdez et al., 2010), the study by (Valdez et al., 2010) focused on some issues related corrosion control in the desalination industry. According authors, the main pretreatment processes and materials used to mitigation the risk of corrosion formation was discussed and it emphasized that using Corrosion Resistant Alloys (CRA) with applying methods of corrosion prevention and control will expect a prolonged life of the desalination plant.

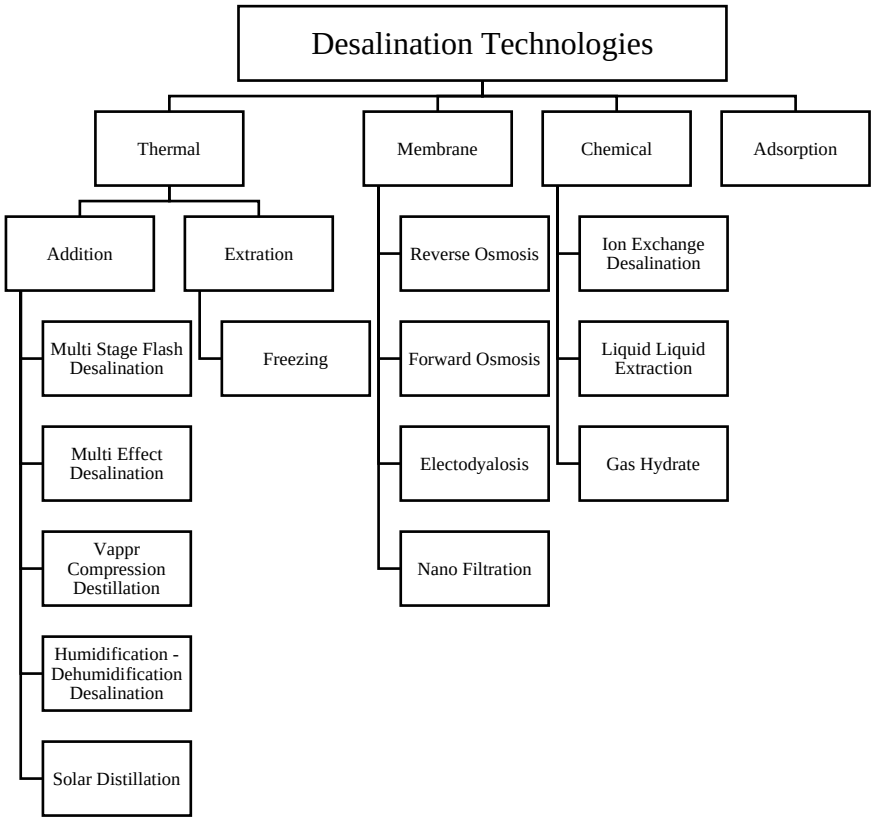

Figure 3 Classification of desalination technologies (Youssef et al., 2014).

The most famous materials used in desalination plants were mentioned in a study by (Larche et al., 2011), it also reviewed features and problems of using it. Based on the study, Carbon steel is the most used material for sea water structures depending on its good mechanical properties, good machinability, good weldability and rather low cost. But it is highly susceptible to general and bimetallic corrosion, so using carbon steel for the components which contact with seawater is not recommended without both specific organic coating and cathodic protection. Copper alloys is naturally resistant to fouling because of the release of copper ions which have biocide properties, but it is susceptible to some types of corrosion like erosion, galvanic and pitting corrosion if the designer doesn't consider some aspects like the velocity of sea water and composition of alloy, etc. Stainless steels are the conventional materials used in different pipes and pumps in RO systems. Prevention of Pitting and crevice corrosion is the main challenge to select the grade of stainless-steel alloys. Also, some types of Nickel-based alloys and Titanium alloys are the best to use in desalination plants depending on high corrosion resistant, but the high cost of these materials makes their use limited. In addition, some seawater applications are made from plastics which proved to be excellent material construction, but strength is the main limitation for using it, and the risk of crevice corrosion in the metallic material in case of contacts between plastics and passive metallic materials such as stainless steel will be not negligible.

A study by (Al Odwani et al., 1998) was studied and compared five of constructed materials for reverse osmosis (RO) desalination plants with a saltwater inlet source from the Arabian Gulf. The five materials were stainless steels of (316L, 317L, 317LNMO, and 254SMO) and Ti2. After Crevice-Corrosion Test Specifications and Electrochemical Test Specifications for all materials. The results showed that using Stainless steels 316L and 317L are not an effective choice depends on their poor localized corrosion resistance, 317LNMO and 254SMO, and Ti2 are preferred to use based on their high corrosion resistance but economic aspects should be considered.

2.3 Major impacts on desalination cost

The major factors that affect the desalination costs are explained as follows (Advisian, 2018):

- Desalination technology: Desalination technology selection has a critical impact where a decision maker required to put a huge investment in the right place (Al-Subaie, 2007).The major factors that vary the desalination technologies from each other are for example: carbon footprint, the machinery used, resources that used for construction, energy supply for steaming, pretreatment necessities, plus the pretreatment and post treatment chemicals, and all the above mentioned factors have impacts on costs of the process (Advisian, 2018). “How to weigh them?" or "How to choose between these technologies?" are important questions to find an appropriate methodology to make sure that the choice is correct (Al-Subaie, 2007).
- Location: The specific location of the desalination plant has a crucial impact on the total costs of any desalination project. This may include: the cost of Intake pipelines from the water source to the constructed plant, the pipeline for the disposal brine water which comes out from the plant, the price of land which pipelines will cross through besides the land on which the plant will be constructed, and also the power transmission cost to the plant. It is recommended to choose the location for the desalination plant to be close as possible to the source of intake water and to a reliable power source.
- Quality of the feed water: The quality of raw water has a crucial influence on the different characteristics of pretreatment processes needed prior to the main desalination system, and the whole scale of the desalination plant. The level of TDS of the water at source has direct impact on the operational costs, due to the high pressures in reverse osmosis technology. Higher salinity of the raw water may also reduce the reasonable recovery of the produced water from reverse osmosis.

- Intake and outfall: For a cost-efficient design and optimum operation of the selected desalination process, intake and outfall especially sea water is one of the most influential technical considerations.
- Pretreatment: Desalination efficiency and cost vary according to the type and complexity of the pretreatment process. Pretreatment depends mainly on the quality of raw water where seawater or brackish water sources have a high level of organics content and biological activity and require more vigorous pretreatment processes, such as dissolved air flotation and ultrafiltration. Other pretreatment processes include single-step media filtration or microfiltration.
- Energy recovery: reverse osmosis processes rely on high-pressure pumps to cope with the osmotic pressure of feed water. The concentrated brine flow from this process contains pressure energy that can be utilized to reduce the whole energy needs.
- Electric power: energy tariffs, distance, connection levies at the planned location of the desalination project determine the price for connected power.
- Post-treatment: the desired quality of produced water determine the specifications of the post-treatment needed and reflects on the costs. A second RO might be needed to achieve a low TDS level or to reduce the contents such as boron or chloride, this might be very expensive. Having a two-RO system is typically 15-30 % more expensive than a single RO system. Stabilizing the produced water requires a pH adjustment and the addition of bicarbonate alkalinity, which can use a combination of carbon dioxide, lime and/or sodium hydroxide and, again, this adds additional cost.
- Environmental regulations: environmental rules and regulations vary according to the local conditions of each geographic region.

2.4 Cost components

Capital expenditure (CAPEX): which consist of direct and indirect costs; 50-85 % of CAPEX is considered direct cost and it related to the assets cost such as buildings and equipment's and infrastructure, while the remaining CAPEX is for overhead and (engineering and administration).

Focusing in desalination process CAPEX can be divided to the items below:

- Extraction and transportation of raw water
- Pretreatment;
- Desal treatment;
- Post-treatment

- Product water pumping and storage;
- Establishing electrical and mechanical system;
- Construction of the plant and site,
- Solids management and brine release
- Engineering and expansion costs.

Operating costs (OPEX): which consist of: fixed costs and variable costs, the fixed related to managerial cost as labor equipment changing membrane assets taxes while the variable costs related to power supply and chemicals.

Focusing in desalination process OPEX can be divided to the items below:

- Power supply
- Disposable materials
- Disposal of solid waste
- chemicals,
- manpower,
- maintenance,
- equipment guarantee,
- and other fixed administration costs

Total cost:

Which considered the Life cycle cost, and it is related to the cost of producing 1 unit production or annualized cost, and it is defined as all CAPEX and OPEX costs to produce one unit of production which could be modified by calculating historical or predicted operating factor , the above mentioned costs are difficult to be calculated relaying on historical estimates is preferred.

A study by (Karagiannis and Soldatos, 2008) was tried to classify and inventory many related publications about desalination plants around the world, to allow meaningful comparisons and clarifications about desalination costs. The paper was examined and classified over 100 different cases of desalination plants in to categories according to the type of feed water, the desalination method and the type of energy used. The following tables display the results of study:

Table 1 Capacity of desalination unit and cost of water produced

Type of feed water	**Size of plant (m3/day)**	**Cost in $ per m^3**
Brackish	< 1,000	0.78-1.33

	5,000-60,000	0.26-0.54
Seawater	<1,000	2.23-11.25
	1,000-5,000	0.70-3.93
	12,000-60,000	0.44- 1.62
	>60,000	0.50-1.00

Table 2 Type of energy supply system and cost of water produced

Type of feed water	**Type of energy used**	**Cost $ per m^3**
Brackish	Conventional	0.26-1.33
	Photovoltaics	5.63- 12.90
	Geothermal	2.50
Seawater	Conventional	0.44-3.38
	Wind	1.25- 6.25
	Photovoltaics	3.93- 11.25
	Solar collectors	4.38-10

Table 3 Thermal methods and cost of water produced

Desalination method	**Size of plant (m^3/day)**	**Cost $ per m^3**
MED	<100	2.50-10
	12,000-55,000	0.95-1.95
	>91,000	0.52-1.01
MSF	23,000-528,000	0.52-1.75
VC	1,000-1200	2.01-2.66

Table 4 Membrane (RO) methods and cost of water desalination

Type of feed water	**Size of plant (m^3/day)**	**Cost $ per m^3**
Brackish	<20	5.63- 12.90
	20-1,200	0.78-1.33
	40,000-46,000	0.26-0.54
Seawater	<1,000	1.50-18.75
	250-1,000	1.25-3.93
	1,000-4,800	0.70-1.72
	15,000-60,000	0.48-1.62
	100,000-320,000	0.45-0.66

2.5 Reverse Osmosis (RO) desalination technologies

The increases in using RO desalination technologies and its growing market share show a number of significant advantages for this technology such as simplicity and reliable operations and maintenance, support by diverse and well-established supply chain of off-the-shelf components and consumables (e.g, membrane elements, pre-filters, compatible

water treatment additives and membrane cleaning chemicals). The process is easily scalable whereby both small- and large scale RO plants can use the similar membrane elements and pressure vessels. (Cohen, 2017). Also, the advancement RO technology assists reduction in cost of pure water production (Shenvi et al, 2015). RO plant consists of four major components: feed water pre-treatment, high pressure pumping, membrane separation and permeate post-treatment Pretreatment (Khawajia et al, 2008 and Shenvi et al., 2015).

2.6 Major components of RO technology:

2.6.1 Pre-treatment

Pre-treatment for feed water is critically essential to protect membranes and other elements from contaminants such as the colloidal suspension, organic matters, mud, sand and other suspended solids (Shenvi et al., 2015 and Jamaly et al., 2014). The study by (jamaly et al., 2014) was divided pretreatment technologies which coupling RO systems to conventional and non-conventional and it summarized the performance of eachto develop efficient RO technologies. The study confirms that understanding of the raw water quality characteristics, and type of water resource is essential to select the pretreatment technology ahead of the RO system. Conventional technologies such as chlorination, clarification/dissolved air flotation (DAF), ozonation, coagulation-flocculation and scale inhibitor. Non- conventional technologies such as Ultrafiltration (UF) and microfiltration (MF), Nano filtration (NF) and Nano-structured membranes. Different chemicals used for pretreatment include: Flocculant dosing (FeC13), Chlorine scavenger dosing (NaHSO3), acid dosing as the protection against carbonate scaling (H2SO4), Citric acid wash and Tannic acid treatment to preserve membrane selectivity were mentioned by (Rautenbach et al., 1997).

2.6.2 High pressure pumping

High pressure stainless steel booster pumps are required in pressurizing process to pump salt water through the system and to keep production steady (Shenvi et al., 2015)

2..3 Membrane

The core element for RO process is the membrane itself, for this reason, scientists and developers have been focused on improving the performance of membranes by using and developing materials which can achieve mechanically and chemically stable under high pressures for a long operation period while attaining a desirable water flux (WF) and rejection of salt characteristics (Otitoju et al., 2018). Chart below showed the main types of membranes:

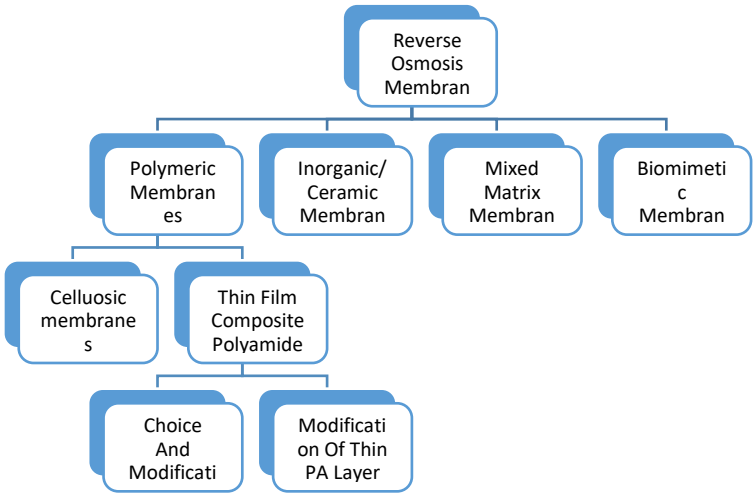

Figure 4 The main types of RO membranes process (Shenvi et al, 2015)

2.6.4 Post-treatment

Post-treatment stage aims to prepare filtered water for use and to prepare rejected water for appropriate discharge, in addition to treatment of the brine and other chemicals generated during process discharge (Shenvi et al., 2015).

2.7 Desalination in Jordan

A study by (Mohsen and Al-Jayyousi, 1999) assessed desalination technologies for utilization of desalinated brackish water in Jordan. By using multi-criteria analysis, the evaluation of various desalination technologies (MSF, MED, VC, RO and EC) was carried out. Technical, economical and environmental were the aspects of the criteria adopted for the evaluation and the results shown that RO technology is the most appropriate technology with the highest rank, then ED has the second favorable option.

A study by (Qtaishat, et al., 2016) were investigated the economic analysis for approximately fifty of desalination plants, all the plants are located in Jordan Valley in Jordan, treated brackish water, using RO system and depends on an electrical grid as the source of energy. It divides plants into three categories (small, medium and large), the capacities of them are range between 360 to 2,400 m^3/d. desalting water is used for irrigation purpose mainly for bananas, strawberries, and dates. The estimated cost of small RO plants (15–19 m3 /h) is $0.48/m3 ± $0.21/m3, for medium RO plants (30–49 m3 /h) is $0.37/m3 and for large RO plants (50–100 m3 /h) is $0.32/ m3. The weighted average is $0.38/m3 ± $0.18/m3.

Another study by (Banat et al., 2012) examined one of small-scale photovoltaic reverse osmosis (PV-RO) desalination plant was in a village in the northern part of Jordan with a capacity of 0.5 m3/day. Water quality and quantity were tested for 10 months to investigate the specific energy consumption of the system under different operating conditions. As the pressure was fixed, the major results showed the percent recovery of fresh water flow depended on temperature, besides the actual specific energy consumption depended on recovery percentage and using softener before RO membrane will increase the percentage recovery by solving the problem of scaling (Banat, 2012).

2.8 Salinity in groundwater from Jericho and Jordan Valley

Salinization is one of the major problems in the lower Jordan valley of local groundwater, Marie and Vengosh were diagnostic geochemical fingerprinting methods to trace the potential sources of salinity in different sub and shallow aquifer systems near Jericho area. The study shown that salinization of groundwater occurs in three aquifer units, and presented the main sources caused increasing salinity in these units including: Upcoming of deep brines, leaching of salts within the aquifer and infiltration of agriculture returns flow and wastewater. The study also warned of increasing the salinization rates in the future, and recommended that this issue must be considered for any desalination plan will be established in future (Marie and Vengosh, 2001).

2.9 Desalination in Jericho and Jordan Valley

A study by (Taha and Al- Sa'ed, 2018) investigates the effectiveness solar cells to operate small desalination plants in Jordan Valley for agriculture. The study focused on Marj Naji desalination plant as a case study. The results showed that using RO-PV system is an economically workable desalination alternative for brackish water, this alternative showed lower annual operation instead of the higher capital cost when it compares with using diesel or electricity network alternatives.

2.10 Privatization for desalination and sanitation projects in Palestine

A study by (Mimi and Marei, 2002) focused on the concept of privatization for desalination and sanitation projects in Palestine. It explained that the cost of desalination water is high but in most cases is less than what Palestinian pays. Researchers recommended the Palestinian Water Authority (PWA) to think seriously in privatization and use its governance power to introduce and implement policies complementary to private sector

working for efficient and economic service levels and work as a facilitator rather than an agent (Mimi and Marei, 2002)

Chapter Three: Study Area and Case Studies

3.1 Description of study area

3.1.1 Location and Population

The Palestinian Jordan Valley extends from Jericho in the south to Bisan in the north and covers an area of about 1.5 million dunums (609.19 km^2), which equals 25 percent of the total area of the West Bank (Daoud, 2018). Jordan Valley is a part of the Jordan Rift in the northern part of the East African-Syrian rift system and extends from Turkey in the north to the Red Sea in the south, passing through Syria, Lebanon, Jordan and Palestine (Farber et al., 2007 and Da'as and Walraevens, 2013). The area of Jericho and Al Aghwar is considered as the most representative area of the Jordan Valley that is located in the central-southern part of the Jordan Valley, to the west of the Jordan River and northwest of the Dead Sea (Wala', 2016).

According to Palestinian Central Bureau of Statistics for 2017, the population of the Jericho and Al Aghwar counts more than 50,000 persons (PCB, 2017).

3.1.2 Economic Activities

The Jordan Valley is a unique area that offers opportunities in nearly all major economic sectors. The Jordan Valley has comparative advantages in the fields of agriculture, tourism, transportation and logistics, and potential for industrial and agribusiness development as well (paltrade, 2010). The Jordan Valley is a fertile productive region, and described as the food basket of Palestine, which constitutes 52% of the total irrigated land in West Bank (Da'as and Walraevens, 2013). Agricultural-related institutions in the Jordan Valley provide jobs for about 20,000 men and women, about 40% of the population, also the estimated of the Jordan Valley contribution to Palestinian revenues is to amount to around US$100 million (Daoud, 2018).

Seasonal vegetables, citrus, fruits, dates, field crops, forage and medicinal fresh-herbs are considered as the main agriculture production in Jordan Valley and grown all over the year. This area provides approximately 108.8 thousand tons of vegetables, fruits, field crops, and forage and forms 13.7 percent of West Bank plant production, and in 2017 the total production of Dates reached 8,000 tons (Daoud, 2018). Thus, most of plant productions in Jordan valley are irrigated, providing water to this area is an essential issue, especially with low precipitation rate, high potential pan evaporation and deteriorating quality in groundwater (increase in salinity) (Da'as and Walraevens, 2013).

