An-Najah National University
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The Assessment of Private Sector Participation through different Contracting Models on the Sustainability of Desalination Plants

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Dedication

I dedicate my humble thesis to my father and angel (God rests his soul in peace) who taught me the meaning of success and patience, supporting me all the way long…

To the heart that never stops giving, to my dearest mother who taught me to pursue my dreams and my ambitions become what I'm now, God bless her …

To my lovely sisters and brothers …

To all my Family …

To our honored teachers and professors who taught us golden letters providing their knowledge to show us the ways of success …

Acknowledgement

At the beginning, praise be to God for giving me the strength and the guidance to finish this thesis.

I would like to express my deepest gratitude, thanks and appreciation to everyone who supported me to make the achievement of this thesis possible ;to the soul of my father (God restshissoulin peace) , as well as my mother , brothers , sisters and family.

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الإقرار

أنا الموقعة أدناه مقدمة الرسالة التي تحمل العنوان:

The assessment of Private Sector Participation through different Contracting Models on the Sustainability of Desalination Plants

اقر بأن ما اشتملت عليه هذه الرسالة إنما هي نتاج جهدي الخاص، باستثناء ما تمت الإشارة إليه حيثما ورد، وان هذه الرسالة ككل، أو أي جزء منها لم يقدم من قبل لنيل أية درجة علمية أو بحث علمي أو بحثي لدى أية مؤسسة تعليمية أو بحثية أخرى.

Declaration

The work provided in this thesis unless otherwise referenced, is the researcher's own work, and has not been submitted elsewhere for any other degree or qualification.

Student's Name: **اسم الطالب: آية هشام حسن عبيسي**

Signature: **التوقيع:**

Date: **التاريخ: 12/09/2017**

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List of Abbreviations

AFR	Africa
AHLC	Ad Hoc Liaison Committee
BOT	Build Operate Transfer
BOOT	Build Operate Own Transfer
CMWU	Coastal Municipalities Water Utility
EAP	East Asia Pacific
ECAs	Export Credit Agency
EU	European Union
ECA	Europe and Central Asia
LAC	Latin America and the Caribbean
MENA	Middle East and North Africa
MIGA	Multilateral Investment Guarantee Agency
MOF	Ministry of Finance
NGO	Non-governmental organization
OECD	Organisation for Economic Cooperation and Development
PARC	Agricultural Development Association
PFI	Private Finance Initiative
PHG	Palestinian Hydrology Group
PPI	Public–Private Infrastructure
PPIAF	Public–Private Infrastructure Advisory Facility
PPP	Public-Private Participation
PSP	Private Sector Participation
PWA	Palestinian Water Authority
RO	Reverse Osmosis
SAR	South Asia

SPSS	Statistical Package for Social Sciences
SWRO	Seawater Reverse Osmosis
UN	United Nations
WEDO	Water and Environmental Development Organization
WHO	World Health Organization
WSRC	Water Sector Regulatory Council

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Abstract

Gaza Strip suffers from water shortages for several reasons, namely: political circumstances, population growth, climate change overexploitation resource... etc. Consequently, seawater desalination plant offers an abundant alternative resource to meet the growing needs of water. The main reason to go for desalination is the levels of salinity have been rising continuously over the last two decades, where in Gaza strip, Levels of total dissolved salts became far in excess of the WHO standards. In addition, the location of Gaza strip which extends along the Mediterranean coast, plays an important role to make the desalination plant a possible choice.

Still, there are problems in the application of such technology, including cost, lack of expertise and managerial competence to operate the desalination plant. Therefore, governments look for Public-Private Participation (PPP) expression which means getting the private sector involved in the construction and operation of desalination plants through different contracting models.

The main purpose of this research is to study and decide the most efficient and sustainable PPP contracts used for desalination plants in Palestine.

So, the adopted approach for selecting the optimal PPP contract was based on extensive literature review to summarize the most well-known PPP contacts and several meetings with experts who have a good background about the desalination process, PPP contracts, sustainability …etc., to finding the beneficial tool to collect the data

Data collected through interview structured, targeted to different organization related to water sectors, or concerned of infrastructure projects and based on five indicators: financial, institutional, technical, socio-economic, and environmental viabilities.

Through the analysis process of the data collected using SPSS program, three points will be assessed; first, the importance rate for sustainability of each of five indicators (financial, technical, institutional, social, and environmental viabilities) for desalination plant in Palestine. Second, sustainability of each of the five indicators that effect on deciding the structural framework of PPP contracts. Third, the different contracting models.

By the end of analysis, the concession contract (Green field contract) got the heighest score with weighted average 3.3 through overall assessment of PPP contracts, that means this contract is the optimal contract which is simulating the reality of the infrastructure in Palestine, achieving the sustainability of the desalination plant , and improving the efficiency of the service to satisfy the citizens.

Chapter One

Introduction

1.1 General Background:

Palestine is one of the countries in the Middle East that suffers from water shortage, (Union for the Mediterranean Secretariat, 2011) due to the political circumstance where Palestine under illegal Israelis' occupation which control on water resource (Palestinian Water Authority, 2012), also climate change, population growth, overexploitation of resources and other reasons increases water shortage. As a result, seawater desalination plant offers an abundant alternative resource to meet the growing needs of water. Desalination technology has become popular throughout the world nowdays, (Lauren F. Greenleea, 2003 ;Water Treatment Guide, 2007) more than 17,000 of desalination plants are now operating in 150 countries worldwide, and by 2020 the capacity could be nearly double, according to the United Nations World Water Development Report in 2014 , In addition, Desalination produces 21 billion gallons of water a day (United Nations World Water Development Report 2014, 2014; (Yale Environment 360, 2014)).

Desalination is the process that removes salts from water to become potable, but this technology is very expensive and needs huge resources to be implemented. So, a successful desalination system requires proper understanding (good experience), good designing and planning to produce

fresh water and to make the system more sustainable (Yale Environment 360, 2014; (Lauren F. Greenleea, 2009); (Akili D. Khawajia, 2007)).

As known Palestine one of the developing countries , that don't have the sufficient affordability to implement such large and risky projects , so public institutions collaborate with the private sector , where the private sector has the ability to carry the responsibility of these projects such as desalination plants .

This research will discuss, the most efficient and sustainable PPP contract used for desalination plants in Palestine, considering the financial, technical, institutional, socio-economi and environment factors or indicators. In other words, we will select among a group of PPP well-known contracts to figure out which one of them is the most efficient and sustainable based on five criteria that are important for decision makers.

1.2 Research Objectives:

The main objective of this research is to evaluate the most efficient and sustainable PPP contracts used for desalination plants in Palestine

Other objectives can be summarized as:

- Analyzing the potential contracting models for Desalination plant in Palestine .
- Assessing the sustainability of each five indicators that effected on deciding the most efficient and sustainable PPP contracts in Palestine
- Identifying the importance rate of the sustainability of each five indicators according to desalination plant in Palestine

1.3 Research Questions:

- What is the suitable framework for public-private participation (PPPs) in Palestine?
- How can the sustainability of each five indicators effecting on deciding the most efficient and sustainable PPP contracts in Palestine?
- What is the importance rate of the sustainability of each five indicators according to desalination plant in Palestine?

1.4 Research Problem:

As shown from Figure 1.1, the main problem in water sector that Palestinians suffered from it, especially in Gaza strip , is water shortage. Because of that, desalination plant found as an alternative resource to meet the water needs. But, a successful large–scale desalination system requires large funding, proper understanding (good experience), in designing , planning and operating… etc, to produce fresh water and make the system more sustainable. So public institutions make arrangements with private sector to implement such a large and risky project .

This research will discuss these arrangements to figure out the most efficient and sustainable PPPcontracts used for desalination plant in Palestine

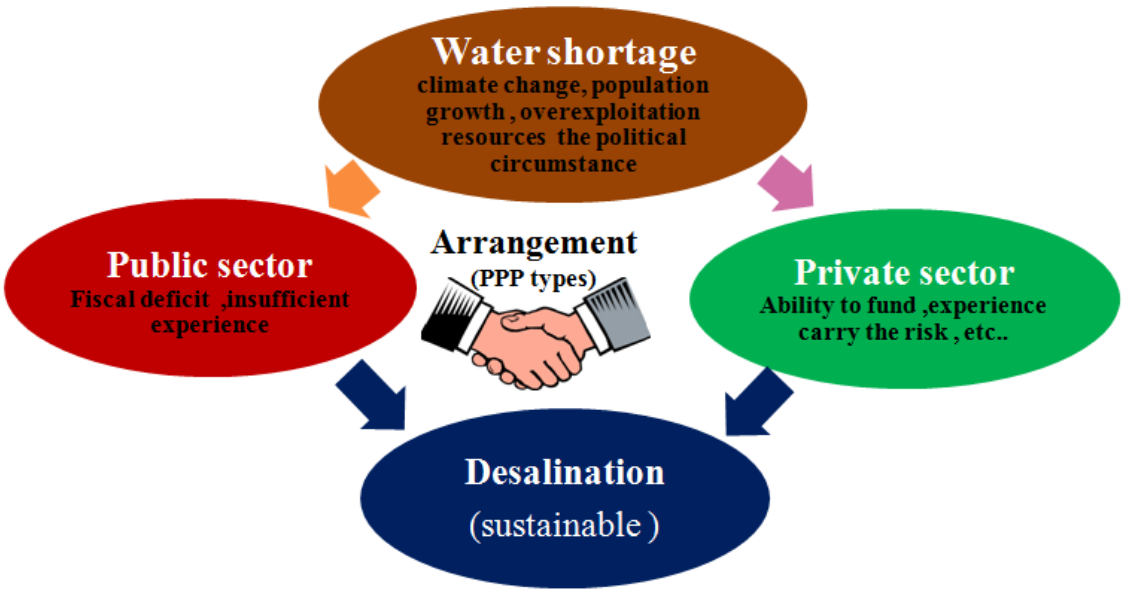

Figure (1.1): Research problem explanation

1.5 Study Area:

Gaza strip is a region located in Palestine country. It's extended along the southwestern portion of the Palestinian coastal plains , that borders; Egypt on the southwest for 11 kilometers and Israel on the east and north along a 51 km. It has an area about of 360 km², the length is about 45 km on the western Mediterranean coast and the width varies from 7 km to 12 km (Gaza Municipality, 2014). Besides, it consists of five governorates , North, Gaza, Middle, Khanyunis, and Rafah. (See Figure 1.2) With the population of 1.8 million , where Gaza strip considered one of the most densely populated regions in the world (over 4,500 people per km^2) (Union for the Mediterranean Secretariat, 2011; UN,2012; Gaza Municipality, 2014 ; PCBS (2014).

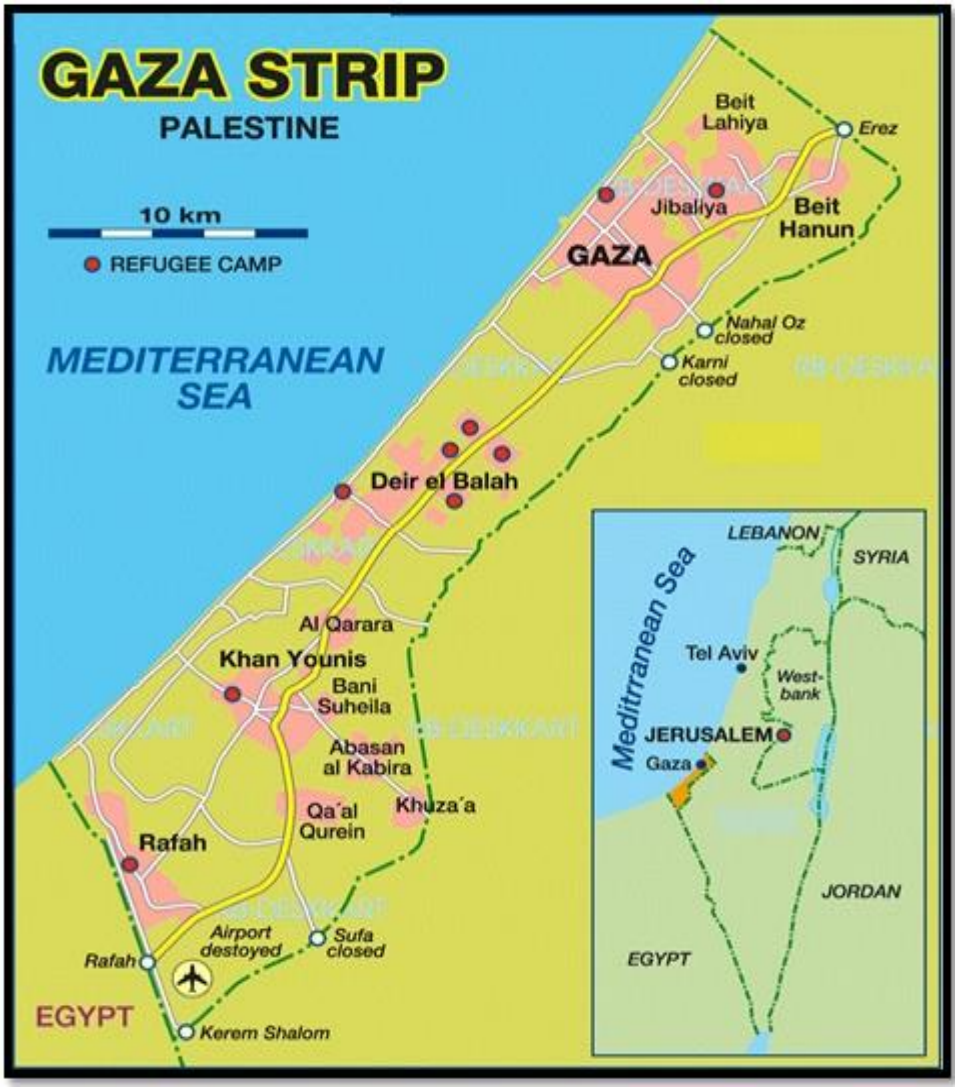

Figure (1.2): Gaza strip location

The coastal aquifer is the main water source in Gaza strip , where it extends from Haifa in the north to Sinai desert in south, and from east Hebron Mountain to the Mediterranean Sea in the west (Union for the Mediterranean Secretariat, 2011).

Coastal aquifer controlled by the Israeli occupation which constructs trapped wells along the Eastern part to seize the natural flow from east to west, and builds dams along Wadi Gaza. So the sustainable yield of the aquifer is approximately 55 MCM/year , where Gaza strip consumes in excess around of 200 MCM/year from the aquifer (PWA,2014) this lead to

overexploitation of the aquifer, also raising seawater intrusion which deteriorated the quality of aquifers, beside the overuse of fertilizers and pesticides in the agricultural activities and in adequate sewage system all of these things polluted the groundwater (CMWU,2010 ;Union for the Mediterranean Secretariat, 2011 ; PWA ,2014).

Over the years, Gaza strip suffered from water shortage, so finding alternative resources such as seawater desalination becomes an essential priority .

1.6 Thesis structure:

This research includes six chapters as manifested in the following:

Chapter one covers the general background about water resource in Palestine, seawater desalination and Public Private Participation (PPP) furthermore to research question, research objective and study area.

Chapter two includes literature review, the definition of PPP, types of the different contracting models and experience of seawater desalination over the world.

Chapter three represents an overview of desalination plant investments in Palestine.

Chapter four describes the methodology approach for the research.

Chapter five represents data analysis and the overall results of the study.

Chapter six gives the conclusion and recommendation.

Chapter Two

Literature Review

2.1. Public Private Participation (PPPs) definition:

Public Private Participation (hereinafter referred to as PPPs) describes the relationship between the public sector and the private sector depends on the types of the provision services which relate benefits on both sectors through profit and the success of the services offered. This term is widely used over the world and there is no exact definition for what is PPPs (Devkar et al. 2013).

World Bank (2003) defines PPPs as "an arrangements, typically a medium to long term, between the public and private sectors whereby part of the services or works that fall under the responsibilities of the public sector are provided by the private sector, with clear agreements on shared objectives for the delivery of public infrastructure and/or public services". The Organization for Economic Co-operation and Development, OECD (2008) defined PPP as a long term agreement between the government and a private sector where the service delivery targets of the government are aligned with the revenue targets of the private sector (Rossi and Civitillo, 2013).

Spiering and Dewulf (2006) clarified that PPPs are contractual framework between public and private sectors to provide a public asset or service where the private sector funding the project and the risk sharing

between both sectors (Bult-Spiering and Dewulf, 2006; Devkar et al. 2013) Skelcher (2007) revealed that Public-Private Partnership (PPPs) associated the two components of the resource of the government and the private agents (business or not-for-profit bodies) in order to provide social goals. (Skelcher, 2007). UK's Private Finance Initiative (PFI) illustrated that PPP is "any arrangement made between a state authority and a private partner to provide a service for the state authority, and included different combinations of design, construction, operations and finance (Devkar et al. 2013).; Rossi a and Civitillo, 2013).

Hodge and Greve (2007) found through these research a five families of PPP (Hodge and Greve, 2007);Rossi and Civitillo, 2013):

- Institutional co-operation for joint production and risk sharing (such as the Netherlands Port Authority).
- Long-term infrastructure contracts (LTICs), which emphasize tight specification of outputs in long-term legal contracts (as exemplified in UK Private Finance Initiative projects).
- Public policy networks (in which loose stakeholder relationships are emphasized).
- Civil society and community development.
- Urban renewal and downtown economic development (and where in the USA a portfolio of local economic development and urban re-growth measures are pursued).

Overall, researchers have been divided in their interpretation of PPPs. Some considered it as a new governance tool that will replace the

traditional method through the competitive tendering. Others considered it as a new application of public management (Rossi and Civitillo, 2013).

2.2. Main type of contracts for PPPs:

PPP is related to fiscal pressures that have led governments to look for innovative solutions and the maximum amount of the re-allocation of resources. From this point, various studies have shown that there is a large potential to achieve the desired gains for the public sector. Otherwise, the private sector can play an important role in infrastructures and public utilities provision, through funding, ability to carry risks and develop public sector expertise... etc. Still, the credibility and transparency of the cooperation between the public and private sectors are critical and it must be depend on a legal framework that regulates the relationship between both of them (Rondinelli, 2003; PESSOA, 2008; Istrate and Puentes, 2011). Because of that , different types of contracts which fall Under a legal framework, define the duties and ensure the rights between the public and private sectors to provide a service through seven mechanisms: Service and Management contracts, Turnkey contracts, Affermage /Lease contracts, Concession contracts, Private Finance Initiative contracts (PFI), joint venture contract and divestiture contract (Felsinger, 2007; PESSOA, 2008; The Institute for Public-Private Partnerships, 2009; Ndandiko, 2010; Scribner, 2011; OECD, 2011; Romania, 2012; Rossi and Civitillo, 2013; Ninh et al.2014; and Siddiqui, 2015).

2.2.1. Turnkey contract (Traditional contract):

This type is known as Design-Build contract, and also known traditional contract where the private contractor is chosen through a Bidding process. The private contractor has a responsibility to design and construction within the agreed tender in performance for a fixed fee (Hosie, 2007;Romania, 2012; Rossi and Civitillo, 2013;). This type of contract is the most used in Palestine for construction any type of projects.

2.2.2. Service and Management contracts:

An agreement by which a private firm is entrusted to provide a service or to manage a part or whole of a public service. Through this contract, the private sector brings his skills into the service such as organization, maintenance, operational control….etc., and it takes payments for his work. However, the public sector carries the responsibility of the service such as financial, technical, institutional matters …etc. The duration of this contract is usually short which between 3-5 years. Figure (2.1) describes the general structure of a management contract (Felsinger,2007; PESSOA, 2008; The Institute for Public-Private Partnerships, 2009; Ndandiko, 2010; Scribner, 2011; OECD, 2011; Romania, 2012; Rossi and Civitillo, 2013; Ninh et al.2014; and Siddiqui, 2015).

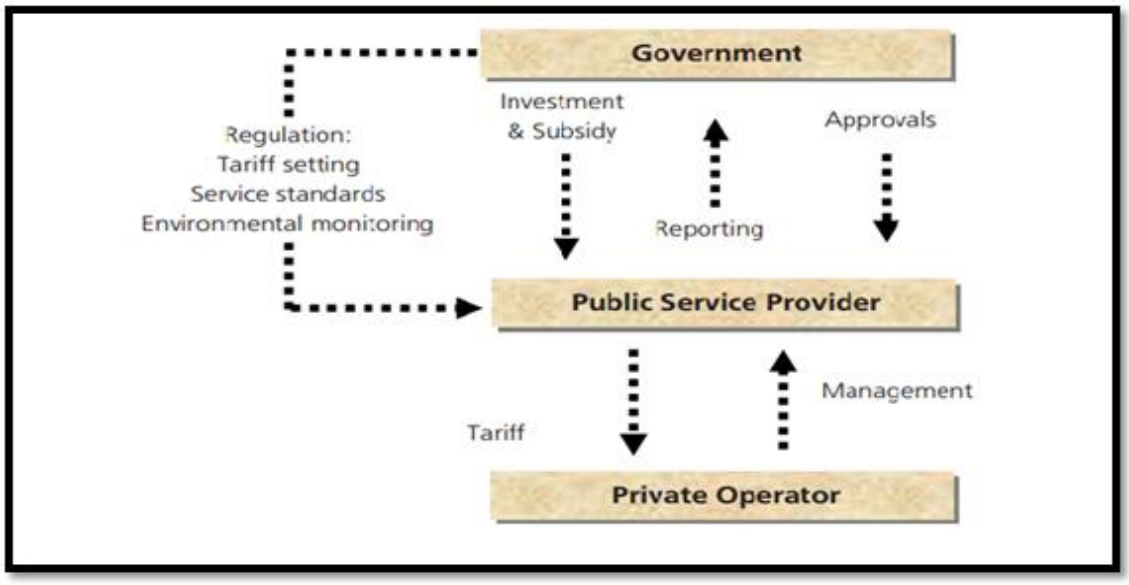

Figure (2.1): The structure of the Service and Management contracts.

Source: Skilling and Booth, 2007.

The figure above explains the relationship between the major components which are; the government, the public service provider and the private operator, where the governance own's and carries the responsibilities of the public service provider and allows the private sector to manage the service. In contrast the governance paid money to private for their work. One of the examples about this contract in Gaza strip was in mid-1996, Lyonnaise des Eaux/Khatib and Alami (LEKA) was awarded a four-year water services management contract to help local government service providers and the Palestinian Water Authority (PWA) improve water service. (Felsinger,2007; PESSOA, 2008; Ndandiko, 2010; Scribner, 2011; OECD, 2011; Romania, 2012; Rossi and Civitillo, 2013; Ninh et al.2014; and Siddiqui, 2015).

As a result, the greatest advantage of this type is that the public sector can gain great benefits without imposing restrictions on service by the private sector. On the other hand, this contract could be tricky since it

restricts the private sector in management only and does not provide any other service.