3.1.3 Climatic Condition and Rainfall

The climate of Jericho and Al Aghwar area is classified as arid. The recorded annual mean temperature was 25.2 °C and the annual mean of maximum air temperature reached 31.7 °C for 2016. Whereas, the annual mean of minimum air temperature was 19.4 °C in Jericho Station in 2016. The data of Jericho Meteorological station in 2016 indicated that the quantities of rainfall reached about 107.4 mm in Jericho Station and 166.0 mm as general average according Palestinian Meteorological between 2018 and April 2019. According to the PCBS, the annual mean of evaporation in Jericho was approached 2,448.8 mm. The annual mean sunshine duration for Jericho Station in 2016 was 8.8 hour\day, while the mean wind speed was 2.0 Km/hr. While the recorded mean annual atmospheric pressure was 1,043.9 mbar (PCBS, 2016).

3.1.4 Water Resources and Salinity

Groundwater originating from the Aquifer System forms the main water resource in the Jordan Valley which is threatened mainly by the high salinity and high concentrations of sulfate and nitrate in some wells which may restrict the use of groundwater, especially for agricultural purposes (Da'as and Walraevens, 2013).

Eastern Aquifer Basin is a part of the Quaternary Aquifer System and divided into two main sub-aquifers, namely the Mountainous Heights, and the upper aquifer. The area of Jericho and the Jordan Valley depends mainly on groundwater. The quantities of water produced from the aquifer were estimated at 26 million cubic meters (PWA, 2018).

The number of Palestinian wells in the eastern aquifer is 169 wells, most of them were established within Jordanian Covenant and have not been renewed due to Israeli obstacles. The occupation authorities do not allow permits to dig wells for Palestinians but allows to Israeli water distributor (Mekorot) drill wells, some of which reach a depth of 100 meters, in order to supply the settlements and their farms with water throughout the year. This policy has dried dozens of wells and springs in the area. Also, drilling of Israeli wells led to the dehydration and disappearance of over 22 natural springs that were considered to be an important source of freshwater and agricultural supplies. And just 111 Palestinian wells are working (Aljazeera.net, 2010). The total pumping rate of the working wells is estimated by 13.3 MCM during 2017, it is used for agricultural purposes. Most of these wells suffer from high salt levels and a severe decline in groundwater level in many wells, which led to the drying of many of them. Moreover, the flow of springs for 2017 was estimated at 16.5 MCM, of which 12.7 million cubic meters were used for agriculture and only 3.8 MCM for drinking (PWA, 2018).

3.2 Desalination Plants in Jordan Valley

3.2.1 Marj Na'jah village and Marj Na'jah Desalination Plant

1. Marj Na'jah village

Marj Na'jah is a small village that is located 36.9 km to the north of the Jericho city, it lays 271 meter below sea level, with a total area of approximately 4,917 dumums, 4,720 dunums (96% of the total village area) were classified as area C according to Oslo II Interim Agreement (ARIJ, 2012), and the population of the village is 828 (PEBS, 2017).

The main economic activity in the village is the agriculture, approximately 80% of the population working in agriculture sector (ARIJ, 2012). And this activity is facing many problems such as: low land quality, water salinity, low productivity of the crops and low fruit quality. His is why some wealthy farmers had to shift from growing vegetables to date palm trees to overcome the water salinity problem and to produce a new cash crop that might have more market advantages (Abdallah, 2016).

In Marj Na'jah village, there are 6 wells that were used for irrigation, these wells are suffering from salinity problems at different levels, now only two wells are working and are used for irrigation one of them has a salinity level 4.5ds/m and it is owned by farmers outside the village and the other one which has the highest salinity level with 8.5 ds/m is used by the village farmers for irrigating their lands (MoA, 2012).

2. Marj Na'jah Desalination Plant

Marj Na'jah desalination plant was established during 2012, the project has been includes: installing a mobile desalination unit on the Marj Na'jah agriculture well number [20-17/011], installing a water tank to feed the desalination unit with a capacity of 150 m^3, installing another water tank to collect the desalinated water from the desalination unit with a capacity 250 m^3 and the infrastructure work required to install the desalination unit and tanks. The total cost of the project was approximately 160,000 USD. Funding the project was in corporation with many parties as table below showed, the implementation of the project was by a Jordanian company named Sukhian Group for Providing Solution and the supervision parties were the Ministry of Agriculture (MoA) and Palestinian Water Authority (PWA) (Abu Hiaja, 2018)

Table 5 cost of Marj Najah desalination plant

Item	Cost in USD	Donor
RO unit	100,000	Arab Organization for Agriculture development (AOAD)
RO infrastructure	4,000	Local Villagers
Saline water collection tank	8,000	United Nation Development Program (UNDP)
Desalinized water collection tank	9,000	United Nation Development Program (UNDP)
Saline water pumping booster	3,000	United Nation Development Program (UNDP)
Braine water line	3,500	Dutch Project
Well rehabilitation	3,500	Red Cross (RC)
Desalinized water conveying line	1,000	JICA

The purposes of the project were to: find a solution which can treated the water quality of the well because of high salinity which approximately reach to 5000 ml/l and to evaluate the effect of using desalinated water from the desalination unit which has a salinity of 750 mg/l in irrigating various crops on the productivity of these crops and farmers' income. Therefore, the production water used for agriculture purposes. 300 dunums are the cultivated area which planted with vegetables, cucumber, beans, and okra and irrigated with desalinated water produced from the desalination unit. (MOA, 2012). The capacity of the well has been 120 m^3/h, and the capacity of desalination unit has been 55 m^3/h with 75% production efficiency.

The plant was provided with three phase of electricity from the diagonal network near the location of plant, where the desalination plant consumes 1.2 kilowatts to produce one cubic meter of desalinated water.

Figure 5 The location of Marj Na'jah desalination plant

Table 6 Cost of establishing Marj Na'jah desalination plant

stage	Items	No	Cost $	Percentage
Pre- treatment	Supply pumps	2	3,300	20.54
	Sand filters	2	14,000	
	5-micron filters	2	4,600	
	Injection pump	1	700	
Ro- treatment	High pressure pump	1	13,000	51.08
	Box Filter –Vessel	9	9,000	
	Hydranatuics – CPA5	36	21,600	
	Hydranatuics – ESPA2	18	12,600	
Piping	Pipes & segment	1	2,820	5.93
	Stainless pipes	1	3,700	
Control panel, Measurement and control Instruments	Measurement and control Instruments	1	3,500	9.54
	Control panel	1	7,000	
others	Container including insulation, painting and 2-ton air conditioning	1	6,000	12.91

	Transfer, supply, operation and training	1	3,000	
	Supply anti-scalent materials and 5-micron filters for 1 year	1	5,200	
Total			110,020	100%

3. The Impacts Study of the Desalination Plant Project:

As mentioned before, in chapter of literature review there are many impacts which effected on desalination projects. Following table (table 6) mentioned these factors in the case of Marj Na'jah desalination project.

Table 7 Main impacts in Marj Na'aja

Impact	Marj Na'jah
Desalination technology	• Small brackish reverse osmosis technology
Location	• Marj Na'jah desalination plant is approximately 10 meters away from the well. • The land owned by local council of Marj Na'jah which supported the project with donors. • The power grid near the plant supplies the electricity which desalination plant needed. • The land is classified as C-zone and it is near Highway 90.
Raw water quality	• TDS is approximately 5000 ml/L in the upper limit • Temperature of feed water is approximately 30°C
	• Automatic pumping system from the well to storage tank

Intake and outfall	
Pretreatment	• Single- step media filtration or MF (Microfiltration)
Energy recovery	• Not supported
Electric power	• The community is exempt from paying electricity charges, Electricity bills are deducted from the clearing • Desalination plant located near the power transmission • The fees of connection? • The tariff is 0.156 $/ kWh
Post-treatment	• The addition of water blended line
Local infrastructure costs	Constructed the following: • Water tank for raw water (150 m^3) • Water tank for production desalinated water (250 m^3) • Concrete foundation • Prepared and leveling the location
Environmental regulations	• Disposal of brine water

4. Current situation of Marj Na'jah desalination project

Based on the data collection, interviews with farmers and interviews with responsible people at the ministry of agriculture, following issues can by mentioned.

In the field visit to Marj Na'jah Desalination Plant, and based on the conversation with some of the responsible farmers in managing and maintaining the Desalination Plant. Two important things to highlight:

1. The Desalination Plant has revived nearly 500 dunums of farmers' lands according to the testimonies of the farmers themselves: “It was not possible to grow vegetables before due to the salinity of the well that irrigate the crops in that area”.
2. Desalination Plant Management:

- According to the agreement between the parties participating in the construction of the Desalination Plant, the responsibility management of the Desalination Plant is by Marj Na’jah Village Council, where some farmers affiliated with the Council carry out the operation of the responsibility and follow up on its maintenance as necessary. However, there is an apparent mismanagement and shortening of the responsibility represented by:
    1. The randomness of work and the failure to define the necessary administrative tasks and divide it fairly among the beneficiaries (Farmers) of the responsibility.
    2. Lack of follow-up file and no records of all matters related to the Desalination Plant status, daily working hours, maintenance costs and follow-up collection from farmers and others.
    3. Neglect and delay of periodic maintenance work exacerbate the problems

- Current Desalination Plant situation:
    1. There is a large loss of water resulting from leaks from the well pump and from pumping pipes from the well to the Desalination Plant, as well as from the pipes inside the Desalination Plant and some of the permeable membrane carriers.
    2. Accumulation of rust at large parts of pumps, metal pipes and equipment inside the Desalination Plant
    3. The automatic system inside the Desalination Plant is broken
    4. Salinity and water temperature measuring devices are broken
    5. The ventilation inside the Desalination Plant is poor

- The obstacles encountered the Desalination Plant:
    1. Reservation of the Desalination Plant when importing it at the beginning of the project in 2012 from the Israeli side for more than three months in the Ashdod port.
    2. The Desalination Plant stopped operating for approximately 6 months due to the farmers' inability to pay maintenance costs in 2015.

3. The inability to develop a system to reduce the cost of electricity consumption by establishing a solar cell system on the pretext that the Desalination Plant is located on the lands of its administrative classification, areas C. When the Ministry of Agriculture tried to install the cells, the Israeli occupation issued a notification of the demolition, and the Ministry had to transfer the cells to another location in 2017.
4. Difficulty in obtaining devices, Anti calcination materials and filters because they are not available in the local market and the complex procedures for purchasing them individually, whether from the Israeli market or importing them from abroad.
5. Some suppliers take advantage of farmers' need for spare parts and materials, and sell these parts double the cost from their original prices.

3.2.2 Al- Zubeidat village and Al- Zubeidat Desalination Plant

1. Al- Zubeidat village

Zubeidat is a small village that is located 35.4 km to the north of Jericho city, it lays 275m below sea level, with a total area of approximately 4,123 dunums, 99% of the total village area were classified as area C according to Oslo II Interim Agreement (ARIJ, 2012), and the population of the village is 1,679 (PEBS, 2017).

The main economic activity in the village is the agriculture, approximately 97% of the population working in agriculture sector (ARIJ, 2012).

Zubeidat village has only three wells, all of them are classified as brackish water. The inhabitants of the village are used the water from the wells for different purposes but not for drinking. The most important purpose is irrigating the crops such as vegetables, palm and grapes. (Arij, 2012 and Yousef, 2013)

2. Al- Zubeidat Desalination Plant

Al- Zubeidat desalination plant was established during 2012, it was the first desalination plant operated by solar electric power (PV) in West Bank. Thinking of using desalination technique for drink purpose in the region was started from 2005 due to politic reasons; the most important of these reasons was looking for alternatives away from buying water from the Israeli side. Al- Zubeidat desalination plant was a pilot plant; the main objective was to support scientific research in this field.

The main stakeholders for established the plants: Al-Najah University in cooperation with local contractor (General Environment Services - GES) under the supervision of PWA. This project was donated by the Mediterranean Renewable Energy Centre (MEDRC).

Several research studies have been published by Palestinian universities related to the Al-Zubeidat desalination plant, some of these studies focused on the plant completely, such as (Yousef, 2013), and others take it as a study case when they talking about desalination plants in the Palestinian Jordan Valley, such as (Basharat, 2014 and Faheem, 2016). The plant has been stopped due to a malfunction in the storage batteries during 2018 there is no financial support for the plant. Currently, nobody is responsible for the management and follow-up of the plant!

During the work of the plant, the villagers used the water to drink, but the amount was not enough for all, so it was limited for approximately only 20 people.

The head of Local Council of Zubeidat was the responsible for monitoring the plant, because of the proximity of the plant to his home, Coordination with water and environmental studies in Al Najah university, but after his death, no one from the village followed up in the plant.

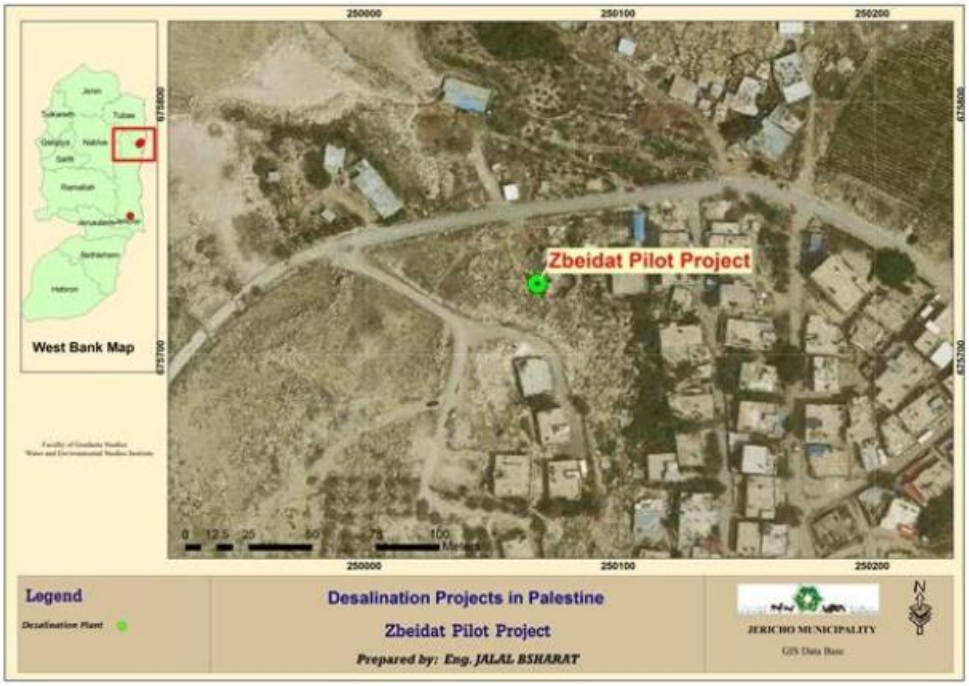

Figure 6 The location of Al -Zubeidat desalination plant

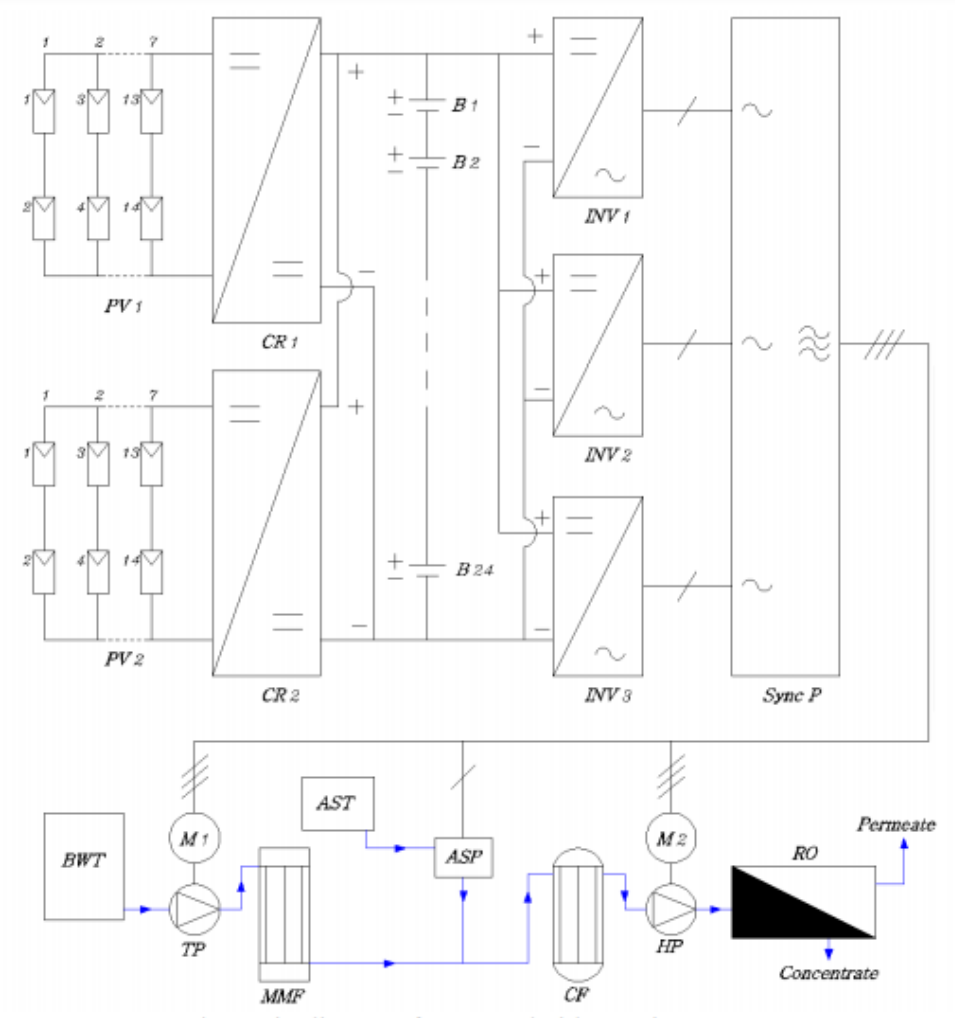

Figure 7 schematic diagram of Al Zbeidat desalination plant

Where:

•PV1, PV2: Photovoltaic arrays. •CR1, CR2: Battery charge regulators. •B1-B24: Storage battery cells. •NV1, NV2, NV3: DC/AC Inverters. •Sync p: Synchronizing control panel. •M1-TP: Transfer motor pump.	•M2-HP: RO HP motor pump. •AST: Anti scaling tank. •ASP: Anti scaling pump. •BWT: Brackish water storage tank. • MMF: Multimedia filter. •CF: Cartridge filter. • RO: RO Vessels containing the membranes

Table 8 Capital costs of Al-Zubeidat BWRO desalination unit

Component	**Quantity**	**Unit price ($)**	**Life time(year)**	**Total price ($)**
PV module (185 W)	5180 WP	1/Wp	20	7770
Batteries (2V/875 Ah)	24	437.5	10	31500
Charge Controller (2.5 kW)	2	1500	20	4500
Inverter (3.6 kW)	3	2100	20	9450
Installation Material	---	---	20	1500
Installation (electrical & mechanical) Cost	---	---	---	2000
Transfer pump	1	2400	30	3600
High pressure pump	1	3500	30	5250
Anti-scaling pump	1	1000	20	1500
Multimedia filter	2	1100	5	13200
Cartridge filter	2	600	5	13200
RO membrane vessel	3	3500	5	13200
Piping, valves, gages	1	3900	20	5850
Electric control panel	1	1200	20	1800
Instrument control panel	1	2000	20	3000
Cleaning system	1	1500	20	2250
Steel structure (epoxy coated)	1	1400	20	2100
Total capital cost of the system ($)				121,670

3. The Impacts Study of the Desalination Plant Project:

As mentioned before, in chapter of literature review there are many impacts which effected on desalination projects. Following table (table 7) mentioned these factors in the case of Zubeidat desalination project.