2.2.3. Affermage /Lease contracts:

In this type of contracts, the private sector leases the asset company which belong to public sector and they become responsible for operating, maintaining and the performance of the service, also the risk related to these processes, under a medium period usually around 2-10 years and may be extended to 20 years. However the public sector owns the service and carries the responsibility of the investment risks. Figure (2.2) describe the general structure of a lease contract (Felsinger,2007; PESSOA, 2008; Ndandiko, 2010; Scribner, 2011; OECD, 2011; Romania, 2012; Rossi and Civitillo, 2013; Ninh et al.2014; and Siddiqui, 2015).

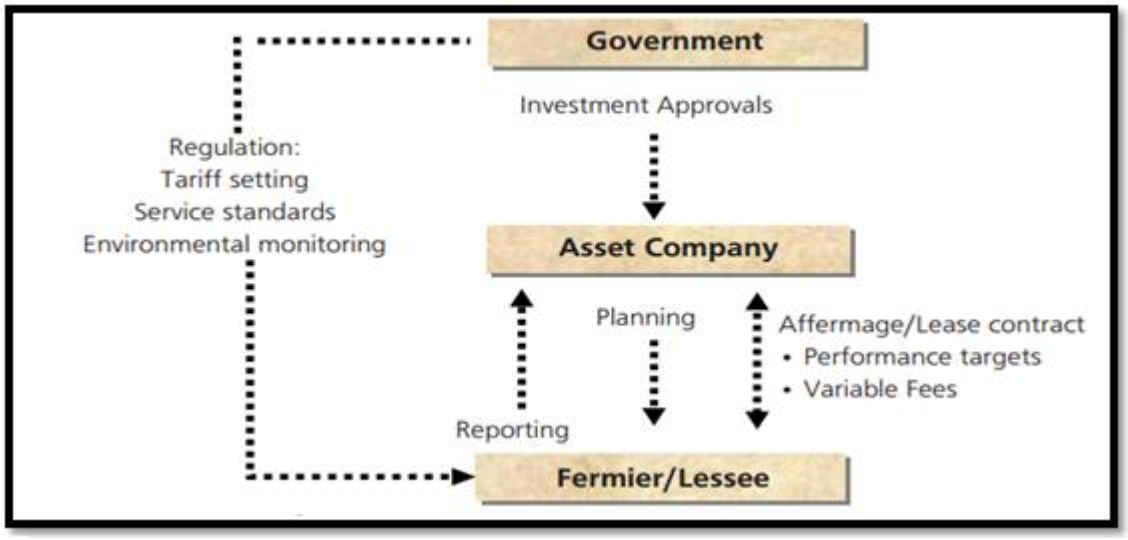

Figure (2.2): The Structure of Affermage / Lease contracts.

Source: Skilling and Booth, 2007.

The difference between affermage and a lease contract is technical. Under a lease, the revenue collected from the customers goes for the private sector and they pay a specified lease fee to the public sector. While

in affermage, the private and public sector's share revenue from consumers, and it is more interesting to private sector than lease contract because it held less risk than lease contract(Felsinger,2007; PESSOA, 2008; Ndandiko, 2010; Scribner, 2011; OECD, 2011; Romania, 2012; Rossi and Civitillo, 2013; Ninh et al.2014; and Siddiqui, 2015).During this contract, the private sector revenues depend on sales and costs on operating and managing services, which lead them to provide a good service with reasonable cost to customers. On the other hand, this may constitute a financial loss to the private sector because they pay a leasing fee to the public sector.

2.2.4. Concession contracts (Green Field contracts):

Under this contract, the private sector carried the responsibility of the whole facility such as funding, designing, building, rehabilitation, operation, and maintenance, etc.., and the most important issue the private sector carry the risk that related to all process for the facility. However, the public sector still owned the service, but sometimes the ownership transfer to the private sector during the contract period that consider between 25–30 years ,which is a long time making the private sector recover the capital cost of investment and take the revenues. By the end of the contract period, the service turns over to public sector. Also, public sector during the contract is responsible for establishing performance and quality standard of services and emphasizes meeting the private sector. Figure (2.3) shows the general mechanism of the Concession contract (Felsinger,2007; PESSOA,

2008; Ndandiko, 2010; Scribner, 2011;OECD, 2011; Romania, 2012; Rossi and Civitillo, 2013; Ninh et al.2014; and Siddiqui, 2015).

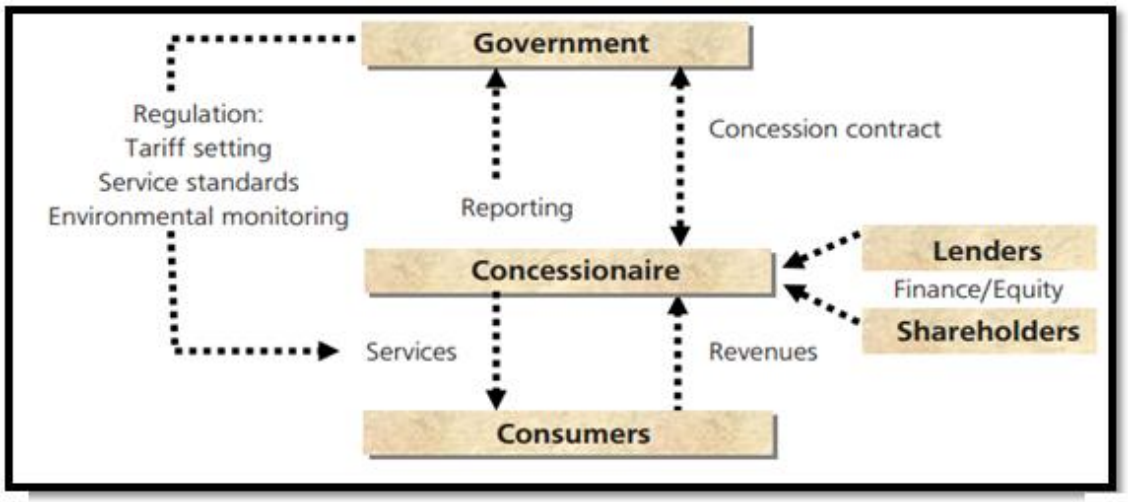

Figure (2.3): The framework of Concession contracts.

Source: Skilling and Booth, 2007.

As a result, Concession contracts (Green Field) considered an attractive contract for financial funding to construct or rehabilitate existing facilities for public sector. Also, it gains good revenue to private sector due to the improvement of the level of the service efficiency. But this contract, the public sector required clarifying the private sector activities, regulation related to service performance, the amount of tariff, and monitoring the contract condition through the contract period.

This contract has many types as follows in Table (2.1) (Felsinger,2007; PESSOA, 2008; Ndandiko, 2010; Scribner, 2011; OECD, 2011; Romania, 2012; Rossi and Civitillo, 2013; Ninh et al.2014; and Siddiqui, 2015).

Table (2.1): Types of concession contract*

Contract	Description
Build Own Operate (BOO) Build Develop Operate (BDO) Design Construct Manage Finance (DCMF) Design Build Finance Operate (DBFO)	The private sector designs, builds, owns, develops, operates and manages a facility without commitment to transfer ownership to the government.
Buy Build Operate (BBO) Lease Develop Operate (LDO) Wrap Around Addition (WAA)	The private sector purchases or leases an existing facility from the public sector, reforms, develops, and expands it, and then operates it, also without commitment to transfer ownership to public sector.
Build Operate Transfer (BOT) Build Own Operate Transfer (BOOT) Build Rent Operate Transfer (BROT) Build Lease Operate Transfer (BLOT) Build Transfer Operate (BTO)	The private sector designs, builds, and operates or leases the facility from the public sector. At the end of the contract transfers to government

Source: Public Private Partnership, Fiscal Affairs Department of the IMF

2.2.5. Private Finance Initiative contract (PFI):

At this contract, the private sector finance, operate, and develop the service. In contrast, the public sector pays a monthly fee to recover the capital cost of the service from the private sector and. In other words, this arrangement is considered as a procurement model where the public sector purchases the service from the private sector(Alshawi, 2009 and Rossi and Civitillo, 2013).

The PFI market is restricted to large size contractors. According Alshawi(2009) “A survey shows that only 15% of construction cost and 13.20% of the operation Net Present Value (NPV) cost of the fifty-three PFI projects they surveyed are less than £10 million’’.

PFI contract could cause financial problems on the governments, especially that the financial consequences of that paid by the private sector may be expensive and could implicate governments to borrow money and can't repay it.

2.2.6. Joint Venture contract:

Under this contract, public and private sectors, both have equal rights on the facilities which they participate in the investment capital, ownership and responsibility to make the project work efficiently. Both of sectors could form a company called joint ventures. This contract helps to match the strongest points on the private and public sectors and to pass over the weakest point that face both sectors see Figure (2.4) Joint venture structure (OECD, 2011; Ninh et al. 2014 and Felsinger, 2017).

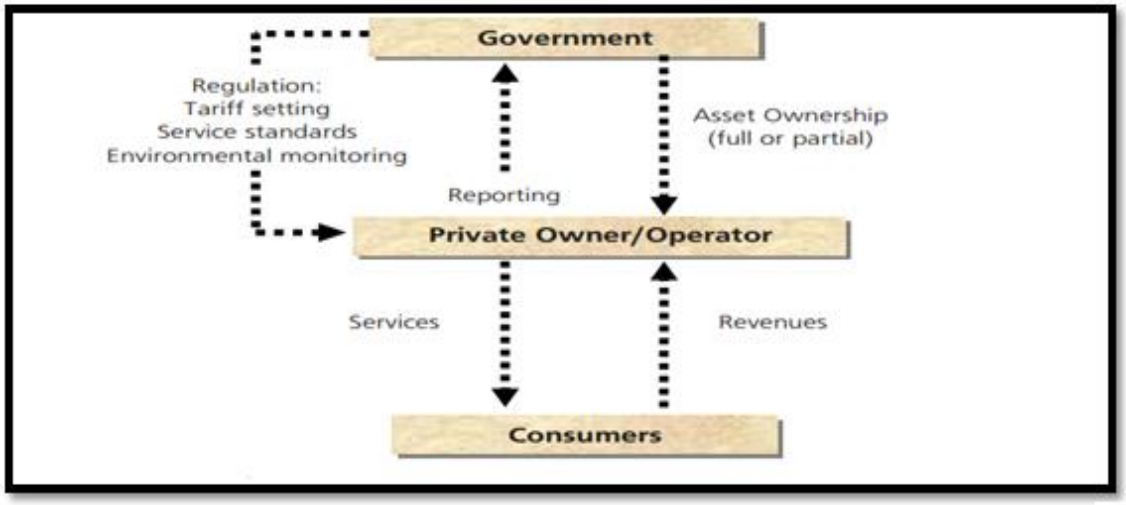

Figure (2.4): The framework of Joint venture contract

Source: Skilling and Booth, 2007.

2.2.7. Divestiture contract:

Under this contract, assets are completely sold to the private sector; where it became responsible for financing, operation, management and the risks. However, these monopolies stayed under supervision of the public sector and independent regulatory agencies (PESSOA, 2008 and Ndandiko, 2010; Scribner, 2011; OECD, 2011).

These different arrangements are changing sometimes in order to meet the conditions of the projects and specific requirements of the public sector,such as the volume of the project or service, complexity, funding sources, financial requirements (CEDR's, 2009; Ndandiko, 2010 and OECD, 2011). In general, the factors which considered in determining the model of contract may include (CEDR's, 2009; Ndandiko, 2010 and OECD, 2011):

- The degree of involvement of the public sector in funding the project.
- The duration and nature of the contract between the public and the private sectors.
- Risk sharing between the private and public parties.
- The tasks and responsibilities of the private and public sectors which included; design, build, finance, operate, maintain, Etc.