Table 9 Main impacts in Zubeidat

Impact	Zubeidat
Desalination technology	• Small brackish reverse osmosis technology
Location	• Zubeidat desalination plant is extremely near the well. • The land owned by local council of Zubeidat which supported the project with donors. • The power grid near the plant supplies by PV power plant. • The land is near the PV power source.
Raw water quality	• TDS is approximately 2600 ml/L in the upper limit • Temperature of feed water is approximately 25°C
Intake and outfall	• Automatic pumping system from the well to the concrete storage tank then to desalination plant.
Pretreatment	• Two stages of filters by used multimedia filter and cartridge filter.
Energy recovery	• Not supported
Electric power	• Worked by PV power
Post-treatment	• Addition of chemicals to the product water to prevent corrosion of downstream infrastructure piping.
Local infrastructure costs	• No details available
Environmental regulations	• Disposal of brine water

Chapter Four: Methodology

As detailed previously, the main purpose of this research is to shed light on the topic of desalination in Palestine, especially in the West Bank. This chapter presents the methodology used in this research, which can be classified as survey research.

The methodology included the following topics: specify the research questions, data collection, and presented the data as the results of research to discuss them.

4.1 Research Questions

"Specify the research questions" is one of the most important steps that help in determining the data required. The research questions could be summarized on the Palestinian participation in water desalination projects, study some study cases, and reviewing the opinions of water experts about desalination in Palestine which discussed through this research.

The participation of the Palestinians in desalination issues that highlighted in this research was focused on: presented some of the scientific efforts made by the Palestinian researchers in the field, studying of the extent to which local capabilities and expertise are utilized in establishing and managing desalination plants which located in Palestine.

Two different experiments were chosen for desalination plants implemented in the Jordan Valley region as case studies, due to the ease of access to them, and the fact that each plant carries a lot of criticism.

Identify stakeholders and thus communicate with some local water experts to answer the questions asked in the research.

4.2 Data Collection

According to the research questions and objectives, data collected by meetings with some officials and workers in sectors related to water in Palestine, visiting some desalination plants and distributed questionnaires for experts.

4.2.1 Meeting

Several visits were conducted to different Palestinian authorities such as the Palestinian Water Authority, the Ministry of Agriculture in Ramallah, Directorate Jericho & AL-Agwar Agri in order to understand the role that each of these authorities played in

establishing desalination projects in Palestine. Also, meeting some private companies which work in this field and farmers which used desalinated water.

The Palestinian Water Authority is one of the supporting bodies in the search for unconventional water sources, and this is evident in its strategy for the year 2017-2019. And it was one of partners which establishing Al- Zbiedat desalination plant. Also, Ministry of Agriculture and Directorate Jericho & AL-Agwar Agri had a great role in establishing Marj Najaa desalination plant.

Two private companies were visited located in West Bank, the discussion was about the future of the private sector in the field of water in Palestine, and asking about their desalination plant which Implemented by them.

4.2.2 Field Visits

Visiting some desalination plants in Palestinian Jordan Valley (Marj Najaa desalination plant and small plant for a farmer in Al-Auja), We did not succeed in visiting Al- Zabidat desalination plant because it was closed since 2016. Field visiting was so important in evaluate the current situation for Marj Najaa desalination plant and talking with farmers which managing the plant. The farmer in Al-Auja was trying to rehabilitation of an old small desalination plant with PV. We discussed with hem the difficulties he faced in obtaining parts and materials in addition to the experiences of installing and operating the plant.

4.2.3 Questionnaires

Two forms (Annex I and II) were published with a specific question related to the desalination topic. The first one for the experts in the water field individual, and the second was for companies working in water field.

The purpose of the two questionnaires were to collect information about the capabilities of Palestinian individuals and companies to establish and manage desalination plant in Palestine. The forms were written and published using Google Drive form.

Representation of the data

Data collection was represented in this research as the description of current situation for study cases, and the results of answering the questionnaires. The information was

presented as it was obtained without using any statistical analysis program or others, due to the lack of clarity of the image regarding the issue of desalination in Palestine and finding some inconsistencies in answering the forms in addition to the weak interaction with the forms, especially the companies form.

Chapter Five: Results and Discussion

The main objective of the research is to study the Palestinian local market and the capability to establish sustainable water desalination projects. The focus is on the local market in the West Bank because the study area is Jericho area and the Jordan Valley which located in West Bank. However, Gaza Strip is not included in the research study due to the blockade imposed by the Israeli occupation authorities that restricted trade between the West Bank and Gaza Strip.

To achieve the goals and to assess the extent of capacity and potential of local resources to implement desalination projects, two questionnaires were created, the first was targeted experts in the water sector individually, and the second was targeted the companies which worked in the water sector.

The first questionnaire includes various sections: definitional questions in general, the desalination in Palestine, the availability of parts and spare parts, the use of renewable energy and Privatization and investment in desalination. 59 responses were obtained. The following sections analyze the results.

- **Section one: *Introductory Questions***

  The aim of this section is to know general information about the respondent, and the answers to the questions were as follows:

- Gender: 73% of males and 27% of females with 59 Response *(Figure 8).*

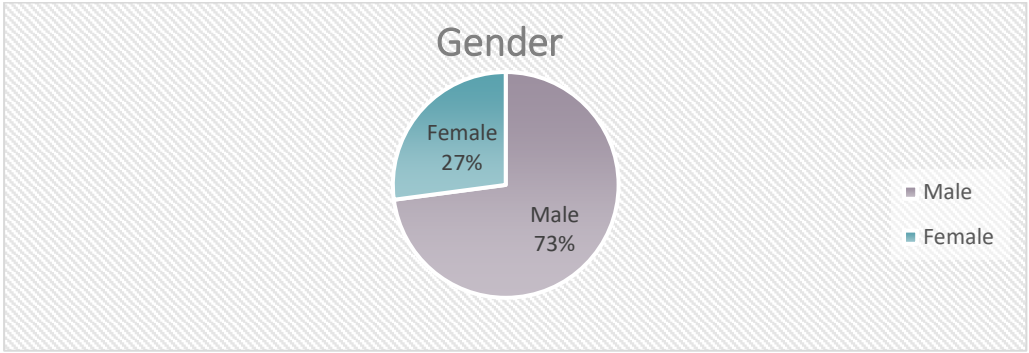

Figure 8 Gender of respondent

- Work area: 86.2% from the West Bank, 8.6% from the Gaza Strip, and 5.1% from other areas (Palestinian Occupied land and Arab regions) with 58 Response *(Figure 9).*

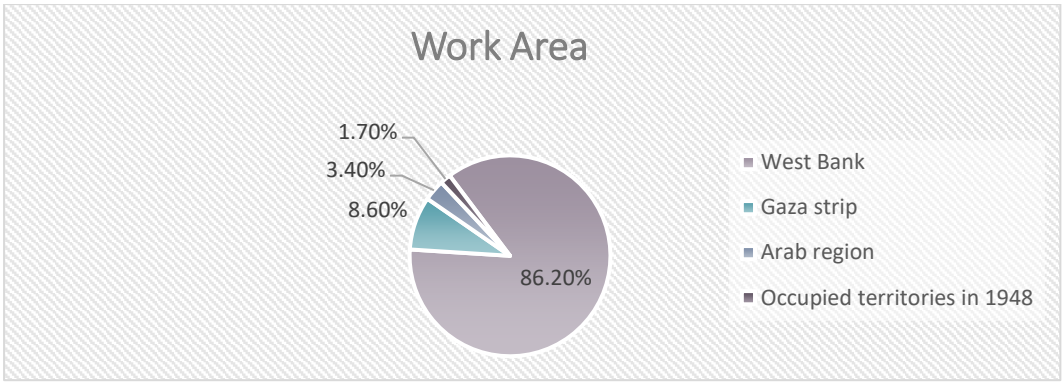

Figure 9 Work area of respondent

- Academic level: 20.3%, Bachelor's, 61% Master, 18.6% PhD with 59 Response *(Figure 10).*

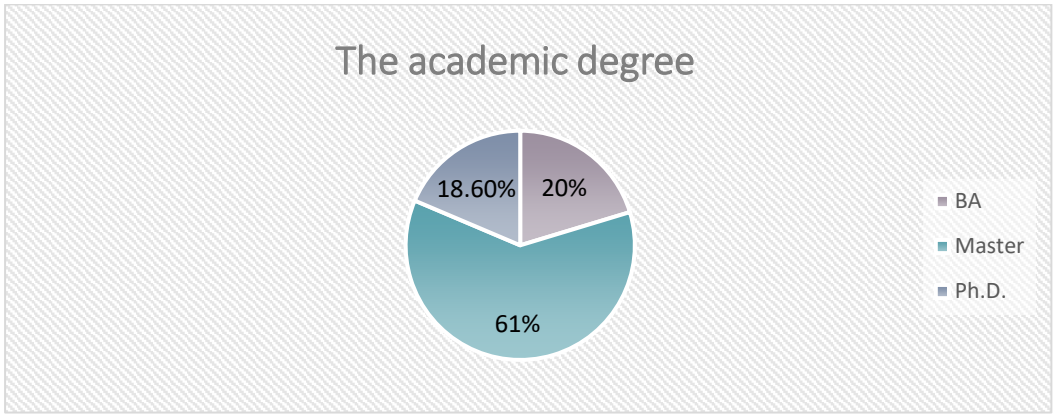

Figure 10 The academic degree of respondent

- Field of work, job title and years of experience: 58.6% had previous experience and 41.4% did not have previous experience on the subject with 58 Response *(Figure 11).*

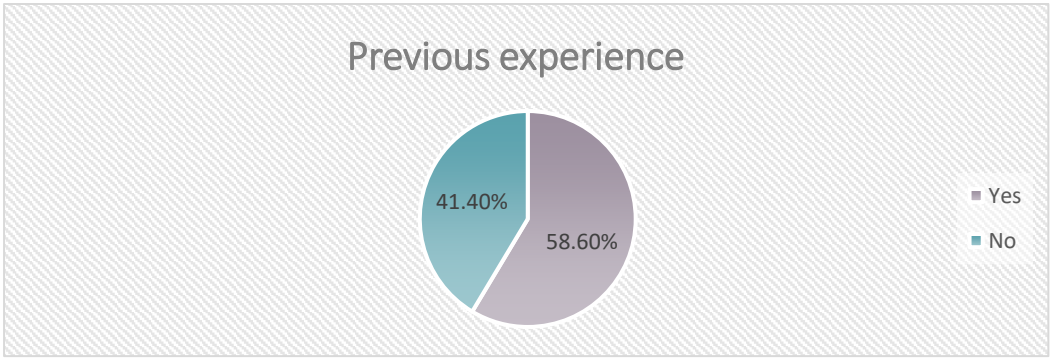

Figure 11 Previous experience of respondent in desalination field

The experiences were mainly in:

a. Experiences in the academic field (Master and Doctorate Research)
b. Practical experiences in establishing and designing desalination plants
c. Training courses
d. Work in desalination plants

2. The second section: *Desalination in Palestine*

The construction of desalination plants is concentrated in two areas: Gaza Strip and the Jordan Valley (Jericho and the Jordan Valley) due to the high percentage of salts present and pollution. In this section, the questions focused on desalination in Palestine in general and about the special capabilities that people have in this field, as well as on the Palestinian ability to manufacture the most important parts used in desalination plants. The answers to the questions were as follows:

- The existence of other Palestinian areas that need desalination plants other than the Jordan Valley and Gaza: 47.5% of people answered no, 22% answered yes (The areas such as Jenin, Tulkarm and Qalqilya), 30.5% of them answered (I don't know) with 59 responses *(Figure 12).*

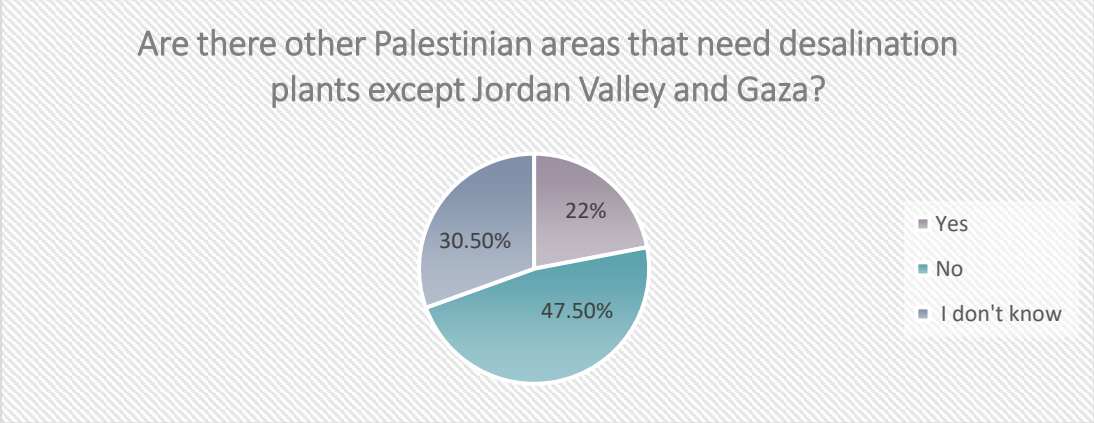

Figure 12 The result of answering a question "Are there other Palestinian areas that need desalination plants except Jordan Valley and Gaza?"

- The need of Jericho and the Jordan Valley to new desalination projects: 47.5% of them think that it is a big need, 30.5% say that the need is medium, 6.8% say that there is no need for this and 15.3% answered without knowing with 59 responses *(Figure 13).*

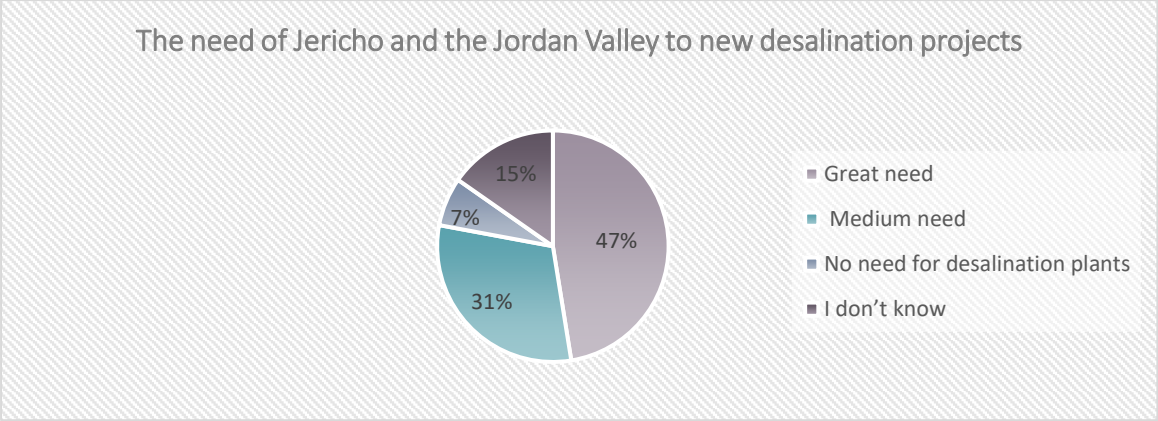

Figure 13 The result of answering a question "what the need of Jericho and the Jordan Valley to new desalination projects"

- Can desalination of brackish wells be a solution to the water scarcity crisis in the Jericho and Jordan Valley areas: %61support that desalination of salty wells can be a solution to the water scarcity crisis in the Jericho and the Jordan Valley area, 25.4% cannot be a solution to the crisis and 13.6% do not know with 59 responses *(Figure 14).*

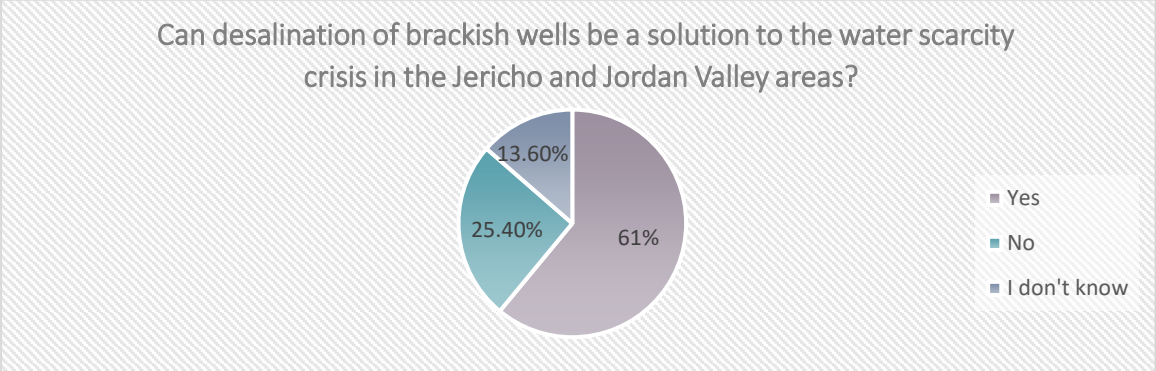

Figure 14 The result of answering a question "Can desalination of brackish wells be a solution to the water scarcity crisis in the Jericho and Jordan Valley areas?"

- The economic feasibility of desalination projects: 15.3% of them supported that desalination projects are economically feasible, 42.4% considered them expensive but there is no other option, 3.9% considered them expensive and there are other alternatives with 59 responses *(Figure 15).*

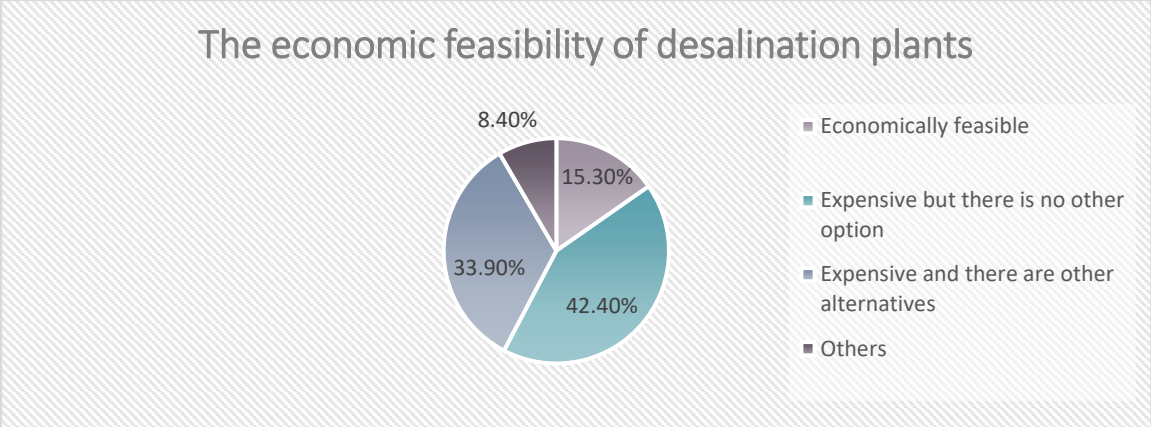

Figure 15 The result of answering a question about the economic feasibility of desalination plants

There other alternatives were:

a. Mix salt water with sweet water or use treated water
b. Take the Palestinian share of water or increase it by drilling new wells
c. The use of modern technology

- The desalination projects deserve special government support for workers in this sector: 86.4% see that desalination projects deserve special government support for workers in this sector, while 10.2% of them considered them not deserving of government support and 3.4% do not know with 59 responses *(Figure 16)*.