PPP Types can be summarized below in Table (2.2) which provides a combination between the criteria's of involvement in choosing PPP types with the different contracting models(Ndandiko, 2010 and OECD, 2010).

Table (2.2):The criteria of involvement in choosing PPP types:

Type of Contract	Asset Ownership	Capital Investment	Design/ Build	Operation/ Maintenance	Commercial Risk	Duration (Years)
Traditional	Public	Public	Public/ Private	Public/	Public	Time schedule
Service and management	Public	Public	Public	Public/ Private	Public	2-5
Lease/ Affermage	Public	Public/ private	Public	Public/ Private	Public/ Private	8~15
Concession	Public	Private	Private	Private	Private	20-30
PFI	Public	Private	Public / Private	Private	Public/ private	20-30
Joint Venture	Public/ Private	Public/ Private	Public/ Private	Public/ Private	Public/ Private	Indefinite
Divestiture	Private	Private	Private	Private	Private	Indefinite

However, selecting PPP types depends on the government requirements, abilities, the economic and political situation of governments to participate with the private sector in such large-scale projects as desalination plants in Gaza strip. Figure (2.5) below shows the process of increasing PPP involvement in any project through types of contracts as follow ;

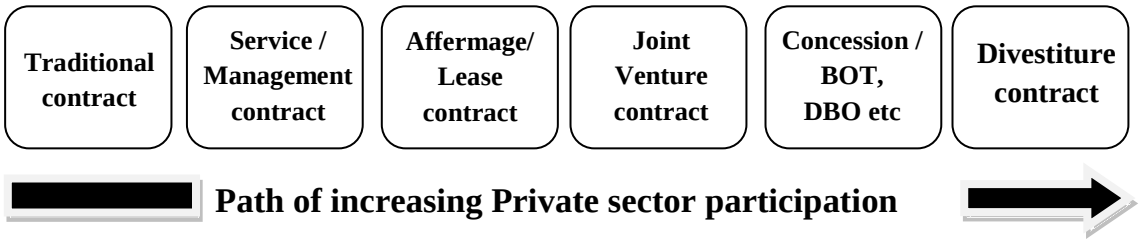

Figure (2.5): Process of increasing of PPP involvement based on the different contracting models.

Source:Thomas Board, 2002.

2.3. PPPs advantage and risk:

PPPs, especially with long-term contracts, can create a significant benefits for both; governments in public services provision and private investors, such as follow (Rondinelli, 2003; Felsinger, 2007; PÂRVU and

VOICU-OLTEANU,2009; Ndandiko, 2010; Rakić and Rađenović, 2011; Romania, 2012; MOF, 2012; and Siddiqui, 2015):

- Private sector has sufficient experience and competitive features. Through PPP, government acquired from the private sector; experience, innovation and competitive features in the delivery of public services which improve the efficiency, quality and the price of services.
- The cost during the project life cycle: By combining design, building, maintaining and operating functions cost of a specific large scale project, it gives strong evidence for a lot of funding. Still, PPP allows private sector involvement in these functions that make the process easier and achieving the same outcomes at lower cost.
- Bearing responsibility of Risks:Where the risks may be determined according to each private and public sector experiences in managing and mitigating the risks in a PPPs projects. However, the private sector carrying designs, construction and financing risks while the public sector may take on political and regulatory risks. The overall risks can be allocated depending on arrangement between private and public sectors
- PPPs provides an investment business market to the private sector through the delivery of public service which related to private with increasing revenue
- PPPs projects implemented in shortest time, which ensures the commitment in of the contract period.

2.4. A historical perspective on PPPs through regions and several sectors

Public Private Partnerships have a long history in many countries, since 1980s the movement has become significantly more popular , where the idea of participation was introduced and used in the public sector services such as power, telecommunications, and transportation, where popularly compared to water supply and sanitation services have been relatively late (Davis, 2005 and Bult-Spiering and Dewulf, 2006). But at the beginning of the 1990s, the phenomenon of PPPs increased through involvement of the private sector in the development and funding of the public facilities such as management of water and wastewater, and especially on improving water service delivery (Marin, 2009 and OECD, 2010). Figure (2.6) shows the increasing movement of using PPP in developing countries by sector from 1990-2008 (Estache et al. 2007); (Farquharson et al. 2011).

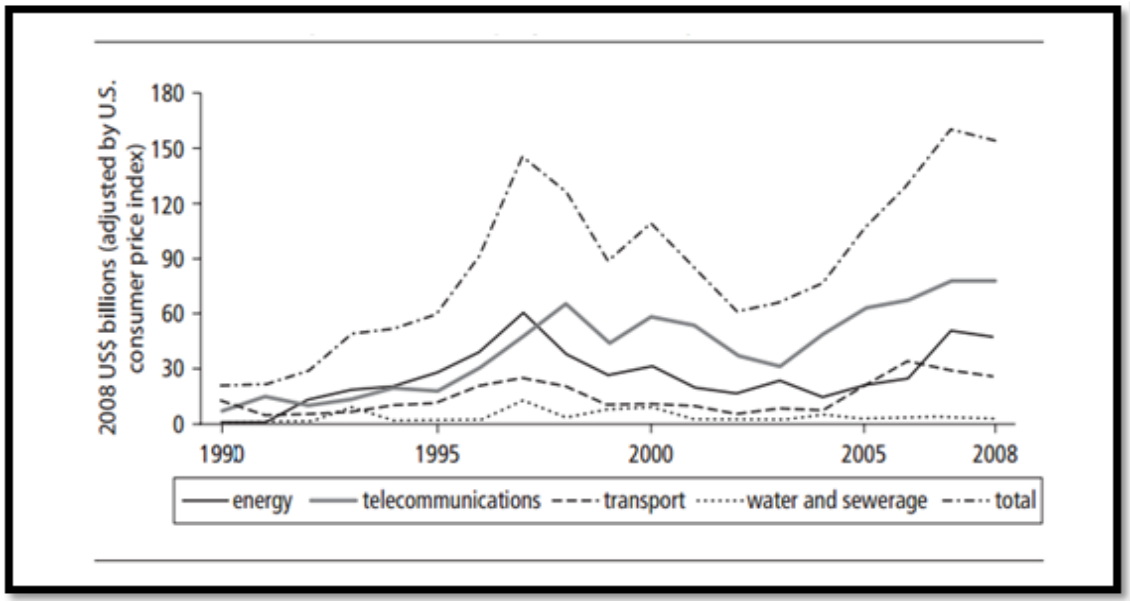

Figure (2.6): Investment Commitments for New and Existing Infrastucture Project with PPP in Developing Countries, by Sectors, 1990-2008.

Source: World Bank and PPIAF PPI project database.

According to the Global Private Participation in Infrastructure (PPI) update report (2015), the largest of the number of PPP projects goes for energy projects with 205 projects followed by transportation projects with55 projects, and lastly water and sewerage projects with40 projects. the Transport sector achieved the highest arrangement of US$69. 9 billion, which is expected to gain around 63 percent of global investment where energy and water and sewerage sectors achieved 34 and 3 percent respectively of global investments. Figure (2.7) and Table (2.3) shows the total investments by sector between 2001-2015 (Estache et al., 2007; Farquharson et al. 2011 ; Hall, 2012 and PPI, 2015).

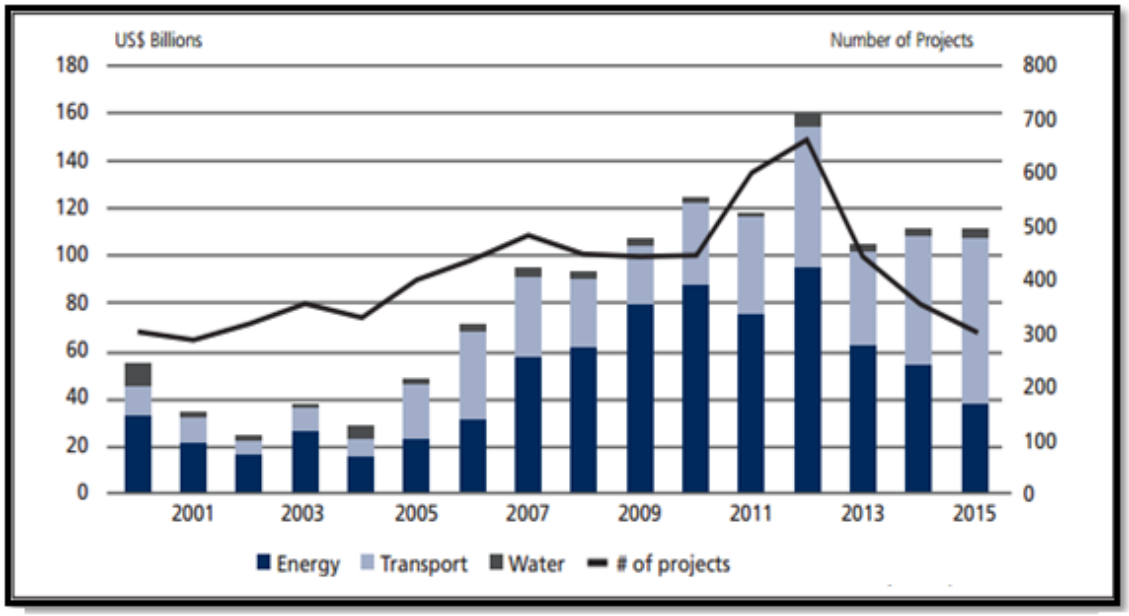

Figure (2.7): Total Investment in Energy, Transport, and Water, by Sector.

Source: World Bank, PPI project database.

Table (2.3): Total investment committed by sector, 2015

	No. of Transactions	Average investment commitment (US $ Millions)	Total investment (US $ Billions)	% Total	Change from 5-year average (%)
Transport	55	$ 1.271	69.9	63	+53
Energy	205	$ 184	37.6	34	-50
Water & Sewerage	40	$ 113	4.1	3	+8
Total	**300**	**$ 372**	**111.6**	**100%**	**+11%**

As result, energy and transport sectors , have attracted larger shares of investment, than water and sewerage sectors ,this refer to the private sector a worries about the risks associated with rehabilitating existing infrastructure assets and about political and regulatory risks, especially those that involve tariff issues for end users in socially sensitive areas such as water.

However, according to World Bank , the most active private sector participation in infrastructure investment were Latin America and the Caribbean (LAC) and East Asia and the Pacifc (EAP), where both regions accounted for over 80 percent of global investment in 2016. East Asia and the Pacifc (EAP) was the only region with higher investment over the previous year, with commitments increasing by 43 percent, and the only region where investments in 2016 exceeded the five-year average by 48 percent See Figure (2.8) shows the total investments by region between 2007-2016 (Estache et al.2007;Farquharson et al2011; Hall, 2012, PPI, 2016).

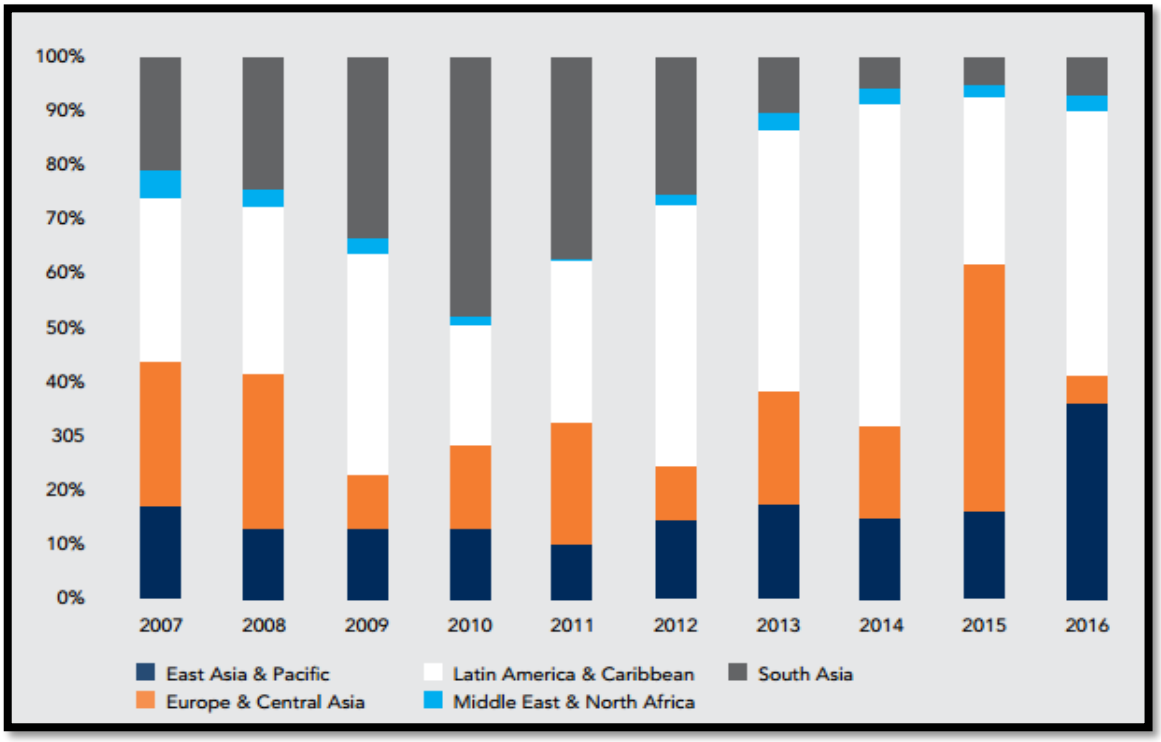

Figure (2.8): Total investment in Energy, Transport, and Water by region.

Source: World bank, PPI project database.

2.5. PPP in water sector:

In 1991, water sector was awarded its first contract in Latin America, which was a concession, for the Argentine region that needs to provide services (from Corrientes, to consortium) through participation a newly privatized British operator (Marin, 2009). After three years, PPP contracts spread widely all over the world. Between 1991-2000 the number of population served, increase rapidly from 6 million to 93 million as shown in Figure (2.9) (Kaufmann, 2008 and Marin, 2009).

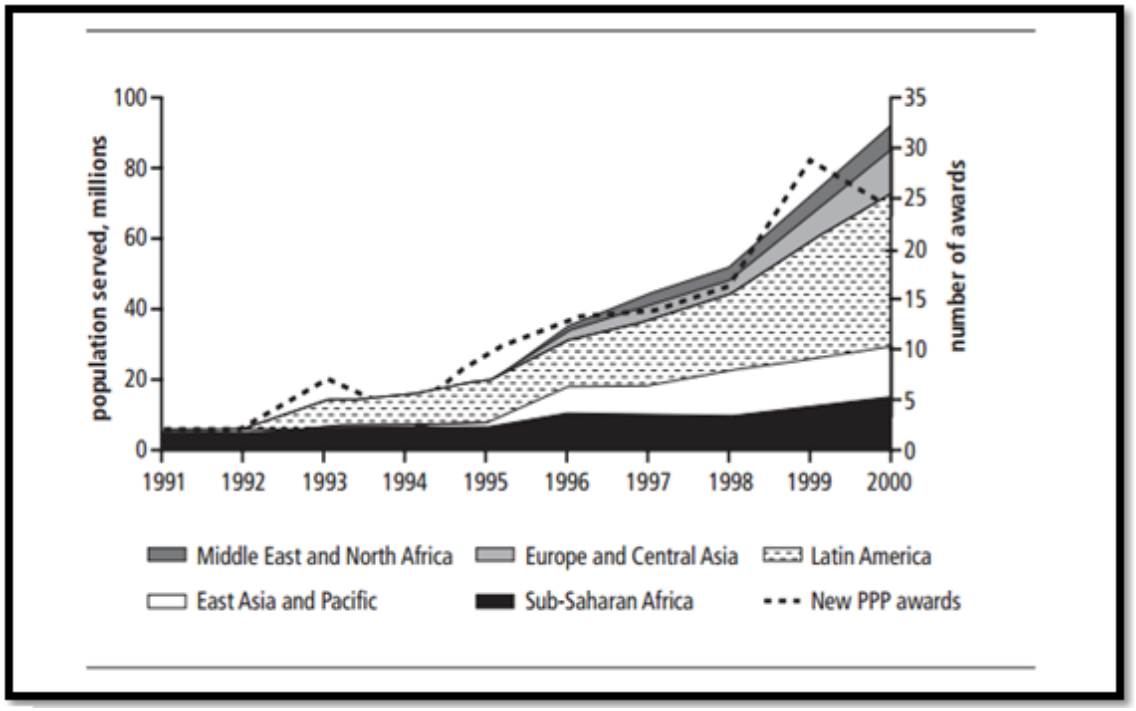

Figure (2.9): developing countries, by regions, 1991-2000 Water utility PPPs awarded and urban populations served in**.**

Source: Philippe Marin, 2009.

During the year 2000, Latin America played a leading role in PPP where the population served approximately 43 million. In this year, Argentina had become the largest country, through participating private water companies and the population served approximately around 18 million. Other areas came far away these numbers of population served, where Asia followed with 14 million, Sub-Saharan Africa with 16 million, Eastern Europe and Central Asia with 13 million and in the Middle East and North Africa with 7 million(Kauffmann, 2008 and Marin, 2009).But, in 2001 was the turning point in the participation of the private sector for water sector ,which dropped obviously and the amount of people is reduced due to the economic crisis, especially in Argentina as shown in Figure (2.10) (Céline Kauffmann, 2008); Marin, 2009).

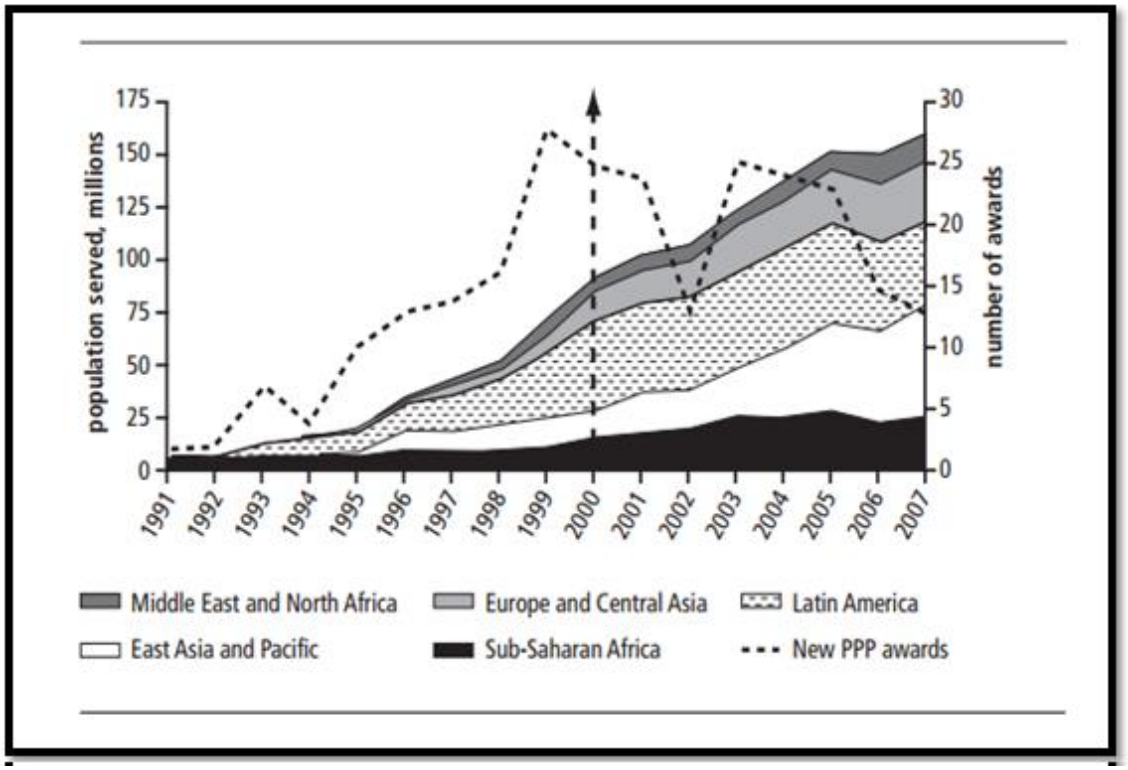

Figure (2.10): Water utility PPPs awarded and urban populations served in developing countries, by regions, 1991-2007.

Source: . Philippe Marin, 2009.

Despite of the decline in the number of contracts, the amount of population served is still rising approximately 94 million in 2000 to 160 million in 2007. Moreover, in this year PPP returned to be more active in the world. By the end of 2007 the population served about 220 millions, and more than 260 PPP contracts were estimated to be a sign by governments in developing and emerging in PPP projects were supplying water to more than 160 million people in these countries (Kauffmann, 2008 and Marin, 2009).

2.6. PPP in desalination:

Desalination is spread widely in particular parts of the world, where the areas suffer from water shortage, especially arid and semi arid area such as the Middle East (The Gulf Region) and North Africa, which have the largest portion of the number of desalination plants, followed by the Mediterranean, the Americas, and Asia. Figure (2.11) shows the percentages of desalination plants for each region. In 1980 the total capacity of desalination plants estimated 5,000,000 m^3/d to become approximately 52,333,950 m^3/d in 2008 and then in 2012 considered to be around 79,000,000 m^3/d from nearly 16,000 plants worldwide (Manero, 2010; World Bank, 2012 and Zotalis et al. 2014)

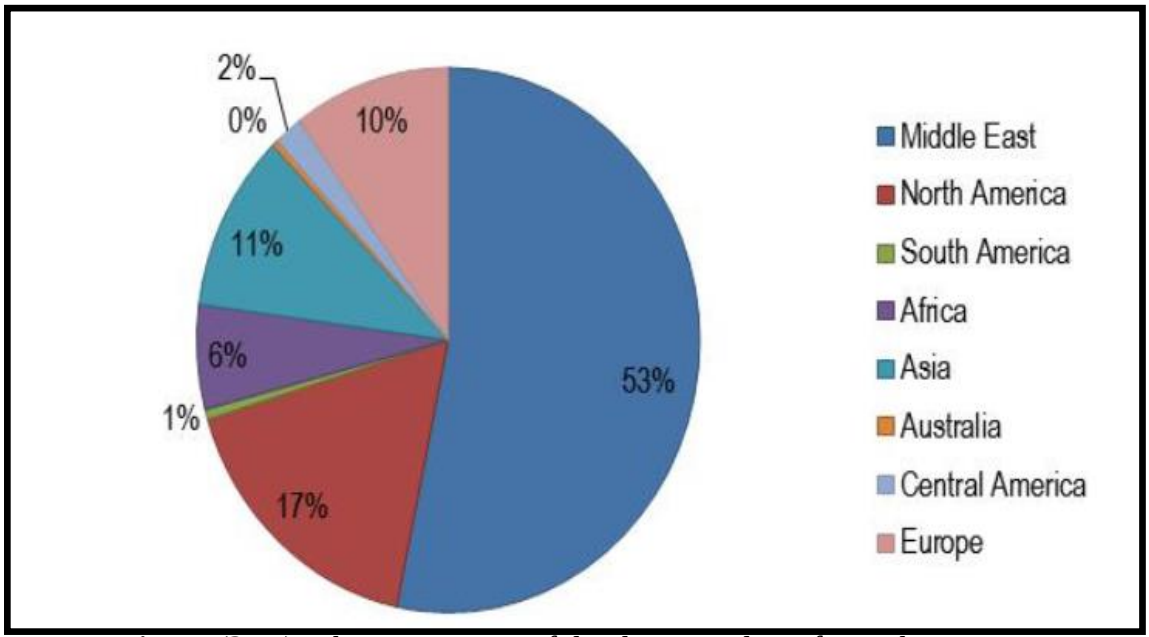

Figure (2.11): The percentages of desalination plants for each region.