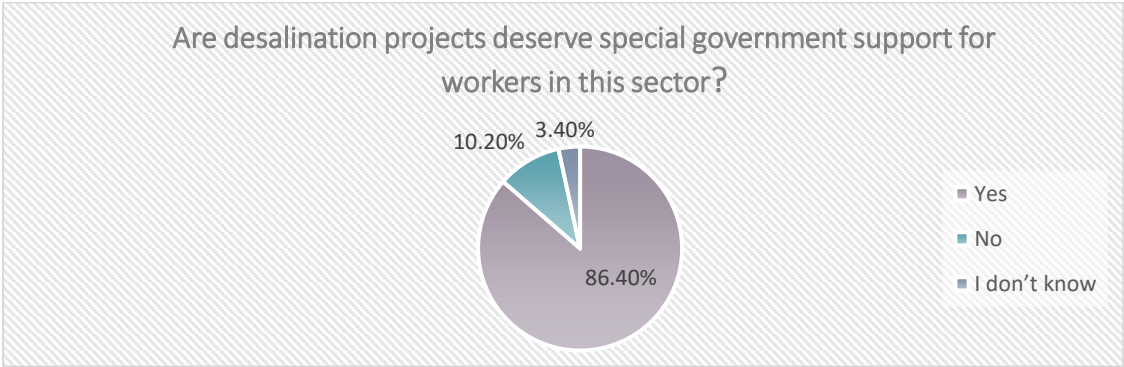

Figure 16 The result of answering a question "Are desalination projects deserve special government support for workers in this sector?"

- The political trend to establish and develop new desalination projects in the Jordan Valley: 20.3% of the people think that there is a political tendency to establish and develop new desalination projects in the valley, while 18.6% of them think that there is no political approach to this, and 61% of them answered with no knowledge with 59 responses *(Figure 16)*.

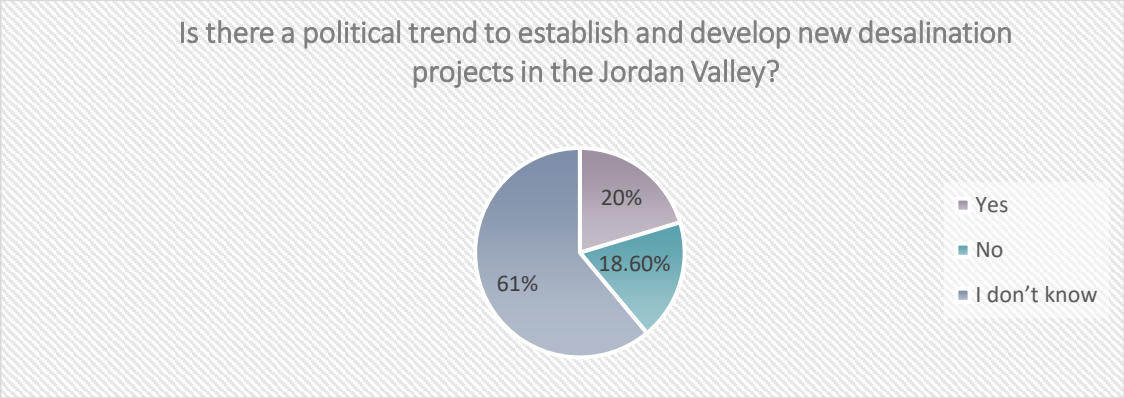

Figure17 The result of answering a question "Is there a political trend to establish and develop new desalination projects in the Jordan Valley?"

- The academic interest from universities to develop competencies to work in the field of water desalination: 47.5% supported that there is academic interest from universities to develop competencies to work in the field of water desalination, 25.4% see that there is no academic interest in the subject, while 27.1% of them do not know with 59 responses *(Figure 18).*

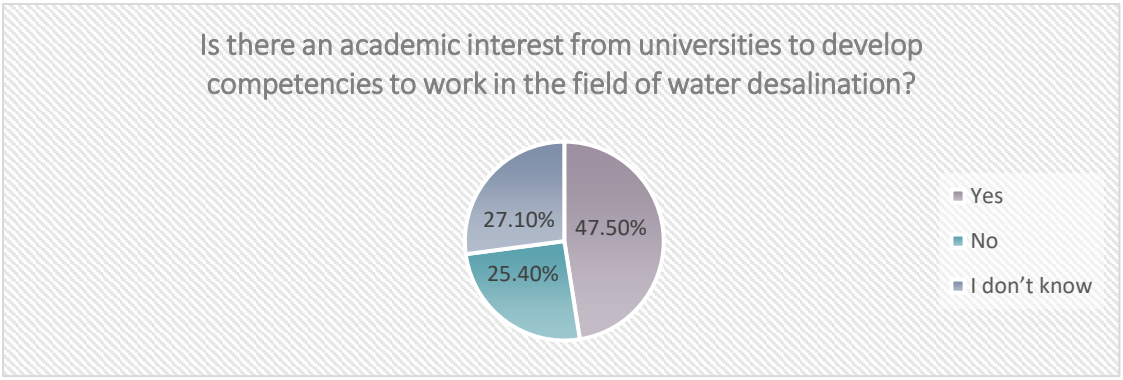

Figure 18 The result of answering a question "Is there an academic interest from universities to develop competencies to work in the field of water desalination?"

- The desalination issue receive more attention from universities and academic institutions in Palestine: 81.4% of the people supported that desalination should receive more attention from universities and academic institutions in Palestine, while 3.4% did not see this important and 15.3 of them had no knowledge of this with 59 responses *(Figure 19).*

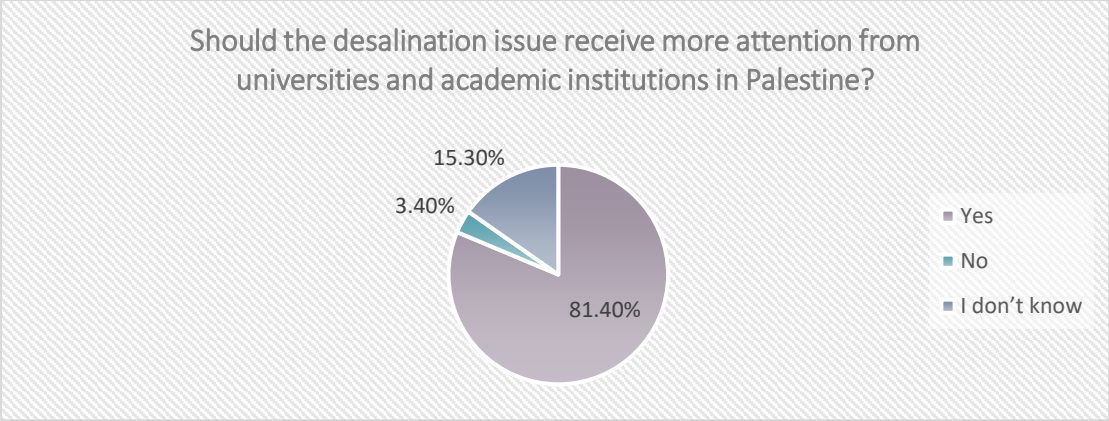

Figure 19 The result of answering a question "Should the desalination issue receive more attention from universities and academic institutions in Palestine?"

The suggested topics that university study plans should include:

a. Water Desalination Techniques and their Possibility in Palestine
b. Proper disposal of desalination process products
c. Economic study, sound management and cost recovery
d. Desalination plants design
e. Practical training
f. Master and PhD programs in desalination
g. Integrated Salt Water Management in Palestine
h. Water Desalination full technical process course that involves all aspects (financial, environmental, capacity, labor force & others)

- The negative environmental impacts of the desalination process: 56.9% answered yes (disposal of brine water), 29.3% answered no and 13.8% answered not knowing it with 58 responses *(Figure 20).*

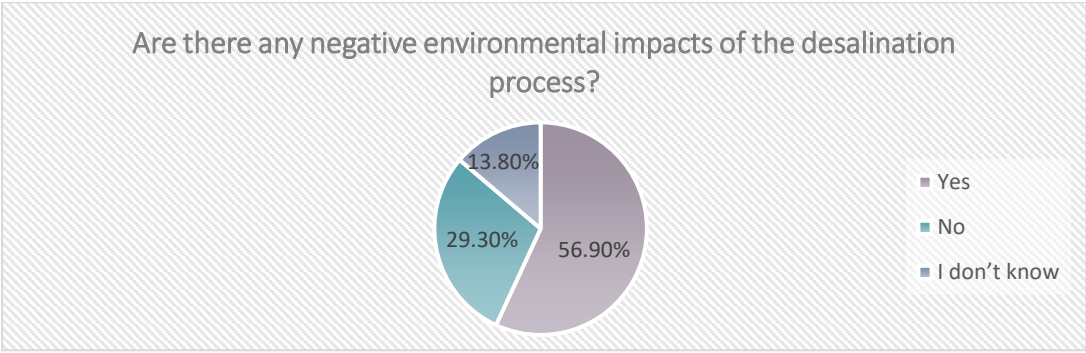

Figure 20 The result of answering a question "Are there any negative environmental impacts of the desalination process?"

- The best technology for desalination plants in Palestine: 55.9%: Reverse Osmosis, 32.2%: I don't know, 6.8%: Electrodialysis, 3.4%: vapor compression distillation and 1.7%: multi stage flash distillation with 59 responses *(Figure 21).*

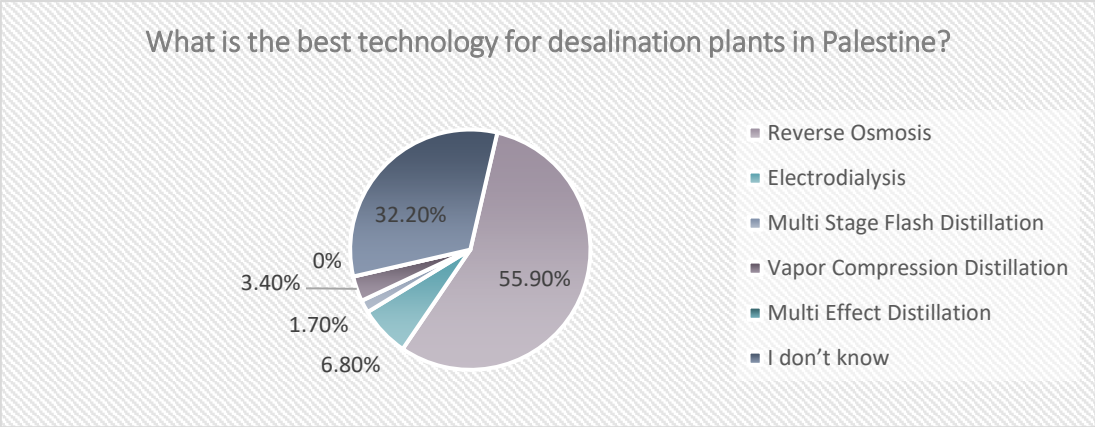

Figure 21 The result of answering a question "What is the best technology for desalination plants in Palestine?"

- The experiences that people have in carrying out the tasks to establish a desalination plant based on Reverse Osmosis System technology: the answers were as follows (considering the division of experiences into levels from 0: lack of experience to 5: significant experience in the field)

    a. Lack of experience: Answer 0
    b. Weak experience: Answers 1 and 2
    c. Medium experience: Answer 3
    d. High experience: Answers 4 and 5

Table 10 The estimate abilities of the respondents in related desalination activities

Desalination Plant ability	High	Mediu m	low	No
Your ability to assess the water quality of the wells and issue reports	%33	%29	%20	%18
Your ability to determine the technical specifications for implementing a desalination plant	%22	%24	%29	%25
Your ability to design a desalination plant	%/18	%4	%37	%41

Your ability to implement (supply, install and operate) water desalination plants	%16	%13	%36	%35
Your ability to connect the station to electronic technologies to monitor its performance and control its operation and stopping it remotely	%11	%9	%36	%44
Your ability to supervise the implementation of desalination plants	%33	%18.5	%30	18.5 %
Your ability to manage and monitor the maintenance of desalination plants	%24	%16	%33	%27

- The Palestinian companies know that they have the ability to design, implement or supervise the establishment of desalination plants: %55.1 does not know, %19 yes and %25.9 perhaps. It is mainly to know the companies in order to communicate, with 58 responses *(Figure 22).*

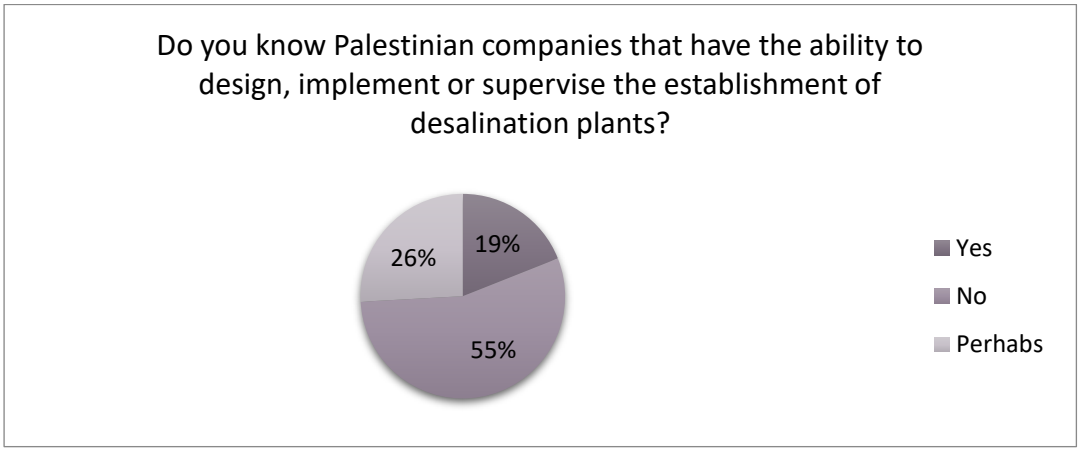

Figure 22 The result of answering a question "Do you know Palestinian companies that have the ability to design, implement or supervise the establishment of desalination plants?"

- The parts that can be manufactured locally in Palestine with 58 Responses as follow figure (23):

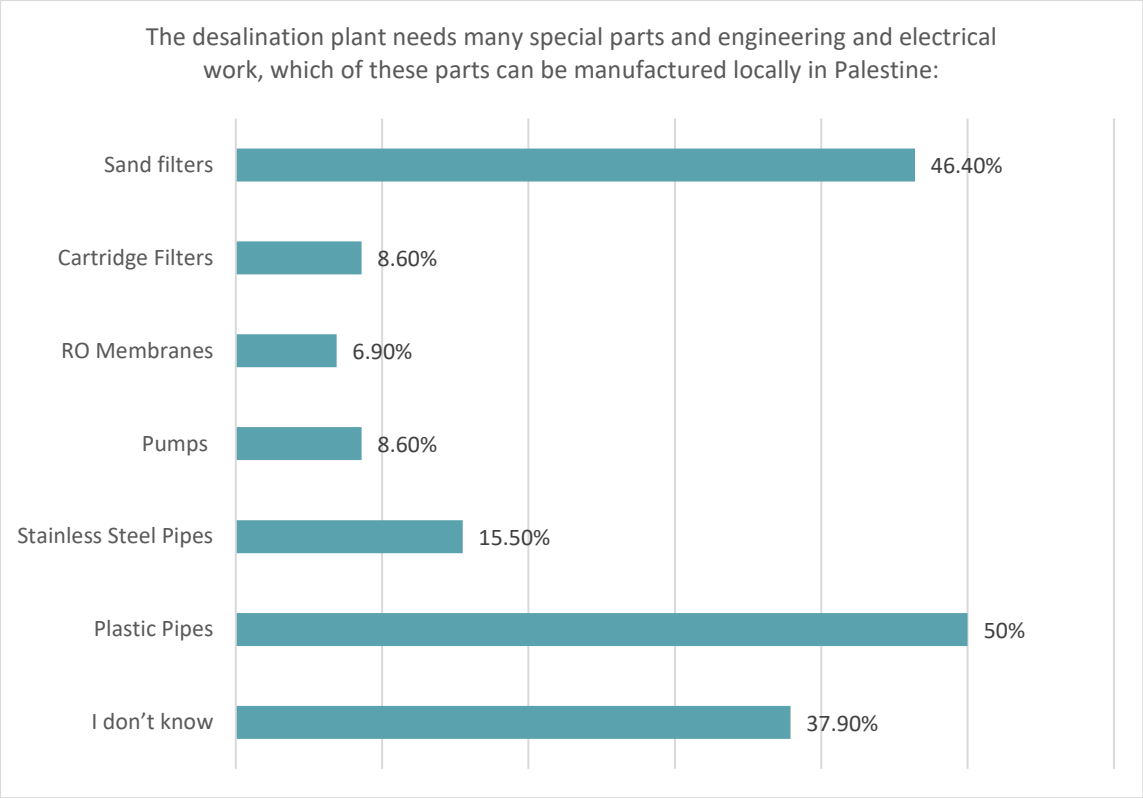

Figure23 The result of answering a question" which part of these can be manufactured locally in Palestine?"

The reasons for the poor manufacturing of most of the parts were as follows:

a. Weak experience and lack of factories to produce various components of the desalination system.
b. Difficulty in obtaining raw materials
c. The absence of government stimulus
d. There is no need
e. The high cost and lack of competitiveness with the importer
f. We have no infrastructure
g. Experiences, lack of financial means and the Israeli hot
h. The Israeli occupation
i. Total dependence on Israeli industry

❖ **Section Three:** ***Availability of parts and spare parts in Palestine***

In this section, a question was asked about most parts used in desalination plants such as supply pumps, sand filters, 5-micron filter containers, 5-micron filters, injection pumps, high-pressure pumps and permeable membranes. The question was also asked about estimating the price per cubic meter of desalinated water in The case of using water for agricultural irrigation and in case of using water for drinking. In addition, the question was asked about the person's knowledge of Palestinian companies specialized in providing the parts to desalination plants and mentioned them if he knew, and finally the question about the existence of Israeli laws that hinder the import of the parts from abroad.

The method of asking about the availability of these pieces in the Palestinian local market was by estimating the availability from the number 0 (evidence that the parts are not available in the market) to number 5 (evidence of the large number of their presence(The answers to this question ranged from 34-38 answers, meaning that approximately 36% of people were unable to answer this section, and it is clear that most of the pieces are not available in the local market because the percentage of the answer to the number 0 was the highest among all answers except for filters Al Ramlieh equaled with the number 3. As for the high pressure pumps was 8.4% lower than the number 3, we conclude from this section that there is a weakness in the availability of parts and spare parts in the Palestinian local market in general.

Table 11 The availability of main desalination equipment in Palestinian local market

Equipment	Not available	Poorly available	Available in average	Greatly available
supply pumps	36.8%	21%	21.1%	21.1%
sand filters	26.3%	18.5%	26.3%	29%
cartage filter	38.2%	35.3%	11.8%	14.7%
5 micron filters	42.9%	31.4%	14.3%	11.4%
injection pumps	31.4%	31.4%	20%	17.1%
high pressure pumps	22.2%	22.2%	30.6%	25%

RO membranes	33.3%	30.5%	19.4%	16.7%

- Estimating the appropriate price per cubic meter of desalinated water for agricultural use: 56.6% the appropriate price is less than 3 shekels, 28.3% from 3-5 shekels, 5.7% more than 5 shekels 9.4% not knowing with 53 Response *(Figure 24)*.