Source: Zotalis,et al. , 2014.

Desalination considered as large-scale water projects and one of an alternative water resource which approximately will increase per year, more than 9% between 2010-2016 (see figure (2.12)) (Zotalis et al.,

2014). So, desalination needs a lot of funding and good experience to deal with. PPPs tool is a good method for achieving this project(Manero, 2010; World Bank, 2012 and Zotalis et al. 2014).

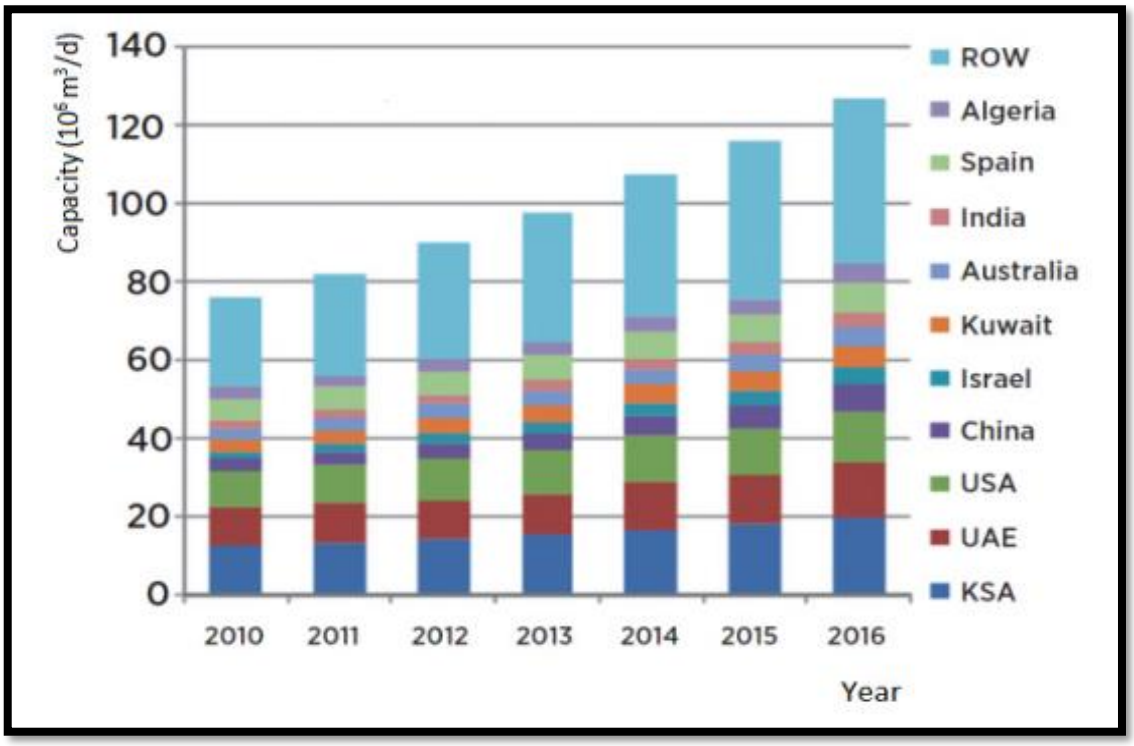

Figure (2.12): Desalination capacity around the world between 2010 -2016.
ROW: Rest of World.
Source: Zotalis,et al. , 2014.

The majority of the largest seawater desalination plants are located in the Middle East, where the biggest desalination plant constructed in the Ras Al-Khair city which named Ras Al-Khair desalination plant(also called Ras Al-Zour or Ras Azzour) in Saudi Arabia, it used both membrane and thermal technology (see Appendix D about desalination technology) with a capacity over 1,000,000 m^3/d to supply Maaden factories with 25,000 m^3 of desalinated water and 1350 MW of electricity, also provide 900,000 m^3/d of desalinated water to Riyadh city and several central cities

Manero, 2010; World Bank, 2012 and Zotalis et al. 2014). The Table (2.4) below shows some of the biggest desalination plants in the world.

Table (2.4): The biggest seawater desalination plants around the world

Location	Capacity (m^3/d)	Feed water	Operation year
Ras Al-Khair, SA	1,025,000	Seawater	2013
Shuaiba, SA	880,000	Seawater	2007
Ras Al-Khair, SA	800,000	Seawater	2007
Al Jubail, SA	730,000	Seawater	2007
Jebel Ali, United Arab Emirates	6000,000	Seawater	2011
Al-Zour North, Kuwait	567,000	Seawater	2007

As far as the membrane technologies are concerned, especially, reverse osmosis (RO) desalination technology (see appendix D about desalination technology) ,the largest membrane desalination plant in the world is the Victoria desalination plant in Melbourne, Australia, which operate in 2012 with a capacity 444,000 m3/d (one of the most renowned), great potential in energy saving and reasonable production cost. However, larger units will soon operate, such as the Magtaa plant in Algeria and the Soreq plant in Israel, with capacities of 500,000 m^3/d and 510,000 m^3/d, respectively (Manero, 2010; World Bank, 2012 and Zotalis et al. 2014). (See Table 2.5).

Table (2.5): Major reverse osmosis (RO) desalination plants around the world

Location	City, Country	Capacity (m^3/d)
Soreq desalination plant	Rishon Letzion, Israel	510,000
Magtaa desalination plant	Oran , Algeria	500,000
Victoria desalination plant	Melbourne , Australia	444,000
Point Lisas desalination plant	Lisas , Trinidad	109,019
Tampa Bay desalination plant	Tampa , USA	94635

Overall , Desalination technology is growing so fast globally, which will play a significant role in water supply in the coming years and it’s expected to grow with annual rate approximately more than 9% between 2010 and 2016 (Zotalis et al. 2014).

Chapter Three

Overview of Desalination plant Investments in Palestine

3.1 Water sector in Palestine:

Palestine one of the countries in the middle east that suffers from water shortage, due to several reasons such as climate change, population growth , loss in the water network, overexploitation... etc., but the main reason for exacerbating this problem is; Palestine under the Israeli occupation which controls water resources and restrict the use of Palestinians' rights from water resource. However, looking at Gaza Strip, the quality of water is considerably worse compared to the West Bank, due to Israel three wars on Gaza strip, which left damages in the Gaza strip infrastructure (PWA, 2012). So, in this section, we will give an overview about water resource and the situation of water in Palestine.

3.1.1 Water resources in West Bank and Gaza strip:

Two major sources which supply Palestinians of fresh water in West Bank and Gaza strip are groundwater and surface water resource (PWA, 2012), that both based on rainfall to be recharged. According to the Palestinian Water Authority (PWA; 2016),in 2016, the average precipitation during the rainfall season till January is about 194 mm in the West Bank and 258 mm in the Gaza Strip. While the long-term annual average rainfall in the West Bank is 454 mm per year and in the Gaza Strip

356 mm per year (PWA, 2016).Furthermore, the rainfall this season transferred to recharge the aquifers of the West Bank with recharge rates estimated at about 222 million cubic meters of water, which constitutes about 32% of the overall recharge rate that approached annually about 688 million cubic meters. However, in Gaza Strip,the recharge rates of the groundwater aquifer were estimated at 33 million cubic meters of water, which constitutes 60% of the overall recharge rate of about 55 million cubic meters annually (PWA, 2016).

3.1.1.1 Groundwater in West Bank and Gaza strip:

Groundwater is considered the main source of water, which provides more than 90% of fresh water for different purposes. It’s classified into two aquifers as explained below, one called Mountain Aquifer in the West Bank and the other in Gaza Strip called Coastal Aquifer (Aliewi, 2007 PWA, 2012 and European Parliament , 2016). (See Figure 3.1)

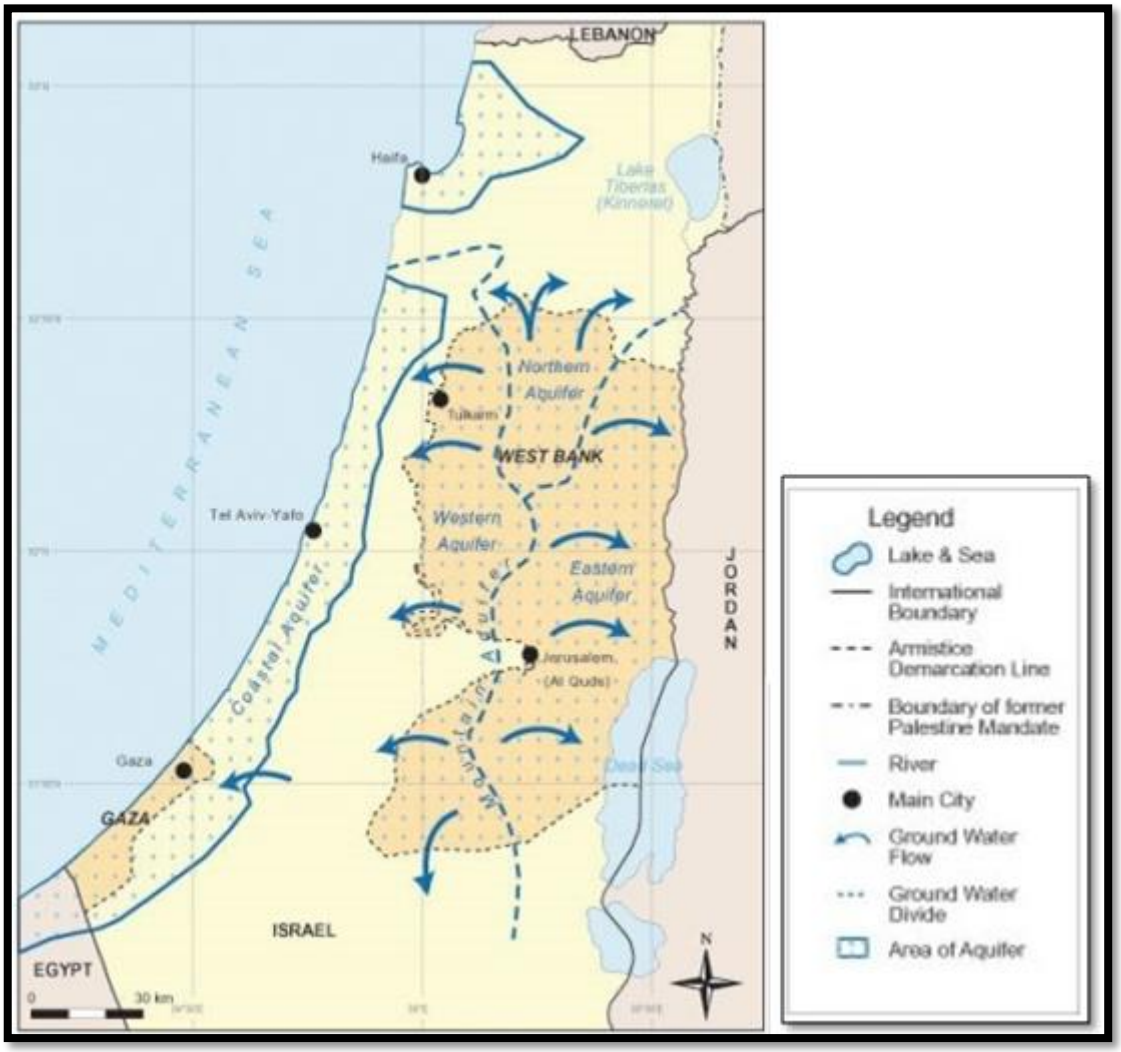

Figure (3.1): The Location of Groundwater in Palestine.