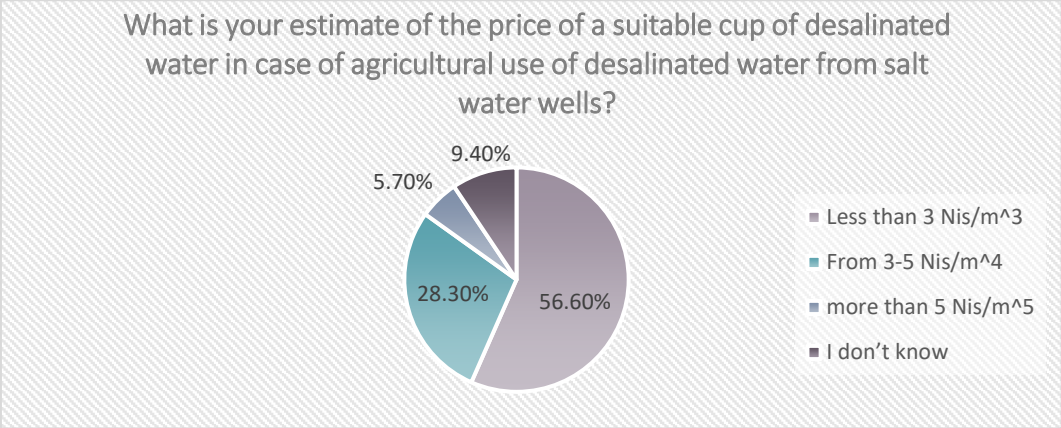

Figure 24 The result of answering a question" What is your estimate of the price of a suitable cup of desalinated water in case of agricultural use of desalinated water from salt water wells?"

- The price of one cubic meter of desalinated water for drinking purposes: 25.5% the appropriate price was less than 3 shekels, 38.2% from 3-5 shekels, 27.3% more than 5 shekels and 9.1% without knowing with 55 responses *(Figure 25)*.

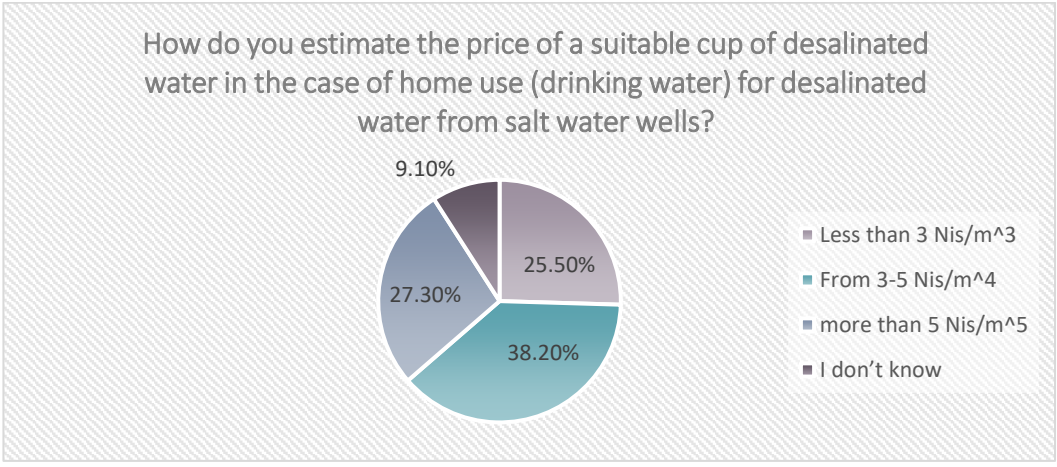

Figure 25 The result of answering a question" How do you estimate the price of a suitable cup of desalinated water in the case of home use (drinking water) for desalinated water from salt water wells?"

- The companies specialized in providing parts and spare parts for desalination plants: 61.8% unknown, 23.6% yes (to communicate with them) and 14.5% there are no specialized companies for this, with 55 responses *(Figure 26).*

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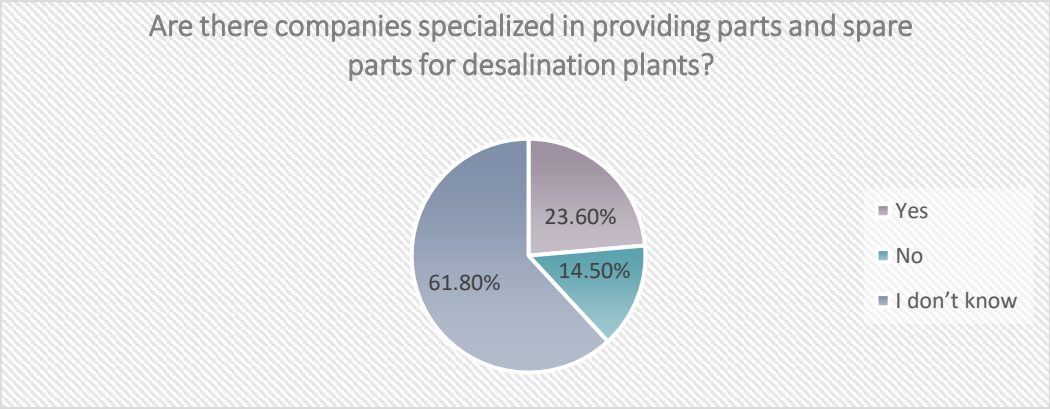


Figure 26 The result of answering a question" Are there companies specialized in providing parts and spare parts for desalination plants?"

- The existence of Israeli laws that impede imports: 60.7% of them do not know, 28.6% of them answered yes and 10.7% of them answered no. with 56 responses *(Figure 27).*

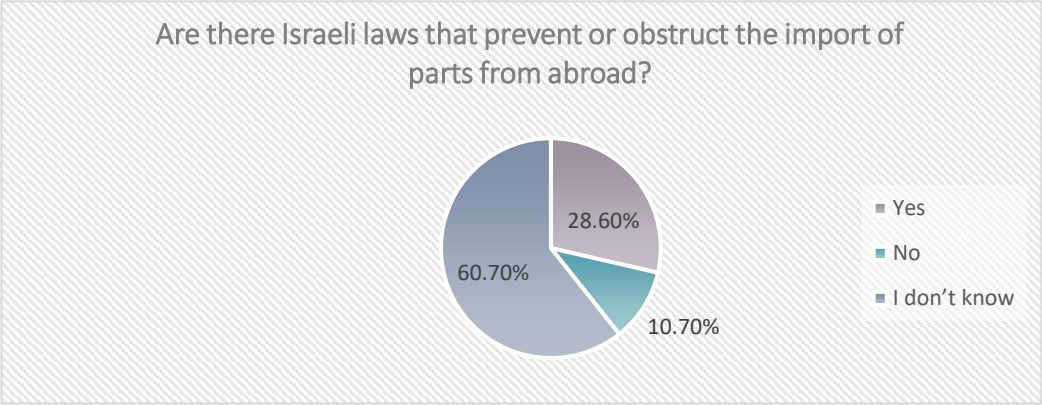


Figure 27 The result of answering a question" Are there Israeli laws that prevent or obstruct the import of parts from abroad?"

The Israeli obstacles that were mentioned, including:

a. Dual use, restrictions on pumps
b. The Oslo Agreement and the Paris Agreement
c. Security and coordination requirements impede entry of all materials

d. Depends on the Israeli restrictions on specific areas & the equipment entry through Israeli borders
e. Pressure to import from Israel

❖ **Section 4: *Using alternative energy in Palestine***

The energy issue is considered one of the most important issues in the field of water desalination, as approximately 50% of the total project cost is spent on the energy needed to run the project. The exploitation of solar energy is considered one of the most important alternative energy sources in Palestine.

The questions in this section focused on the ability of Palestinian companies to build plants to generate solar energy, and is there special government support for workers in this sector. In addition, there is questions about the availability of parts and equipment for the construction of solar power plants in the Palestinian market, and are there Israeli restrictions on importing parts and materials for power plants solar energy. The answers to the questions were as follows:

- Palestinian companies have the ability to build solar power plants for desalination plants: 83.9% answered that Palestinian companies are able to build solar power plants for desalination plants, 1.8% answered that they were unable to do so and 14.3% answered they do not know, with 56 responses *(Figure 28).*

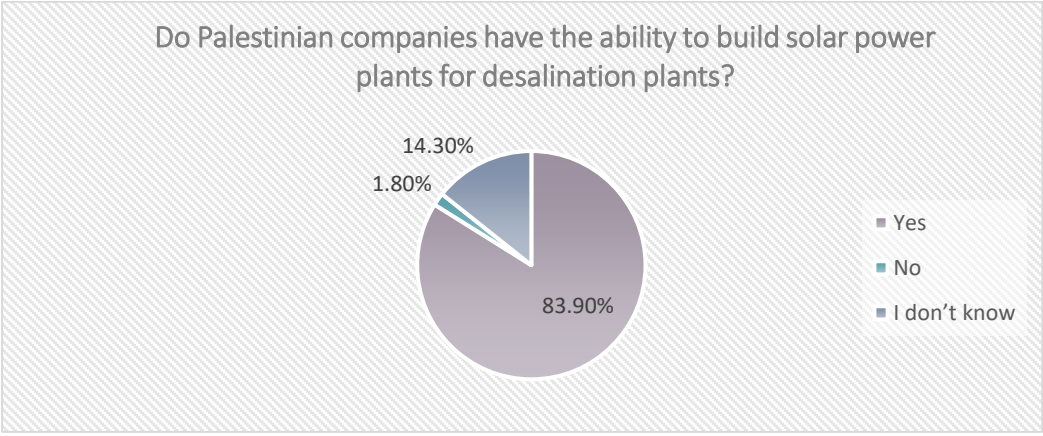


Figure28 The result of answering a question" Do Palestinian companies have the ability to build solar power plants for desalination plants?"

- Special government support for workers in the alternative energy sector: 37.5% said that there is special government support for workers in the alternative energy sector, while 32.1% answered that there is no support and 30.4% answered that they do not know this, with 56 responses *(Figure 29).*

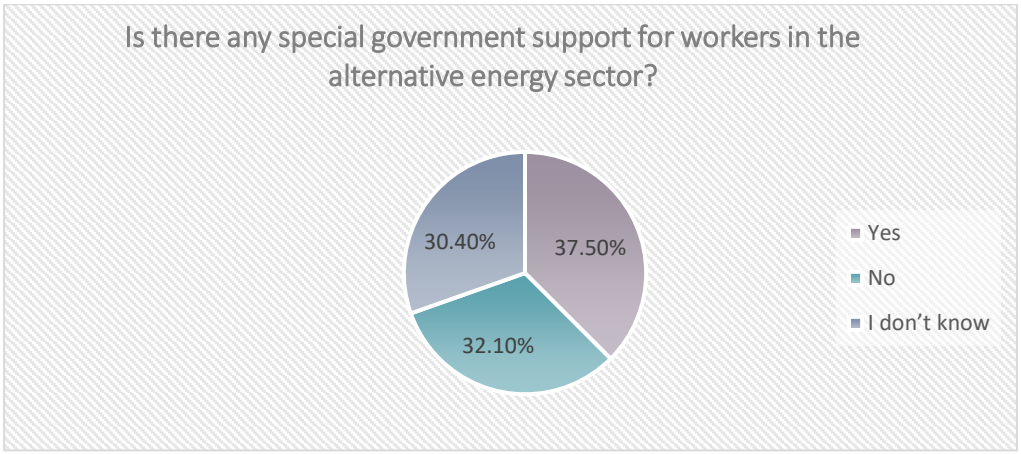


Figure29 The result of answering a question" Is there any special government support for workers in the alternative energy sector?"

- The availability of parts and equipment for the construction of solar power plants in the Palestinian market: 61.8% answered it is available, 27.3% answered that they were not available and 10.9% answered that the do not know, with 55 responses *(Figure 30).*

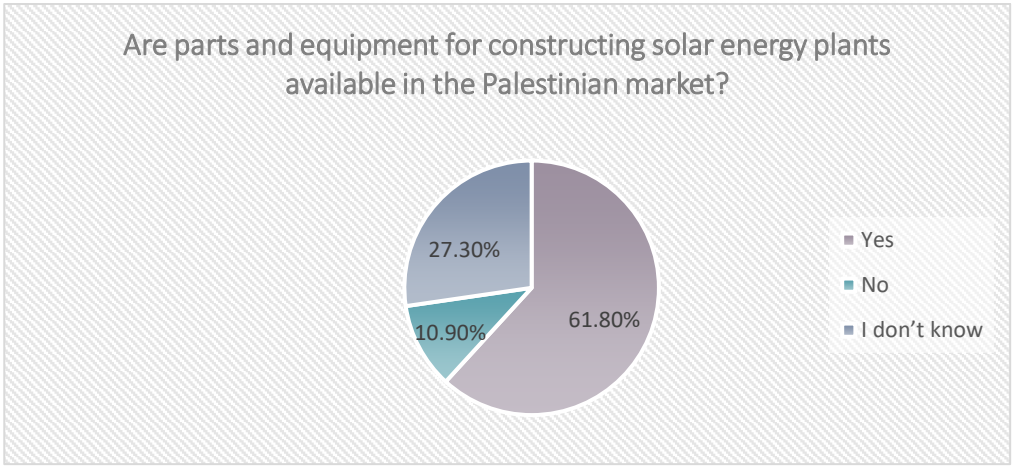


Figure30 The result of answering a question" Are parts and equipment for constructing solar energy plants available in the Palestinian market?"

- The Israeli restrictions on importing parts and equipment: 46.4% answered they do not know, 30.4% answered that there were Israeli restrictions and 23.2% answered that there were no restrictions, with 56 responses *(Figure 31).*

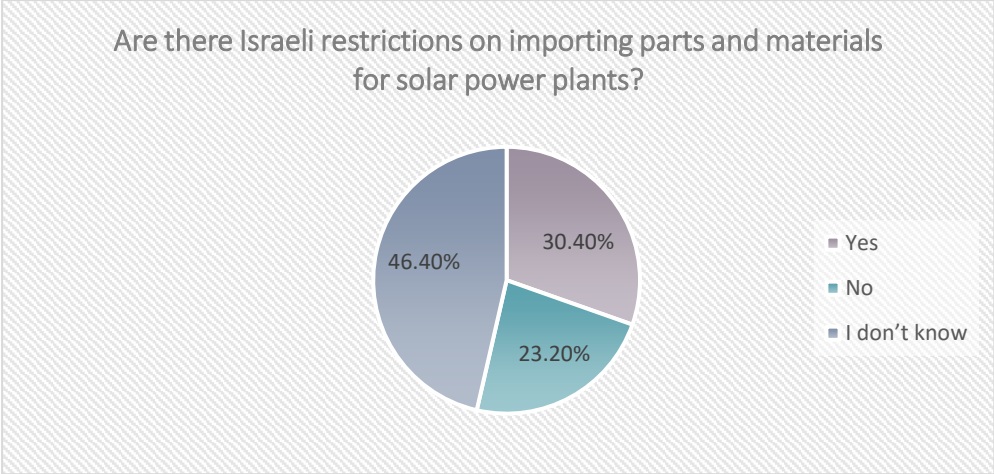


Figure 31 The result of answering a question" Are there Israeli restrictions on importing parts and materials for solar power plants?"

❖ **Section Five: *Investing in the desalination sector and involving the private sector***

In this section, the question was asked about the respondent's point of view regarding the ability of desalination projects to attract the private sector to invest in them, and it support for the idea of privatizing these projects and the type of privatization that supports them. The answers to the questions were as follows:

- **The field of desalination is an attractive project for investment from the private sector**: 61.4% answered that these projects are attractive to private sector investment, 17.5% said they did not agree, and 21.1% said they do not know, with 57 responses *(Figure 32).*

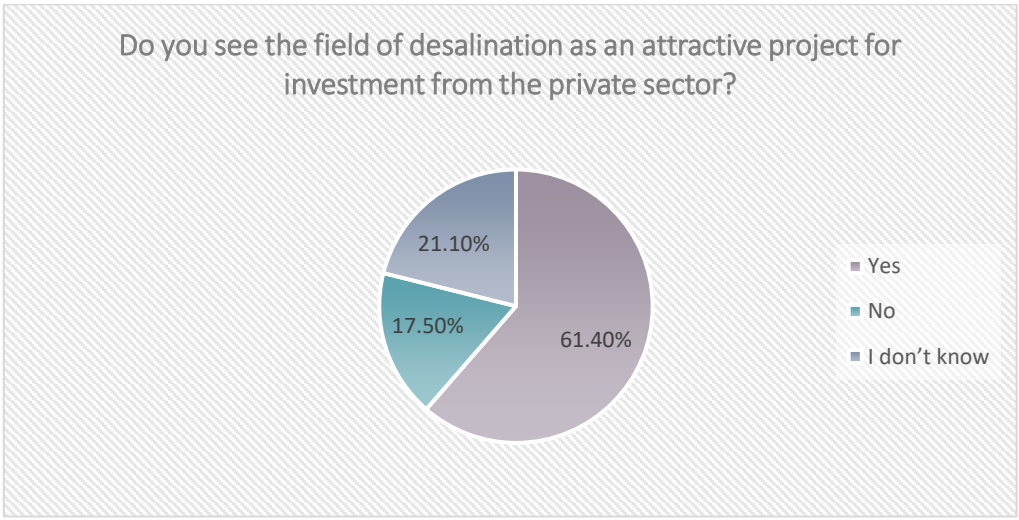


Figure 32 The result of answering a question" Do you see the field of desalination as an attractive project for investment from the private sector?"

- Supporting the privatization of water desalination projects: 67.3% supported the idea of privatizing these projects, 21.8% opposed that and 10.9% answered with no knowledge, with 55 responses *(Figure 33).* The type of privatization: 70% of them supported the partial privatization and 30% supported the full privatization, with 40 responses *(Figure 34).*

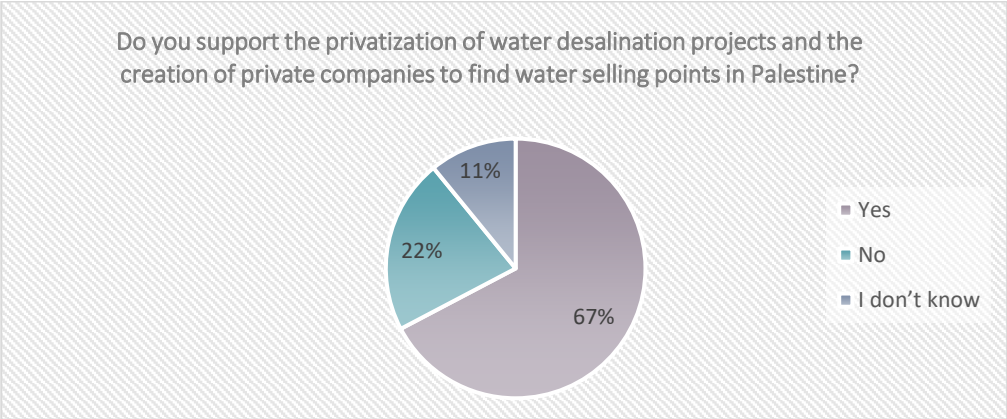


Figure33 The result of answering a question" Do you support the privatization of water desalination projects and the creation of private companies to find water selling points in Palestine?"

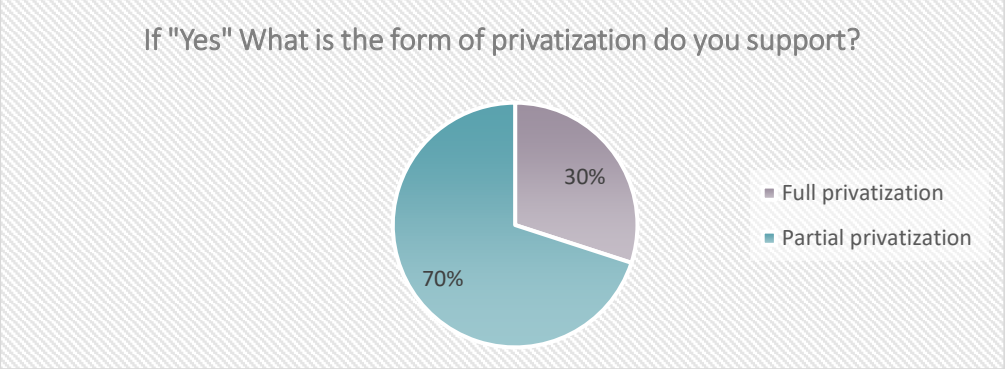


Figure 34 The result of answering a question" What is the form of privatization do you support?

Questionnaire two: Questionnaire for companies regarding water desalination in Palestine

Four Palestinian companies which specialized in the water sector were contacted, and a form for desalination was filled out with each of them.

The companies are located in the West Bank distributed as following:

- Two companies in the middle of West Bank (Ramallah and Birzeit)
- One company in the northern West Bank (Jenin)
- One company in the South Company (Bethlehem)

All the companies are classified as private joint stock companies in the Ministry of Economy, and only one company has a classification in the Palestinian Engineers Association and the Palestinian Contractors Union.

These companies have agencies from foreign companies such as:

- CLACK, USA
- Vikawa, Kanda
- Kazanı, Turkey
- BWT - France
- Electromechanical – UAE

The experiences that companies have in carrying out the tasks to establish a desalination plant based on Reverse Osmosis System technology: the answers were as follows (considering the division of experiences into levels from 0: lack of experience to 5: significant experience in the field)

e. Lack of experience: Answer 0
f. Weak experience: Answers 1 and 2
g. Medium experience: Answer 3
h. High experience: Answers 4 and 5

Table 12 Desalination Plant ability for the companies

Desalination Plant ability	High	Medium	low	No
The company's ability to assess the water quality of the wells and issue reports	50%	50%	0%	0%
The company's ability to determine the technical specifications for implementing a desalination plant	75%	25%	0%	0%
Your ability to design a desalination plant	50%	50%	0%	0%
Your ability to implement (supply, install and operate) water desalination plants	75%	25%	0%	0%

The company's to connect the station to electronic technologies to monitor its performance and control its operation and stopping it remotely	50%	50%	0%	0%
The company's ability to supervise the implementation of desalination plants	75%	25%	0%	0%
The company's ability to manage and monitor the maintenance of desalination plants	75%	25%	0%	0%
The company's ability to provide the required spare parts	75%	25%	0%	0%

The majority experiences of companies' workers are in the field of water treatment and purification, and they are got some training like:

- SCADA system, MBBR technology, membrane recovery (chemical + physical)
- CLACK W.T. course in Amsterdam , KAZANCI W.W.T course –in Turkey
- Sea and salt water treatment, sewage treatment, chemical and bacterial contamination
- Technical Training Course in France how to install the RO System

All of the companies used the reverse osmosis membrane technology in their implemented projects for different purposes: purification, desalination and for medical purpose. Among these projects:

- Al-Teereh WWTP in Ramallah.
- Al- Zbiedt desalination plant in Jordan valley.
- Consultative hospital in Ramallah.
- Dead Sea Pearls Factory for Cosmetics in Bethlehem.
- Beit Jala Pharmaceutical Factory in Bethlehem.
- Al Jebrini Dairy Factory in Hebron.
- Holy Family Hospital in Bethlehem.
- Dialysis units in hospitals, aluminum factories, restaurants and coffee, water factories and fodder factories in different regions in West Bank.

All of the companies supported use of alternative energy to power the plants.

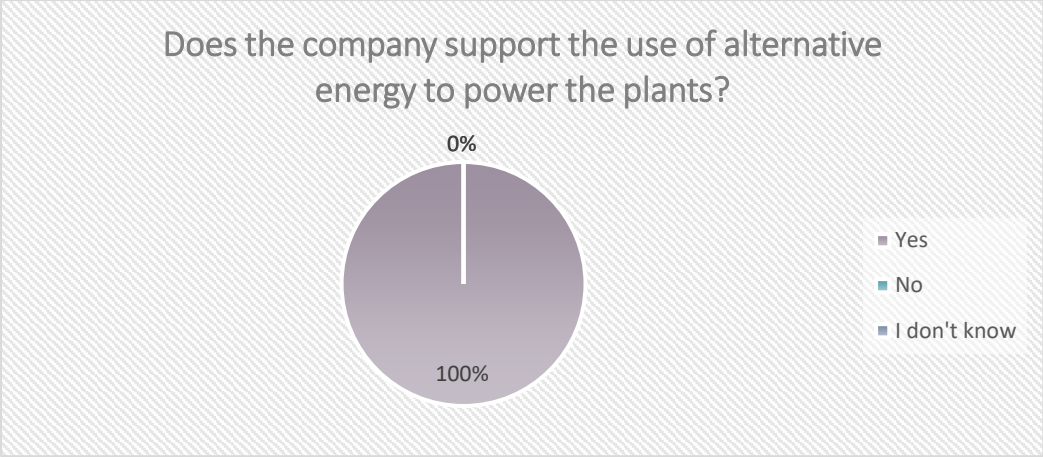


Figure 35 The result of answering a question" Does the company support the use of alternative energy to power the plants?"

Part two: The availability of parts and spare parts for water desalination plants in Palestine

The method of asking about the availability of parts and spare parts in the Palestinian local market was by estimating the availability from the number 0 (evidence that the parts are not available in the market) to number 5 (evidence of the large number of their presence). The table below presented the results

Table 13 The availability of main desalination equipment in Palestinian local market

Equipment	Not available	Poorly available	Available in average	Greatly available
supply pumps	0%	0%	25%	75%
sand filters	0%	0%	25%	75%
cartage filter	0%	0%	25%	75%
5 micron filters	0%	0%	25%	75%
injection pumps	0%	25%	0%	75%
high pressure pumps	0%	25%	25%	50%
RO membranes	25%	0%	25%	50%

Estimating the appropriate price per cubic meter of desalinated water for agricultural use: 25% the appropriate price is less than 3 shekels, 25% from 3-5 shekels, 25% more than 5 shekels and 25% not knowing *(Figure 36)*

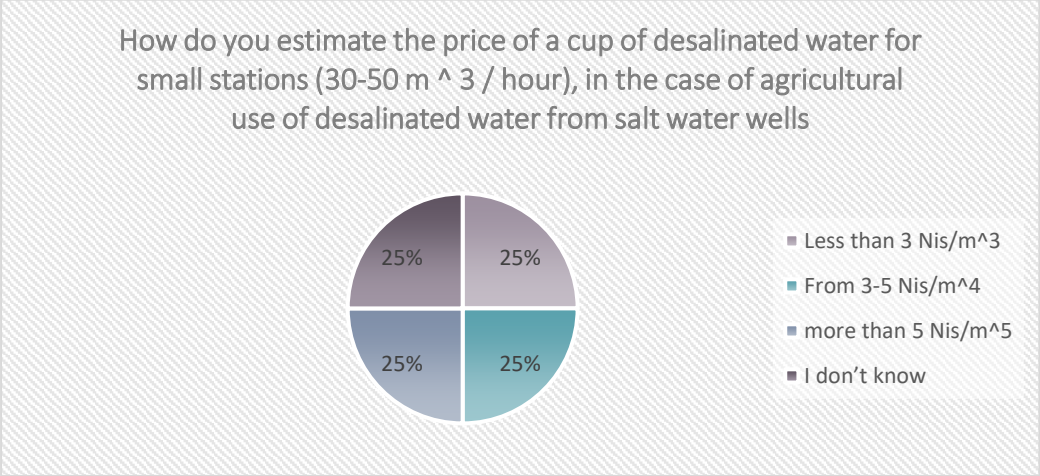


Figure 36 The result of answering a question" How do you estimate the price of a cup of desalinated water for small stations (30-50 m ^ 3 / hour), in the case of agricultural use of desalinated water from salt water wells"

The price of one cubic meter of desalinated water for drinking purposes: 0% the appropriate price was less than 3 shekels, 25% from 3-5 shekels, 50% more than 5 shekels and 25% without knowing *(Figure 37).*

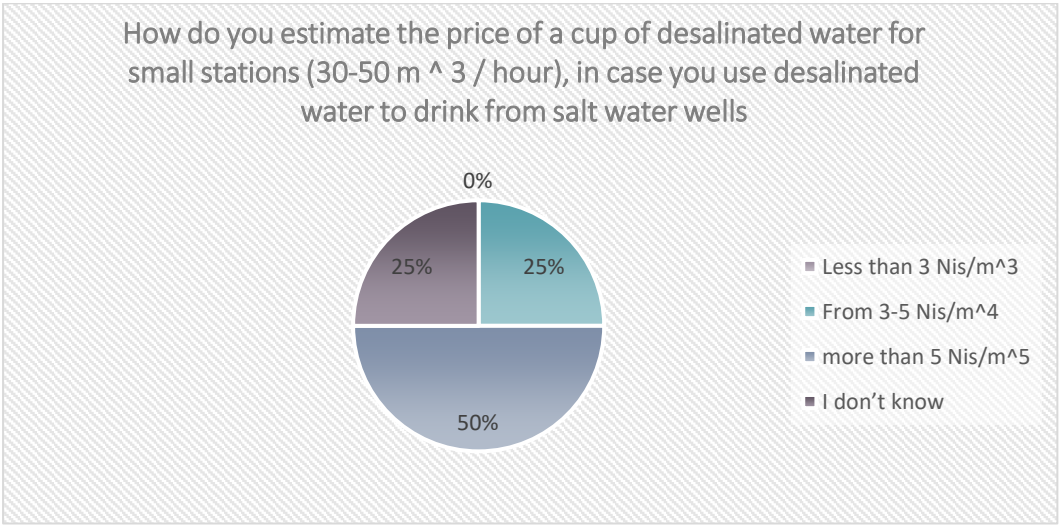


Figure 37 The result of answering a question" How do you estimate the price of a cup of desalinated water for small stations (30-50 m ^ 3 / hour), in case you use desalinated water to drink from salt water wells"

- The existence of Israeli laws that impede imports: 50% of them answered yes, 50% of them answered no and 0% of them do not know. with 56 responses *(Figure 38).*

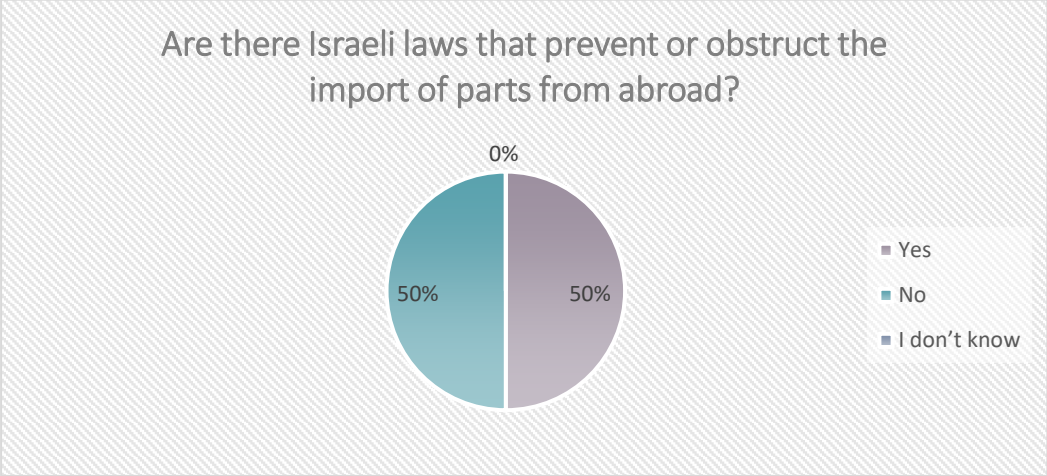


Figure 38 The result of answering a question" Are there Israeli laws that prevent or obstruct the import of parts from abroad"

The Israeli obstacle that mentioned is Israeli "TAKEN" which impede import and sometimes cause exorbitant costs.

All of companies confirmed that the parts are available on the Israeli market (Figure 39), 50% of them suppose that their some obsticals to buy parts from the Israeli market and 50% suppose not (Figure 40).

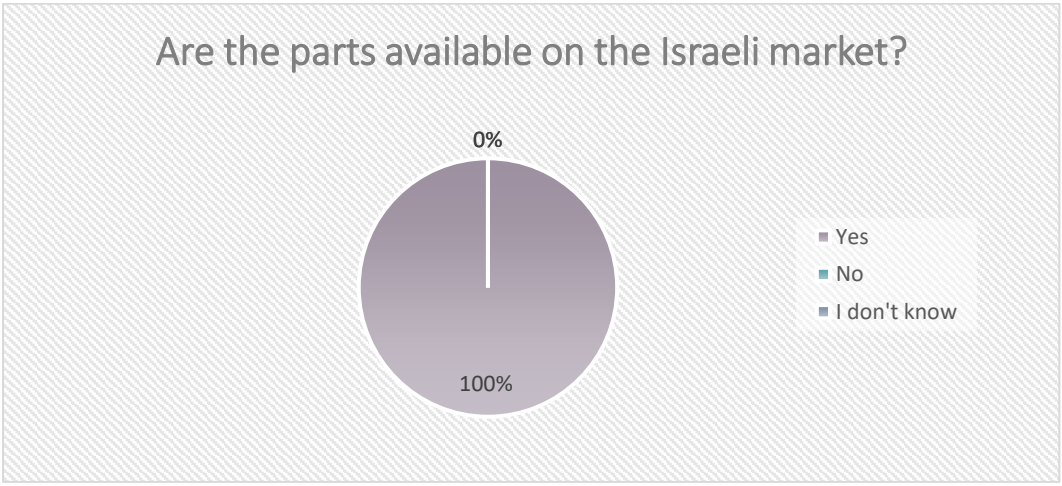


Figure 39 The result of answering a question" Are the parts available on the Israeli market?"

Figure 40 The result of answering a question" Are there any obstacles to buying parts from the Israeli market?"

The Israeli obstacle that mentioned was emphasis on the import of some chemicals materials which needed.

- The desalination projects deserve special government support for workers in this sector: all companies approved that desalination projects deserve special government support for workers in this sector *(Figure 41).*

Figure 41 The result of answering a question" Are desalination projects deserve special government support for workers in this sector?"

The economic feasibility of desalination projects: 75% of them supported that desalination projects are economically feasible, 25% considered them expensive but there

is no other option, 0% considered them expensive and there are other alternatives *(Figure 42).*

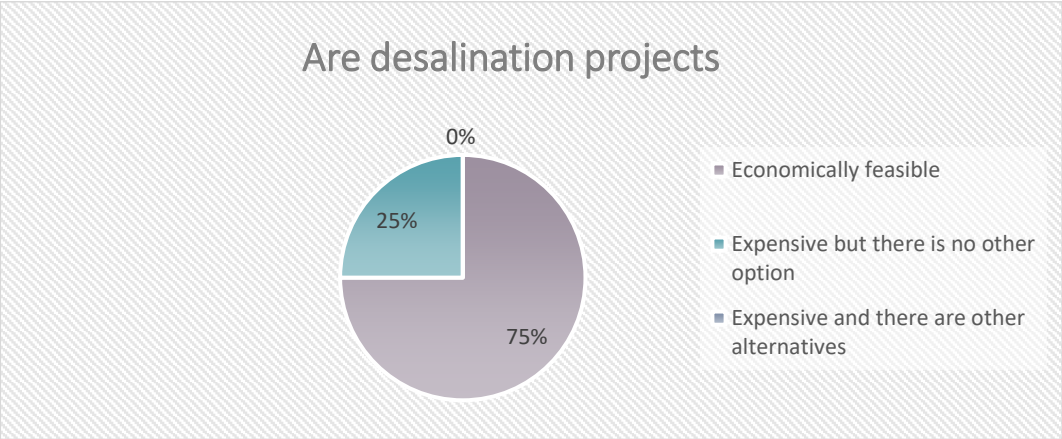


Figure 42 The result of answering a question about the efficiency of desalination plants

- All of companies were supporting the privatization of water desalination projects: *(Figure 33), 50% of them supported the* partial privatization and 50% supported the full privatization (Figure 43).

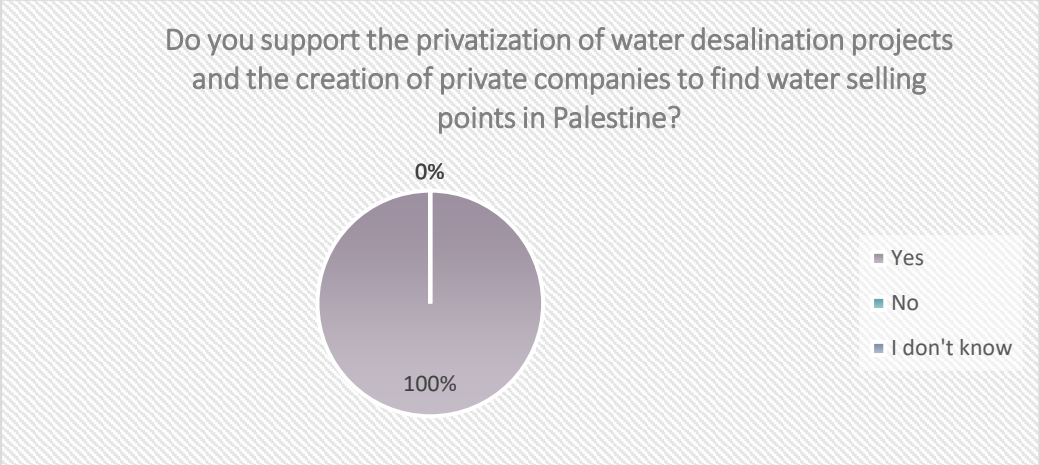


Figure 43 The result of answering a question" Do you support the privatization of water desalination projects and the creation of private companies to find water selling points in Palestine?"

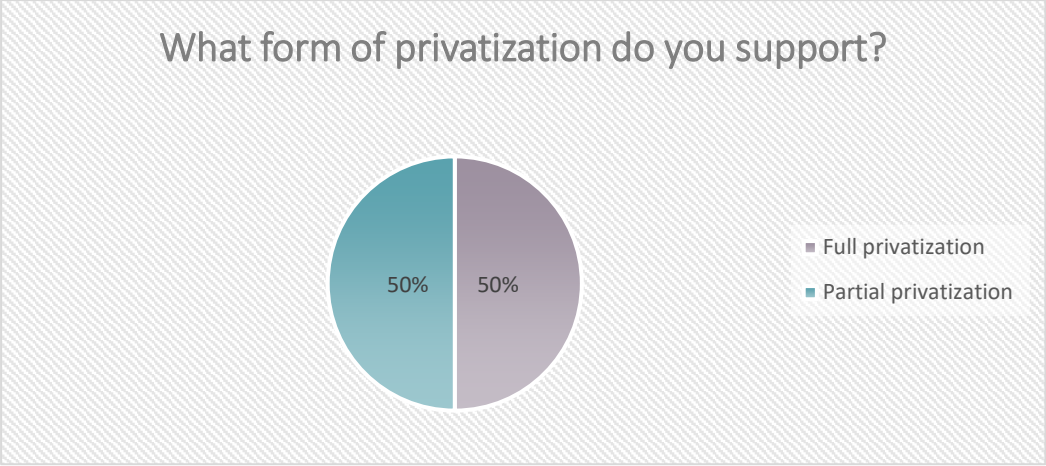


Figure 44 The result of answering a question" What form of privatization do you support?"

Discussion

Although the great effort to publish the questioners, the number of responses did not exceed 59 for individuals and only 4 from companies working in the water field.

The results show the following:

The responses are represented in the West Bank by a large percentage exceeding 85%, and the academic level of the respondents is high, as the percentage of postgraduate studies (Master and Doctorate) exceeds 80%. In addition, by looking at the positions and years of experience of each of the respondents, we find that they work in close fields of environment, water and engineering. And about 60% of them have direct previous experience of water desalination, and thus the sample can be considered representative and the group of responses can reflect the picture of the situation in the field of desalination generally in Palestine and the West Bank in particular.