Source: (United Nations Environment Programme (UNEP), DEWA/GRIDGeneva, 2015)

- **Mountain Aquifer**: It's the largest and highest-quality water resource in West Bank, where it's located west of the Jordan river with 130 km long and approximately 35 km wide and it's divided into three basins: Western Aquifer basin, Northeastern Aquifer and Eastern Aquifer basin (Aliewi, 2007 , PWA, 2012 and European Parliament , 2016)
- **Coastal Aquifer**:In the Gaza Strip, Coastal Aquifer is considered the main and the only water source for all types of human usage (domestic, agricultural and industrial) (CMWU, 2010); (PWA,

2012).It's extended from north Haifa to Sinai desert in south , and respectivelyfrom east, west Hebron Mountain and the Mediterranean Sea (CMWU, 2010); (PWA, 2012).With the thickness of the water bearing layers in the east and southeast ranging from several meters to about 120-150 m in the western regions and along the coast (CMWU, 2010 and PWA, 2012; 2015).The sustainable yield of the aquifer is around 55 million cubic meters (MCM)/year. However, recording to PWA in 2015 " more than 1.8 million Palestinians in Gaza consume in excess of 200 MCM/y from the aquifer - thus taking approximately four times as much as the aquifer can sustainable recharge each year"(CMWU, 2010 , PWA, 2012; 2015 and European Parliament , 2016).

3.1.1.2. Surface water in West Bank and Gaza Strip:

Surface water resources refer mainly to the Jordan River and Ephemeral Wadiswhere it can be classified into three Wadis depend on the flow direction : the first towards the Mediterranean (West Bank and Gaza Strip), second goes to the Jordan Valley and finally towards the Dead Sea (PWA ,2012 and ARIJ, 2015). (See Figure3.2)

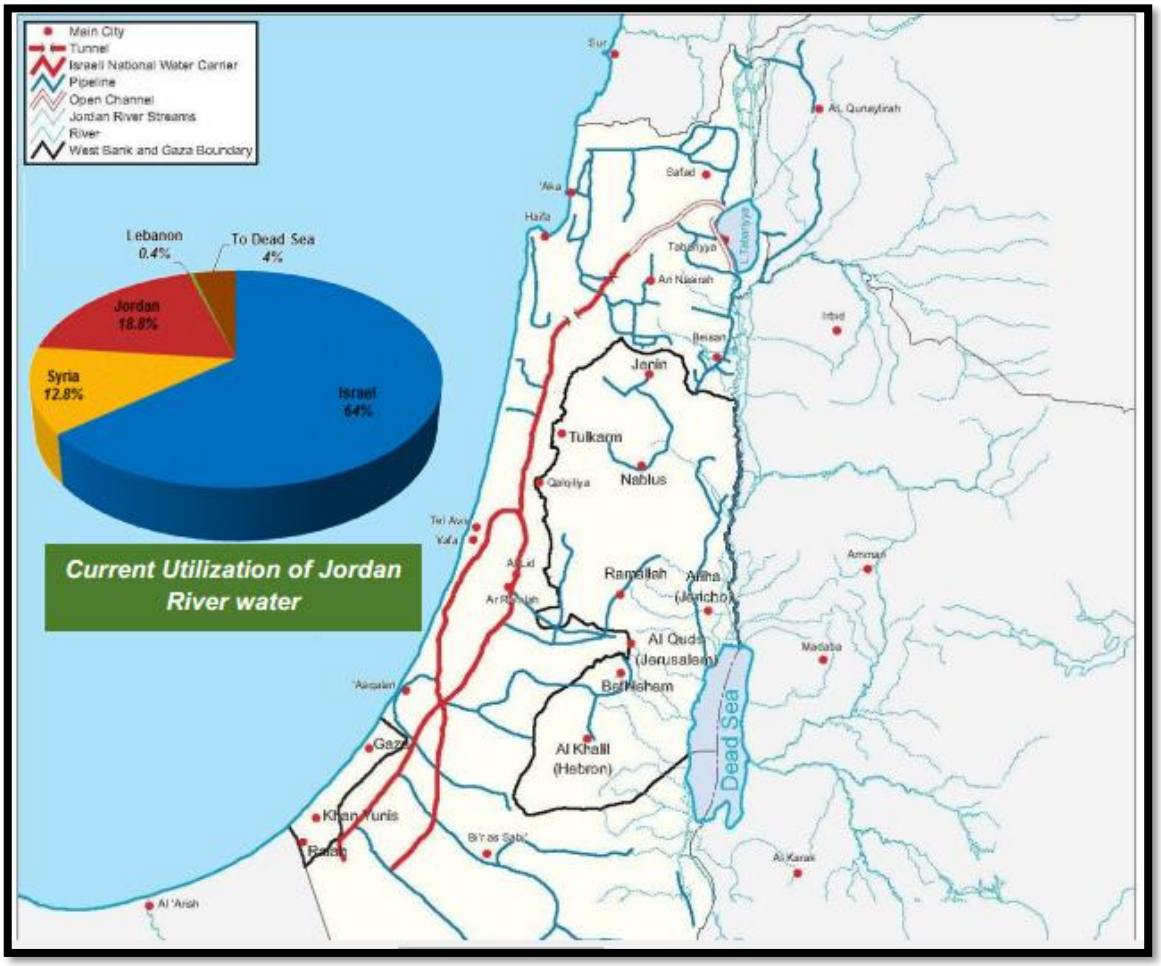

Figure (3.2): Jordan river location .

Source: (Applied Research Institute – Jerusalem (ARIJ), 2015)

3.1.2 Water situation in West Bank and Gaza Strip:

The Palestinian water resources is restricted and controlled by Israel occupation, where in September 1995, the Israeli-Palestinian signed interim agreement was called Oslo II, which stipulates the division of water resources between Palestinians and Israelis, and allows Israeli to extract water from the Mountain Aquifer to 80% and the remaining 20% goes to the Palestinians. But Israel didn't Commit with the agreement and increased water withdrawals (B'Tselem, 2010). Moreover, the Palestinian average consumption of water is estimated around 70 liters per capita per

day less than the recommended consumption rate of 100 liters per capita per day by the World Health Organization (WHO), while Israeli average consumption is about 300 liters per capita per day (Amnesty International, 2009and ARIJ, 2015). (See figure 3.3).

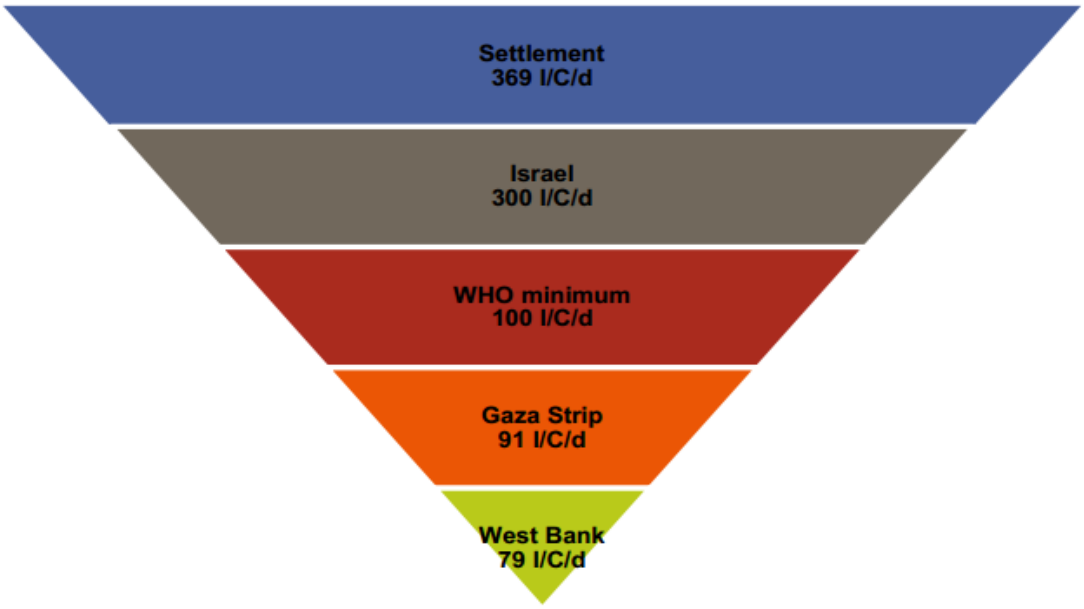

Figure (3.3): Water consumption in Palestine and Israel .

Source: (Applied Research Institute – Jerusalem (ARIJ), 2015).

However, Gaza Strip is facing a challenge by deficient in terms of quantity and quality, of water supply due the three Israeli wars in Gaza Strip for the last six years, which left the water sector degraded (Amnesty International, 2009; Shuttleworth, 2015 , PWA, 2015 and ARIJ, 2015). The damage of the infrastructure in Gaza strip effected in bad way on the Coastal Aquifer through leakage the sewage which polluted the aquifer. Moreover unacceptable water quality which related to high rate of groundwater extraction led to reduce the water level and increase the level of total dissolved salts due to damage of the trans-boundary between the aquifer and seawater that following the intrusion from the Mediterranean

(CMWU, 2010 and PWA, 2012; 2015). In 2015, PWA assessment report on water quality, 96.5% of the aquifer water is yielding water that fails all drinking water quality standards (PWA, 2012; 2015 and UN,2012).

Overall , Despite of the inequality access of water and the restricted controls on water resources in West Bank and Gaza Strip by Israel , there are other factors effect negatively on water resource; climate change, population growth, over-consumption,Water distribution network losses …etc , All of these factors increase the water crisis in Palestiine (Amnesty International, 2009 , PWA 2012and ARIJ,2015). So, finding alternative solutions to reduce this problem is become priority to meet the growing need of water. Because of that, seawater desalination plant is an alternatives of water resources in the Gaza Strip, which will explain in part two in this chapter.

3.2 Seawater Desalination in Gaza Strip:

Securing potable water for domestic use is becoming a heavy target on the PWA to achieve, so one of the alternative solutions found by PWA was Seawater desalination. Where in 2011 a comparative study conducted that desalination is an essential option to provide fresh water for Gaza strip under bad condition that facing area(CMWU, 2010 and PWA, 2014;2015).

3.2.1 History of seawater desalination in Gaza strip:

In 1993 ,Gaza Strip started its first experiment in desalination. It was built in Deir Al Balah city by EMS, a branch of Mekorot Company

with a turnkey contract cost of 650,000 US$. This plant is constructed to desalinate seawater with a capacity of 45M^3/hr at a recovery rate of 75%.The treated water is pumped for citizen at southern part of the city, besides one free filling point in front of the plant for consumers (El Sheikh et al. 2003; Ismail, 2003; Aish, 2003 and Albattnigi, 2015).

In May 1997, Italian Government through Italian Developing Program supported Khanyunis municipality with grants to establish reverse osmosis (RO) brackish water desalination plant nearby the existing municipal well at a turnkey contract cost about US$ 500,000 and capacity estimated 55M^3 /hr . the desalinated water pumped to area suffer from lack of fresh water according to an allocated distribution system. In the next year, Italian Government sent a grant to a Khanyunis municipality to construct RO brackish water desalination plant nearby the existing municipal well at a turnkey contract cost about US$ 500,000 and capacity estimated 80M^3 /hr (El Sheikh et al. 2003; Ismail, 2003; Aish, 2003 and Albattnigi, 2015).