The results confirmed that the most important areas in Palestine that need to establish desalination plants are: the Gaza Strip, Jericho and the Jordan Valley, and by reference to the reports issued by the Palestinian Water Authority, the quality of water in the northern areas of the West Bank (such as Qalqilya and Tulkarem) is acceptable and conforms to Palestinian specifications, but increases The possibility of contamination of agricultural wells with nitrates due to agricultural activity in those areas (PWA, 2018).

The results of the questionnaire supported the need to find new desalination projects in Jordan Valley, at a rate of nearly 80%, and that desalination of brackish water in the area could be a solution to the water scarcity in the region.

Previous studies confirm the possibility of increasing salinity in groundwater wells in the Palestinian Jordan Valley (Marie and Vengosh, 2001 and Da'as and Walraeevens, 2013). Also, the reports published by the Palestinian Water Authority indicate that agricultural water wells in the Jericho and Palestinian Jordan Valley region have high salinity where the chloride concentration exceeds 500 mg / l (PWA, 2018).

Since the desalination technology of brackish water is one of the strong solutions presented (42% considered desalination the only option), this solution must be studied for each case alone and compared to other solutions.

The results supported by more than 80% that desalination projects need government support, but there is a lack of clarity in the current government's approach to supporting new desalination projects in Jericho and Jordan Valley.

By speaking to some workers in government sector who directly contributed to the construction of desalination plants in Jordan valley (PWA and MOA), they considered that these projects were not sustainable and costly due to the lack of experience. Therefore, the government will think carefully before coming to support such projects again.

From the results of the questionnaire, more than 80% support that the issue of desalination needs greater academic attention by universities, and it is noticeable that the current interest is weak.

The results supported by more than 55% that RO technology is the best choice for desalination in Palestine. This choice is consistent with a study for Mohsen and Al-Jayyousi, 1999 in Jordan. It is worth mentioning that there are current efforts by Al- Najah University to study other desalination technologies, such as electrodialysis in Jordan Valley.

As more than 55% confirmed that RO technology has negative environmental effects, most important is brine disposal. This corresponds to (Lenntech, 2020) which mentioned that brine disposal is a real environmental problem that should be considered and studied when installing a desalination plant.

Postgraduate studies (Master and Doctorate) exceeds 80%. In addition, by looking at the positions and years of experience of each of the respondents, we find that they work in close fields of environment, water and engineering. And about 60% of them have direct previous experience of water desalination, and thus the sample can be considered representative and the group of responses can reflect the picture of the situation in the field of desalination in general in Palestine and the West Bank in particular.

In talking about the ability of the Palestinians to establish desalination plants in Palestine, it became clear to us from the beginning that these capabilities are rare, in the search for people with the ability to fill out the questionnaire

Table No. (10) Presented the general weakness in design, implementation, management, maintenance, etc. desalination plants in Palestine, by reviewing the most important tasks needed to establish a desalination plant.

Desalination plants need many special parts that are difficult for Palestinians to manufacture most of them like RO membranes and pumps, because of complicated of its manufacture, needed to very high industrial expertise and huge factories for manufacturing. As for stainless pipes, they cannot be manufactured locally due to the prevention from Israeli occupation.

Either sand filters and cartridge filters, they are not currently manufactured, but this can be done in the future because of the availability of raw materials for this industry.

As for the plastic pipes are widely available locally.

The average price of water in Jericho and Palestinian Jordan Valley is 2.56 NIS/m^3.

In recent years, the Palestinian government has pushed the trend towards encouraging the search for alternative sources of energy. In 2015, the Renewable Energy and Energy Efficiency Law was issued as support to achieve the strategic goals of the Palestinian Energy and Natural Resources Authority in the field of renewable energy. These laws helped the private sector to invest in renewable energy projects. Nowadays, 35 companies work in Palestine in the field of renewable energy (Palestine Economy, 2018).

Private sector participation in water projects in Palestine is focused on infrastructure contracting work, but funding and management for these projects is rarely existed by the private sector (Al-Hindi, 2016). It is worth noting that there is a trend by the Palestinian government to increase the involvement of the private sector in water projects and this is

evident through the private sector participation program referred to in the Water Authority Strategy 2015-2017 in order to achieve efficiency in the use of water, efficiency in operation and maintenance, creation of job opportunities and rationalization of government expenditures (PWA, 2015)

Referring to the issue of desalination in Palestine, it became clear to us through the research that there are local companies (despite their small number), but they have the ability to establish and follow up the maintenance of desalination plants and they already have some projects implemented for factories, installations, and others. In addition, it has agencies from many international private companies in the field of water and desalination.

The importance of the presence of local companies for such projects lies in their ability to import parts and spare parts more easily than the ability of individuals to do so, in addition to their ability to follow up and manage these projects in a scientific and effective manner.

Government support is necessary for such companies in order to encourage private investment in the water sector

Chapter Six: Conclusions and Recommendations

6.1 Conclusions

This research aims to study desalination topic and to assess the availability and capability of local resources for the implementation of sustainable desalination project in Palestine.

Based on the results that obtained in this research:

1. Palestinians haven't sufficient skills to plan, design, implement and operate sustainable desalination project in West Bank.

2. the local equipment and materials which can be used in desalination plants are limited

3. to increase the Palestinian participation in water desalination projects especially in West Bank, the Palestinians government, universities and private sector companies must be supported this field together.

It is worth noting that water issues in Palestine carry special dimensions due to the complex political conditions in it. And so, it is not possible to separate the discussion from any issue related to water without talking about the methodology of the Israeli occupation in controlling water sources, whether by military force or by agreements that given them the guarantee to control the quantities of water that Palestinians are allowed to obtain. Also, controlling all devices and technologies that are imported to Palestine to improve water sector and thus they should be approve to allowing the entry of them across borders.

6.2 Recommendations

Based on the results obtained in this research study, the following recommendations can be made:

- Increase the academic interest from the Palestinian universities in the issue of desalination by add courses and training for some of engineering programs in plan, design, implement and operate sustainable desalination project in order to find sufficient local expertise to develop the water sector in Palestine.

- The Palestinian government should support private sector companies (technically, financially and tax incentive) and involve them in water projects to ensure the sustainability of these projects further.
- Researchers should study similar models of how the desalination sector has evolved in other places around the world.

References

Abdallah.W, “Techno-economic Evaluation of BWRO Systems for Brackish Water Desalination in the Jordan Valley”, P7, MSc Thesis, Birzeit University, Birzeit, Palestine, 2016

Abu-alnaeem. F, Yusoff, I., Ng, T. F., Alias, Y., and Raksmey, M. Assessment of groundwater salinity and quality in Gaza coastal aquifer, Gaza Strip, Palestine: An integrated statistical, geostatistical and hydrogeochemical approaches study. Science of the Total Environment, 615, 972–989, 2018.

Advisian (2018), the cost of desalination, [online] Available at: https://www.advisian.com/en-gb/global-perspectives/the-cost-of-desalination

Aljazeera.net, (2010), Palestinian Ghour water and survival battle, [online] Available at: https://www.aljazeera.net/news/reportsandinterviews/2010/11/25/%D9%85%D9%8A%D8%A7%D9%87-%D8%A7%D9%84%D8%A3%D8%BA%D9%88%D8%A7%D8%B1-%D8%A7%D9%84%D9%81%D9%84%D8%B3%D8%B7%D9%8A%D9%86%D9%8A%D8%A9-%D9%88%D9%85%D8%B9%D8%B1%D9%83%D8%A9-%D8%A7%D9%84%D8%A8%D9%82%D8%A7%D8%A1

Al Odwani, A., Al-Tabtabaei, M., and Abdel-Nabi, A., Performance of high chromium stainless steels and titanium alloys in Arabian Gulf seawater. Desalination, 120(1-2), 73–81, 1998.

Aliewi. A. (oct 2007), Water Resources in Palestine, [online] Available at: http://www.hwe.org.ps/Projects/Training/Sustainable%20Management/presentations/WR%20in%20Palestine%20[Compatibility%20Mode].pdf

Al-Subaie, K. Z. (2007). Precise way to select a desalination technology. Desalination, 206(1-3), 29–35.

Al-Hindi. A. (2016). “Encouraging private investment in water projects: benefits and drawbacks”, [online] Available at: https://www.mas.ps/files/server/20161310124024-2.pdf

ARIJ (2012), Marj Naga Village guide, [online] Available at: http://vprofile.arij.org/jericho/ar/pdfs/vprofile/marjnaja.pdf

ARIJ. (sept 2012). Zubeidat Village Guide, [online] Available at: http://vprofile.arij.org/jericho/ar/pdfs/vprofile/zbeidat_vp_AR.pdf

Banat. F., Qiblawey. H., and Al-Nasse. Q. (2012). Design and Operation of Small-Scale Photovoltaic-Driven Reverse Osmosis (PV-RO) Desalination Plant for Water Supply in Rural Areas, Computational Water, Energy, and Environmental Engineering, 2012, 1, 31 36.

Cohen, Y., Semiat, R., and Rahardianto, A.,. (2017). Reverse Osmosis Water Desalination: Quest for Sustainability. American Institute of Chemical Engineers (AIChE) Journal.

Daoud, Kh.,. (2018). Agriculture in the Palestinian Jordan Valley Current Reality and Future Prospects, [online] Available at: https://thisweekinpalestine.com/wp-content/uploads/2018/01/Agriculture-in-the-Palestinian-Jordan-Valley.pdf

Durham, B., and Walton, A.,. (1999). Membrane pretreatment of reverse osmosis: long-term experience on difficult waters. Desalination, 122(2-3), 157–170.

Rahimi. B and Tong Chua. H (2017), Low Grade Heat Driven Multi-Effect Distillation and Desalination [online] Available at: https://www.sciencedirect.com/topics/chemical-engineering/desalination

El Sheikh, R., Ahmed, M., & Hamdan, S. (2003). Strategy of water desalination in the Gaza Strip. Desalination, 156(1-3), 39–42.

Frank Water (2015), Why is There a Water Crisis in Gaza?, [online] Available at: https://water.fanack.com/specials/gaza-water-crisis/why-water-crisis-in-gaza/

Frank Water (2016), Shared Water Resources in Palestine. [online] Available at: https://water.fanack.com/palestine/shared-water-resources/

Jones, E., Qadir, M., van Vliet, M. T. H., Smakhtin, V., & Kang, S. (2019). The state of desalination and brine production: A global outlook. Science of The Total Environment, 657, 1343–1356.

Karagiannis, I. C., & Soldatos, P. G. (2008). Water desalination cost literature: review and assessment. Desalination, 223(1-3), 448–456.

Knesset. (2018). Israeli Water Sector—Key Issues, [online] Available at: https://m.knesset.gov.il/EN/activity/mmm/mmmeng250218.pdf

Kurihara, M., & Takeuchi, H. (2019). The Next Generation Energy Efficient Membrane Desalination System With Advanced Key Technologies. Current Trends and Future Developments on (Bio-) Membranes, 387–406.

Larché, N., & Dézerville, P. (2011). Review of material selection and corrosion in seawater reverse osmosis desalination plants. Desalination and Water Treatment, 31(1-3), 121–133.

Marie, A., & Vengosh, A. (2001). Sources of Salinity in Ground Water from Jericho Area, Jordan Valley. Ground Water, 39(2), 240–248.

Mimi, Z. A., & Marei, A. (2002). Privatization of Sanitation and Desalination Projects in Palestine. Water International, 27(2), 219–224.

Abu Hiaja, I., (2018). Ministry of agriculture.

Mohsen, M. S., & Al-Jayyousi, O. R. (1999). Brackish water desalination: an alternative for water supply enhancement in Jordan. Desalination, 124(1-3), 163–174.

Otitoju, T. A., Saari, R. A., & Ahmad, A. L. (2018). Progress in the modification of reverse osmosis (RO) membranes for enhanced performance. Journal of Industrial and Engineering Chemistry.

Da'as, A., & Walraevens, K. (2013). Hydrogeochemical investigation of groundwater in Jericho area in the Jordan Valley, West Bank, Palestine. Journal of African Earth Sciences, 82, 15–32.

Paltrade (2010), the Jordan Valley: Challenges and the Lost Potential, [online] Available at: https://www.paltrade.org/upload/multimedia/admin/2014/06/53a01b7f6aa76.pdf

Palestinian Central Bureau of Statistics (PCBS) 2017, [online] Available at: http://www.pcbs.gov.ps/Downloads/book2383.pdf, p 71

Palestinian Central Bureau of Statistics (PCBS) 2016, Average air pressure (mbar) in Palestine according to the station's location and year, 2009-2016, [online] Available at: http://www.pcbs.gov.ps/Portals/_Rainbow/Documents/Metr9ta2016.htm

Palestinian Central Bureau of Statistics (PCBS) 2017, Selected Indicators for Water Statistics in Palestine, 2017. . [online] Available at: http://www.pcbs.gov.ps/Portals/_Rainbow/Documents/water/water-E-main.html

Palestinian Water Authority (2011), Annual Status Report on water resources, Water Supply, and Wastewater in the Occupied State of Palestine. [online] Available at: http://pwa.ps/userfiles/file/%D8%AA%D9%82%D8%A7%D8%B1%D9%8A%D8%B1/Annual%20Water%20Status%20report%202011.pdf

PWA (2018), a study on the water situation and its effect on date palm cultivation in Jericho and Al Aghwar Governorate, General Department of Water Resources, Ramallah

Qtaishat. H, Al-Karablieh. E, Salman. A, Tabieh. M, Al-Qudah. H and Seder. N (2016), Economic analysis of brackish-water desalination used for irrigation in the Jordan Valley, Desalination and Water Treatment, 72 (2017) 13–21.

Rautenbach, R., Linn, T., & Al-Gobaisi, D. M. K. (1997). Present and future pretreatment concepts — strategies for reliable and low-maintenance reverse osmosis seawater desalination. Desalination, 110(1-2), 97–106.

Shenvi, S. S., Isloor, A. M., & Ismail, A. F. (2015). A review on RO membrane technology: Developments and challenges. Desalination, 368, 10–26.

Jamaly, S., Darwish, N. N., Ahmed, I., & Hasan, S. W. (2014). A short review on reverse osmosis pretreatment technologies. Desalination, 354, 30–38.

Middle East Monitor MEMO 2018, The Paris Protocol and the impoverishment of the Palestinian people, [online] Available at: https://www.middleeastmonitor.com/20180920-the-paris-protocol-and-the-impoverishment-of-the-palestinian-people/

Taha, M., & Al-Sa'ed, R. (2017). Application potential of small-scale solar desalination for brackish water in the Jordan Valley, Palestine. International Journal of Environmental Studies, 75(1), 214–225.

UN. (2018). UN spotlights rainwater recycling, artificial wetlands among 'green' solutions to global water crisis, [online] Available at: https://news.un.org/en/story/2018/03/1005332

United nation university.(2019). “unconventional water resources”, [online] Available at: https://inweh.unu.edu/projects/unconventional-water-resources/

UNICEF (2019), the UN and the EU begin expansion of Southern Gaza Seawater Desalination Plant to help address shortages of safe drinking water in the Gaza Strip, [online] Available at: https://www.unicef.org/sop/press-releases/un-and-eu-begin-expansion-southern-gaza-seawater-desalination-plant-help-address

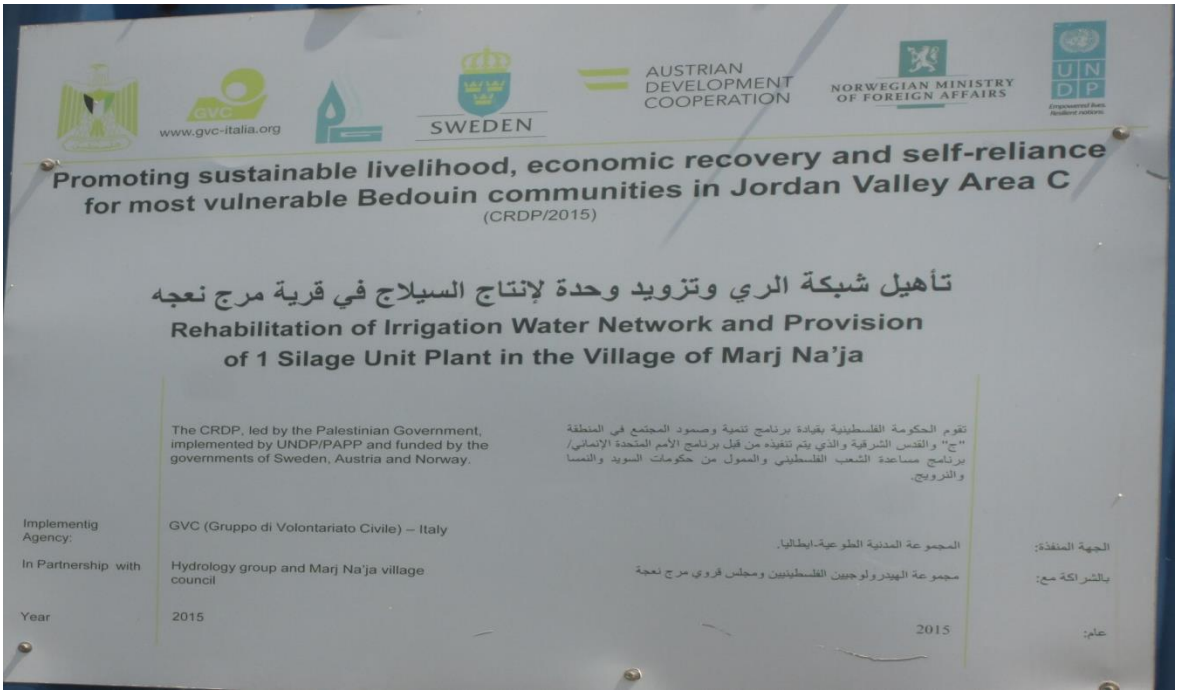
Valdez, B., & Schorr, M. (2010). Corrosion Control in the Desalination Industry. Advanced Materials Research, 95, 29–32.

World Wildlife Fund, (2009). [online] Available at: https://www.worldwildlife.org/threats/water-scarcity

Youssef, P. G., AL-Dadah, R. K., & Mahmoud, S. M. (2014). Comparative Analysis of Desalination Technologies. Energy Procedia, 61, 2604–2607.

Annexes

Photos of Maarj Na’aja BWRO unit


www.gvc-italia.org
SWEDEN
AUSTRIAN DEVELOPMENT COOPERATION
NORWEGIAN MINISTRY OF FOREIGN AFFAIRS
UNDP
Promoting sustainable livelihood, economic recovery and self-reliance for most vulnerable Bedouin communities in Jordan Valley Area C
(CRDP/2015)
تأهيل شبكة الري وتزويد وحدة لإنتاج السيلاج في قرية مرج نعجه
Rehabilitation of Irrigation Water Network and Provision of 1 Silage Unit Plant in the Village of Marj Na'ja
The CRDP, led by the Palestinian Government, implemented by UNDP/PAPP and funded by the governments of Sweden, Austria and Norway.
تقوم الحكومة الفلسطينية بقيادة برنامج تنمية وصمود المجتمع في المنطقة "ج" والقدس الشرقية والذي يتم تنفيذه من قبل برنامج الأمم المتحدة الإنمائي/ برنامج مساعدة الشعب الفلسطيني والممول من حكومات السويد والنمسا والنرويج.
Implementig Agency:
GVC (Gruppo di Volontariato Civile) – Italy
المجموعة المدنية التطوعية-ايطاليا.
الجهة المنفذة:
In Partnership with
Hydrology group and Marj Na'ja village council
مجموعة الهيدرولوجيين الفلسطينيين ومجلس قروي مرج نعجة
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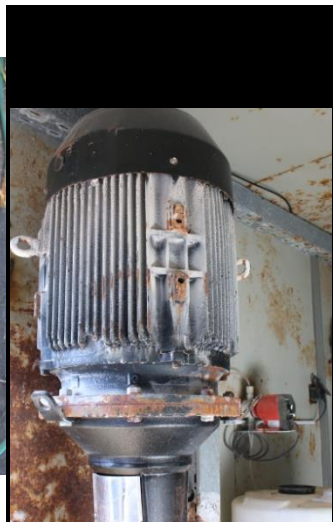

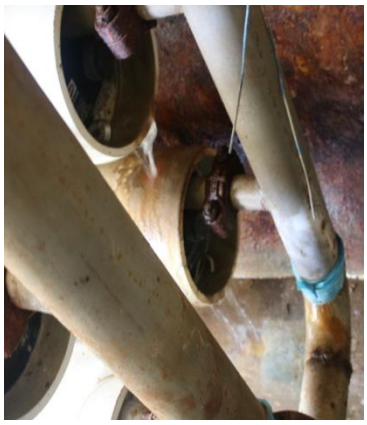

استمارة بحثية بخصوص تحلية المياه في فلسطين

في ظل أزمة شح المياه التي تعاني منها فلسطين، هناك توجه عام لايجاد مصادر مياه بديلة وغير تقليدية لزيادة كميات المياه المطلوبة للاستخدام المنزلي، الزراعي، الصناعي وغيره، كانشاء محطات خاصة لمعالجة أو تنقية المياه المستخدمة ومحطات أخرى لتحلية مياه الابار الجوفية التي تعاني من الملوحة كما في منطقة الأغوار الفلسطينية ومياه البحر كما في قطاع غزة.
تقوم الطالبة أريج الشريف من كلية الدراسات العليا بجامعة بيرزيت والملتحقة ببرنامج ماجستير هندسة المياه والبيئة باكمال رسالة بحثية عنوانها "تقييم مدى القدرة والامكانية للموارد المحلية لتنفيذ مشاريع التحلية المستدامة في فلسطين" لانجاز متطلبات رسالة التخرج.

تستهدف الاستمارة التالية جمع المعلومات من العالمين بقطاع المياه ومشاريعه، فأرجو الاجابة على الأسئلة بما هو مناسب

اسئلة تعريفية

الجنس

- ذكر
- أنثى

منطقة العمل

- الضفة الغربية
- القدس
- قطاع غزة
- أخرى: _____

المستوى الأكاديمي

- بكلوريوس
- درجة ماجستير
- درجة دكتوراه
- أخرى: _____

مجال العمل

- المجال الاكاديمي
- سلطة المياه
- وزارة الزراعة
- شركة خاصة
- بلديات
- أخرى: _____

المسمى الوظيفي

إجابتك

عدد سنوات الخبرة في مجال العمل

إجابتك

هل تملك خبرة سابقة في مجال تحلية المياه (مشاريع سابقة، دورات تدريبية، مساقات جامعية، أبحاث... الخ)

- نعم
- لا

اذا كانت اجابتك ب "نعم" فما هي؟

إجابتك

التحلية في فلسطين

في فلسطين، يتركز انشاء محطات تحلية المياه في منطقطين: قطاع غزة وغور الاردن بسبب نسبة الاملاح العالية الموجودة والتلوث

هل هناك مناطق فلسطينية اخرى تحتاج الى محطات تحلية

- نعم
- لا
- لا اعلم

اذا كانت الاجابة ب"نعم" اذكر هذه المناطق

إجابتك

ما مدى حاجة منطقة أريحا والاغوار الى مشاريع تحلية جديدة لمياه الابار المالحة فيها؟

- الحاجة كبيرة
- متوسة الحاجة
- لا حاجة لمحطات تحلية
- لا اعلم

هل تحلية مياه الابار المالحة يمكنها ان تكون حل لازمة شح المياه في منطقة اريحا والاغوار الفلسطينية؟

- نعم
- لا
- لا اعلم

هل مشاريع تحلية المياه

- مجدية اقتصاديا
- مكلفة ولكن لا يوجد خيار اخر
- مكلفة وهناك بدائل اخرى
- أخرى: _____

هل مشاريع تحلية المياه تستحق دعم حكومي خاص للعاملين بهذا القطاع؟

- نعم
- لا
- لا اعلم

هل هناك توجه سياسي الى انشاء وتطوير مشاريع تحلية جديدة في غور الاردن

- نعم
- لا
- لا اعلم

هل هناك اثار بيئية سلبية لعملية تحلية المياه؟

- نعم
- لا
- لا اعلم

اذا كانت الاجابة ب "نعم" فما هي؟

إجابتك

هل هناك اهتمام اكاديمي من الجامعات على تطوير كفاءات للعمل في مجال تحلية المياه؟

- نعم
- لا
- لا اعلم

هل يجب ان تحظى أن يحظى موضوع تحلية المياه اهتمام اكبر باهتمام من الجامعات والمؤسسات الاكاديمية في فلسطين؟

- نعم
- لا
- لا اعلم

اذا كانت الاجابة ب "نعم" فما هي المساقات التي يمكن تضمينها بالخطط الدراسية للجامعات؟

إجابتك

ما هي افضل تقنية يمكن استخدامها بمحطات تحلية المياه في فلسطين

- تقنية التبخير الومضي متعدد المراحل multi stage flash distillation
- تقنية التبخير متعدد التأثير multi effect distillation
- تقنية التحلية بضغط البخار vapor compression distillation
- تقنية التناضح العكسي Reverse Osmosis
- تقنية الفصل الكهروبائية electrodialysis
- لا اعلم
- أخرى:

*جميع محطات تحلية المياه الحالية في فلسطين قائمة على تكنولوجيا التناضح العكسي (Reverse Osmosis system)، بناءا على ذلك:

	0	1	2	3	4	5
ما قدرتك على تقييم جودة المياه للابار واصدار التقارير	○	○	○	○	○	○
ما قدرتك على تحديد المواصفات الفنية لتنفيذ محطة تحلية للمياه	○	○	○	○	○	○
ما قدرتك على تصميم محطة تحلية	○	○	○	○	○	○
ما قدرتك على تنفيذ (توريد، تركيب وتشغيل) محطات تحلية المياه	○	○	○	○	○	○
ما قدرتك على ربط المحطة بتقنيات الكترونية لمراقبة ادائها والتحكم بتشغيها وايقافها عن بعد	○	○	○	○	○	○
ما قدرتك على الاشراف على تنفيذ محطات التحلية	○	○	○	○	○	○
ما قدرتك على ادارة ومتابعة صيانة محطات التحلية	○	○	○	○	○	○

هل تعلم شركات فلسطينية لديها القدرة على التصميم او التنفيذ او لاشراف لانشاء محطات تحلية

- نعم
- لا
- ربما

اذا كانت اجابتك ب" نعم"، اذكرها

إجابتك

تحتاج محطة التحلية الى العديد من القطع الخاصة والاعمال الهندسية والكهربائية، أي من هذه القطع يمكن تصنيعها محليا في فلسطين:

- الفلاتر الرملية sand filters
- فلاتر كارتيج cartridge filters
- الاغشية النفاذة RO membranes
- المضخات pumps
- انابيب نقل المياه المصنوعة من الستانلس ستيل piping system
- انابيب نقل المياه المصنوعة من البلاستك piping system
- لا اعلم

ما هي الاسباب الخاصة في ضعف تصنيع معظم القطع الخاصة بمحطات التحلية؟

إجابتك

مدى توفر القطع وقطع الغيار لمحطات تحلية المياه في فلسطين
ملاحظة: تجاوز الاجابة ان لم تعرف

مضخات الفلاتر الرملية ومضخات الغسيل العكسي (مضخات تزويد) supply pumps

	0	1	2	3	4	5	
غير متوفر	○	○	○	○	○	○	متوفر

الفلاتر الرملية sand filters

	0	1	2	3	4	5	
غير متوفر	○	○	○	○	○	○	متوفر

cartage filter حاوية فلاتر 5 ميكرون

	0	1	2	3	4	5	
غير متوفر	○	○	○	○	○	○	متوفر

فلاتر 5 ميكرون

	0	1	2	3	4	5	
غير متوفر	○	○	○	○	○	○	متوفر

مضخات الحقن injection pumps

	0	1	2	3	4	5	
غير متوفر	○	○	○	○	○	○	متوفر

مضخات الضغط العالي high pressure pumps

	0	1	2	3	4	5	
غير متوفر	○	○	○	○	○	○	متوفر

الأغشية النفاذة (أغشية التحلية) RO membranes

	0	1	2	3	4	5	
غير متوفر	○	○	○	○	○	○	متوفر

ما تقديرك لسعر كوب المياه المحلاة المناسب في حالة الاستخدام الزراعي للمياه المحلاة من ابار المياه المالحة

- ○ اقل من 3 شيكل لكل م^3
- ○ من 3- 5 شيكل لكل م^3
- ○ اكثر من 5 شيكل لكل م^3
- ○ لا اعلم

ما تقديرك لسعر كوب المياه المحلاة المناسب في حالة الاستخدام المنزلي (مياه صالحة للشرب) للمياه المحلاة من ابار المياه المالحة

- ○ اقل من 3 شيكل لكل م^3
- ○ من 3- 5 شيكل لكل م^3
- ○ اكثر من 5 شيكل لكل م^3
- ○ لا اعلم

هل هناك شركات متخصصة بتوفير القطع وقطع الغيار الخاصة بمحطات التحلية

- نعم
- لا
- لا اعلم

اذا كانت الاجابة نعم، اذكرها

إجابتك

هل هناك قوانين اسرائيلية تمنع او تعيق استيراد القطع من الخارج

- نعم
- لا
- لا اعلم

اذا كانت الاجابة ب "نعم" ما هي

إجابتك

استخدام الطاقة المتجددة

يعتبر موضوع الطاقة من اهم القضايا في مجال تحلية المياه، حيث ان ما يقارب من 50%من تكلفة المشروع الكلية تنفق على الطاقة اللامة لتشغيل المشروع. ويعتبر استغلال الطاقة الشمسية من اهم مصادر الطاقة البديلة في فلسطين. بناءا على ذلك

هل الشركات الفلسطينية لديها القدرة على بناءمحطات توليد الطاقة الشمسية لمحطات التحلية؟

- نعم
- لا
- لا اعلم

هل هناك دعم حكومي خاص للعاملين بقطاع الطاقة البديلة؟

- نعم
- لا
- لا اعلم

هل القطع والمعدات الخاصة بانشاء محطات توليد الطاقة الشمسية متوفرة في السوق الفلسطينية؟

- نعم
- لا
- لا اعلم

هل هناك قيود اسرائيلية على استيراد القطع والمواد الخاصة بمحطات توليد الطاقة الشمسية؟

- نعم
- لا
- لا اعلم

هل ترى مجال التحلية مشروع جاذب للاستثمار من القطاع الخاص

- نعم
- لا
- لا اعلم

هل تؤيد خصخصة مشاريع تحلية المياه وايجاد شركات خاصة لايجاد نقاط بيع المياه في فلسطين؟

- نعم
- لا
- لا اعلم

اذا كانت الاجابة "نعم" ما شكل الخصخصة الذي تؤيده

- الخصخصة الكاملة
- الخصخصة الجزئية (بعقود نقل الادارة مثلا)

ملاحظات يمكن اضافتها

إجابتك

شكراً

إرسال

استمارة خاصة بالشركات بخصوص تحلية المياه في فلسطين

في ظل أزمة شح المياه التي تعاني منها فلسطين، هناك توجه عام لايجاد مصادر مياه بديلة وغير تقليدية لزيادة كميات المياه المطلوبة للاستخدام المنزلي، الزراعي، الصناعي وغيره، كانشاء محطات خاصة لمعالجة أو تنقية المياه المستخدمة ومحطات أخرى لتحلية مياه الابار الجوفية التي تعاني من الملوحة كما في منطقة الأغوار الفلسطينية ومياه البحر كما في قطاع غزة.
وبهدف ايجاد فرصة لأصحاب الشركات المحلية لزيادة مشاركتها بمشاريع المياه المستقبلية، تقوم الطالبة أريج الشريف من كلية الهندسة بجامعة بيرزيت والملتحقة ببرنامج هندسة المياه والبيئة باكمال رسالة بحثية عنوانها "تقييم مدى القدرة والامكانية للموارد المحلية لتنفيذ مشاريع التحلية المستدامة في فلسطين" لانجاز متطلبات رسالة التخرج.

تستهدف الاستمارة التالية جمع المعلومات من العالمين بقطاع المياه ومشاريعه، فأرجو الاجابة على الأسئلة بما هو مناسب

معلومات خاصة بالشركة

اسم الشركة

إجابتك

موقع الشركة

إجابتك

تصنيف الشركة لدى وزارة الاقتصاد

- ◯ شركة عادية- عمومية
- ◯ شركة مساهمة خصوصية
- ◯ شركة عامة محدودة
- ◯ شركة أجنبية
- ◯ أخرى: _____

تصنيف الشركة او المكتب لدى نقابة المهندسين

- ◯ استشاري
- ◯ مكتب مهندس رأي
- ◯ مهندس أ
- ◯ مهندس ب
- ◯ مهندس ج
- ◯ هندسي أولى
- ◯ هندسي ثانية
- ◯ هندسي ثالثة
- ◯ غير مصنف

تصنيف الشركة لدى اتحاد المقاولين

	أولى أ	أولى ب	ثانية	ثالثة	رابعة	خامسة
الطرق	☐	☐	☐	☐	☐	☐
الابنية	☐	☐	☐	☐	☐	☐
كهروميكانيك	☐	☐	☐	☐	☐	☐
صيانة كهروميكانيك	☐	☐	☐	☐	☐	☐
ميكانيك	☐	☐	☐	☐	☐	☐
كهرباءالكترونيات	☐	☐	☐	☐	☐	☐
مياه ومجاري	☐	☐	☐	☐	☐	☐
محطات التنقية	☐	☐	☐	☐	☐	☐
الري والصرف	☐	☐	☐	☐	☐	☐
غير مصنف	☐	☐	☐	☐	☐	☐

هل لدى الشركة وكالة لشركات خاصة بمجال تنقية أو معالجة أو تحلية المياه

- ◯ نعم
- ◯ لا

أذكرها، ان وُجدت

إجابتك

كيف تقييم اداء الشركة بالنسبة لقدرتها على القيام بالامور التالية (محطات التحلية المذكورة بتقنية الاغشية النفاذة Reverse Osmosis)

	0	1	2	3	4	5
قدرة الشركة على تقييم جودة المياه للابار واصدار التقارير	○	○	○	○	○	○
قدرة الشركة على تحديد المواصفات الفنية لمحطات تحلية المياه بناءا على فحوصات جودة المياه	○	○	○	○	○	○
قدرة الشركة على تصميم محطة تحلية	○	○	○	○	○	○
قدرة الشركة على تنفيذ محطة تحلية من توريد وتركيب وتشغيل للمحطة	○	○	○	○	○	○
قدرة الشركة على ربط المحطة بتقنيات الكترونية لمراقبة ادائها والتحكم بتشغيها وايقافها عن بعد	○	○	○	○	○	○
قدرة الشركة على الاشراف على تنفيذ محطات تحلية المياه	○	○	○	○	○	○
	○	○	○	○	○	○

قدرة الشركة
على صيانة
محطات
التحلية

قدرة الشركة
على توفير قطع
الغيار المطلوبة
والمواد
الكيميائية
اللازمة
لاستمرار
تشغيل محطات
تحلية المياه

○	○	○	○	○	○

ما هي الخبرات المميزة للعاملين في الشركة؟

إجابتك

هل تلقى طاقم العمل اي تدريب مميز للعمل على المشاريع الخاصة بمجال المياه؟

- ○ نعم
- ○ لا

اذكر اهم التدريبات

إجابتك

هل تم استخدام تقنية أغشية التناضح العكسي في المشاريع المنفذة من قبل الشركة؟

- ○ نعم
- ○ لا

ما سبب الاستخدام؟

- [ ] تنقية المياه
- [ ] تحلية المياه
- [ ] أغراض طبية

اذكر هذه المشاريع ونبذة قصيرة عنها (مكان المشروع، سبب الاستخدام وقدرة المحطة على المعالجة بالساعة، ..)

إجابتك

هل تؤيد الشركة استخدام الطاقة البديلة لتشغيل المحطات

- ◯ نعم
- ◯ لا
- ◯ لا اعلم

مدى توفر القطع وقطع الغيار لمحطات تحلية المياه في فلسطين

مضخات الفلاتر الرملية ومضخات الغسيل العكسي (مضخات تزويد) supply pumps

	0	1	2	3	4	5	
غير متوفر	◯	◯	◯	◯	◯	◯	متوفر

الفلاتر الرملية sand filters

	0	1	2	3	4	5	
غير متوفر	○	○	○	○	○	○	متوفر

حاوية فلاتر 5 ميكرون cartage filter

	0	1	2	3	4	5	
غير متوفرة	○	○	○	○	○	○	متوفرة

فلاتر 5 ميكرون

	0	1	2	3	4	5	
غير متوفر	○	○	○	○	○	○	متوفر

مضخات الحقن injection pumps

	0	1	2	3	4	5	
متوفر	○	○	○	○	○	○	غير متوفر

مضخات الضغط العالي high pressure pumps

	0	1	2	3	4	5	
متوفر	○	○	○	○	○	○	غير متوفر

الأغشية النفاذة (أغشية التحلية) RO membranes

	0	1	2	3	4	5	
متوفر	○	○	○	○	○	○	غير متوفر

ما تقديرك لسعر كوب المياه المحلاة للمحطات الصغيرة (30-50 م^3/الساعة)، في حالة الاستخدام الزراعي للمياه المحلاة من ابار المياه المالحة

- ○ اقل من 3 شيكل لكل م^3
- ○ من 3 الى 5 شيكل لكل م^3
- ○ أكثر من 5 شيكل لكل م^3
- ○ لا اعلم

ما تقديرك لسعر كوب المياه المحلاة للمحطات الصغيرة (30-50 م^3/الساعة)، في حالة استخدام المياه المحلاه للشرب من ابار المياه المالحة

- ○ اقل من 3 شيكل لكل م^3
- ○ من 3 الى 5 شيكل م^3
- ○ أكثر من 5 شيكل لكل م^3
- ○ لا اعلم

هل هناك قوانين اسرائيلية تمنع او تعيق استيراد القطع من الخارج

- ○ نعم
- ○ لا
- ○ لا اعلم

اذا كانت الاجابة ب "نعم" ما هي

إجابتك

هل القطع متوفرة في السوق الاسرائيلي

- نعم
- لا
- لا اعلم

هل يوجد معيقات لشراء القطع من السوق الاسرائيلي

- لا
- نعم
- لا اعلم

اذا كانت الاجابة ب "نعم" ما هي المعيقات؟

إجابتك

أسئلة عامة

في فلسطين، غالبا ما تكون مشاريع المياه بتمويل ودعم من القطاع الحكومي او بتمويل من مؤسسات المجتمع المدني دعما للسكان وتعزيز صمودهم

هل مشاريع تحلية المياه تستحق دعم حكومي خاص للعاملين بهذا القطاع؟

- نعم
- لا
- لا اعلم

هل مشاريع تحلية المياه

- مجدية اقتصاديا
- مكلفة ولكن لا يوجد خيار اخر
- مكلفة وهناك بدائل اخرى
- أخرى: _____

هل تؤيد خصخصة مشاريع تحلية المياه وايجاد شركات خاصة لايجاد نقاط بيع المياه في فلسطين؟

- نعم
- لا
- لا أعلم

ما شكل الخصخصة الذي تؤيده

- الخصخصة الكاملة
- الخصخصة الجزئية (بعقود نقل الادارة مثلا)

ملاحظات يمكن اضافتها

إجابتك

شكراً

إرسال

عدم إرسال كلمات المرور عبر نماذج Google مطلقًا.