Moreover, in the north of Gaza another RO plant started to construct by 1999 where the French Government sent a grant to PWA. This plant supply desalinated water to people in El Shati refugee camp (80,000 inhabitants) and the area nearby who are suffering from the deterioration of water quality and bad environmental health and its establish in two phases where the first capacity had 1250 M^3 /day to be raised to 5000M^3/day in the second phase (El Sheikh et al. 2003; Ismail, 2003; Aish, 2003 and Albattnigi, 2015).

Also, in July 2000, PWA got a grant from the Austrian Government for design and construction the seawater desalination plant to supply the citizen in Middle area,Deir El Balah, and Zwaydah in particular (65000 inhabitants) of potable water. This plant built in two phases where the first phase had a design capacity that produce a 600 M^3/day and to be increased up to 1200 M^3/day in phasetwo (El Sheikh et al. 2003; Ismail, 2003; Aish, 2003 and Albattnigi, 2015).

Ismail, (2003) said that ‘‘ between 1999 and 2003, the total number of small scale RO private desalination plants for commercial use was 25 in Gaza Strip, in addition to seven vendors". Table (3.1) andTable (3.2) explore the desalination plants and water vendors in the Gaza Strip (Ismail, 2003).

Table (3.1): Small -scale RO desalination plants in the governorates of Gaza strip

No.	Plant Name	Governorate	Source of raw water	Design capacity (M^3/day)	Quantity sold (M^3/day)	Brine discharge
1	Al methali	**North**	brackish well	**96**	**96**	irrigated gardens
2	Al khayria		municipal water	**12**	**12**	Municipal network
3	Al Karama		municipal water	**20**	**10**	NA
4	Al gadir		municipal water	**30**	**20**	Municipal network
5	Yaffa		brackish well	**96**	**40**	Municipal network
6	Al ainsafi		brackish well	**90**	**40**	irrigated gardens
7	Al Ain		brackish well	**40**	**30**	Municipal network
8	Al		municipal	**12**	**12**	Municipal

	khayria2		water			network
9	Al khayria3	**Gaza**	municipal water	**12**	**12**	Municipal network
10	Salsabil		brackish well	**20**	**10**	irrigated gardens
11	Sehaa		municipal water	**10**	**6**	Municipal network
12	Al janoub		brackish well	**60**	**40**	WadiGaza
13	Al kemma		brackish well	**12**	**12**	Municipal network
14	Al fardaws		brackish well	**100**	**60**	Municipal network
15	Al sahib		brackish well	**100**	**40**	Municipal network
16	Al sabra		brackish well	**20**	**10**	Municipal network
17	Akwa	**Gaza**	brackish well	**1200**	**120-80**	Municipal network
18	Al khayria 4		municipal water	**12**	**12**	Municipal network
19	Al khawthar		brackish well	**40**	**20**	Municipal network
20	Al shalal	**Middle**	municipal water	**12**	**12**	Municipal network
21	Al khayria5		brackish well	**12**	**12**	irrigated gardens
22	Al furat		brackish well	**50**	**12**	Wadi Gaza
23	Al westa		brackish well	**12**	**12**	irrigated gardens
24	Zamzum	**Rafah**	brackish well	**20**	**10**	Municipal network
25	Al furat		municipal water	**20**	**10**	Municipal network

Source: Ismail, M., (2003)

Table (3.2): The existing water vendors in Gaza strip governorates

NO	Vendors name	Location	Source of Desalination plant	Sold water (M^3/day)	TDS (Mg/L)
1	Mecca	Gaza	Industrial zone RO plant	12	270
2	Al-Ain	Gaza	Al-ain RO plant	40	80
3	Al-Naba	Gaza	Khanyunis municipality RO plant	12	140
4	Al-Faoumi	Gaza	Al Methali RO plant	8	110
5	Al-Saffi	Rafah	Khanyunis municipality RO plant	6	145
6	Al-Marwa	Rafah	khanyunis municipality RO plant	4	140
7	Al-Madina/Hanin	Rafah	Khanyunis municipality RO plant	5	150

Source: Ismail, M., (2003).

According to PWA (2012) the total number of desalination increased to be 30 plants due to bad conditions that facing Gaza which effect badly on the quality of water.Figure(3.1) shows seawater desalination plants locations in Gaza strip (PWA, 2012 and Albattnigi, 2015).

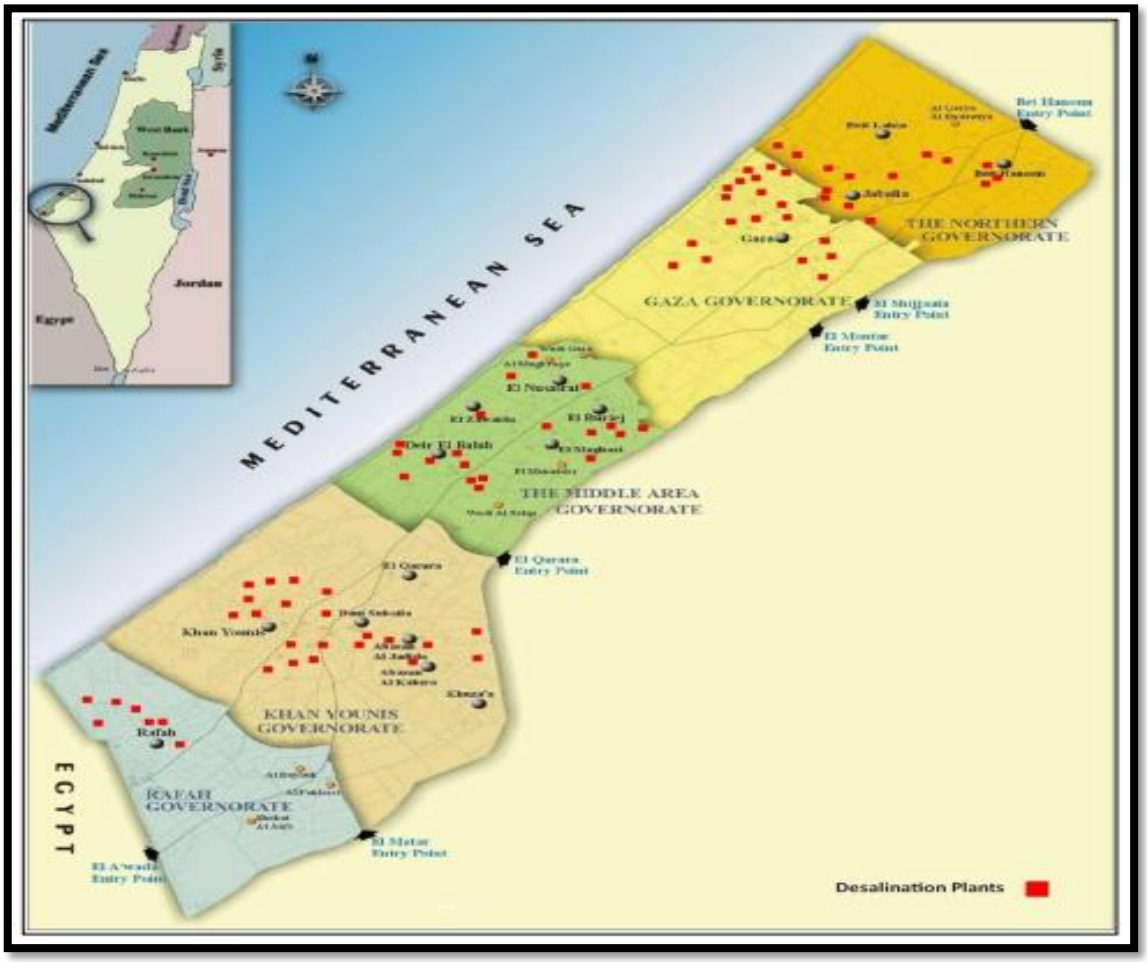

Figure (3.4): The distribution of the seawater desalination plants in Gaza strip.
Source: PWA,2012.

3.2.2 Current situation of seawater desalination in Gaza strip:

The desalination plant became a priority in the Gaza Strip because of the critical conditions that facing the area during the three war years by illegal Israel,which destroyed totally the Infrastructure, as well as the depletion of resources which cause increase the salinity (PWA, 2015). According to UN report(2012), if Gaza remains in this situation, with an excessive withdrawal of groundwater, Groundwater will be severely damaged by 2020**.**

As a result, in 2013 ,the planning process to construct a desalination plant was began where the main objective was to improve water quality and supply water to citizens in addition to secondary goals; reduce the drawdown rates of groundwater and Job creation opportunities during construction and operation process of desalination plant (PWA, 2015).The area of the desalination plant is 80 dunams in the first phase with a capacity of 55 million cubic meters and the capacity have the possibility to expand later in the second stage to become for the proposed desalination about 110 million cubic meters (PWA, 2015).

The technology that will be used is reverse osmosis (RO) and the energy proposed will be solar energy for the desalination plant because of the political circumstances that suffered of the Gaza strip (PWA, 2015). The overall budget for the proposed central desalination plant is considered about 500 million dollar (PWA, 2015).

During the year of 2016, the conceptual design and the establishment studies of the desalination plant was taken by a German consultant office participated with Madar Consulting Engineer from Ramallah and the Environmental and Social Studies were taken byEuropean Union (EU) wascompleted (PWA, 2016). However, the connected projects to desalination plant (transmission line 42 km from north to south, water networks of various sizes and lengths, 12 pumping stations, 5 main booster stations along the transmission line, mixing tanks with a total capacity of 200 000 m^3, as well as replacing 20 km of old or inappropriate networks with new and identical ones) were taken by The consultant's office consists

of two companies, "Lotte" and Ei Engineering "Italian" participated with Technical Consulting Engineers from Gaza strip to design and implement this project which is still under preparation (PWA, 2016). Currently at 2017, the financial and political issues remain pending, so PWA stands for doing conferences and meetings to attract donors and to involve the private sector (PWA, 2017).

Therefore, this research provides a helping hand to study the assessment of private sector participation through different contracting models by analyzing PPP types in the coming chapters, and selecting the suitable PPP types which simulates the situation of Gaza Strip for a sustainable desalination plant.

Chapter Four

Research Methodology

At the beginning the preparation phase for a clear methadology stand on gathering the necessary data to reach the main objective of the research; which is choosing the optimal contract for the desalination plant in Palestine.

The data collection process faces some obstacles related to the determination of the population and the set of organizations which have knowledge about the desalination process and PPP types and sustainability in Palestine. Also, the subject of public-private partnership is new in Palestine and it's described at first time on PWA ; water law 2014, which means that the information about is still limited. Another obstacle is concerned with the sample size from Gaza strip where we couldn't use the direct interview with the respondents as we have applied in West Bank.

Because of that we depend on two basic foundations to pass over these obstacles; first: literature review through identifying a group of well-known of PPP types, second : several meetings with experts who have a good background about the desalination process, PPP contracts, sustainability .. etc., to finding the beneficial tool to collect the data.

The structured interview with the respondent was found to be the most proper approach to collect data. The novelty of the subject and the need of researcher to clarify the main of the project and the ways the

respondent should answer the quessionnare make the direct interview the most proper approach.

The section below represents the research methodology process in general .

4.1 Research methodology process :

In this research, the methodology used is divided into five steps as follows (see figure 4.1).

4.1.1 Literature review

The literature review is considered the basis for building new researches. (see chapter two)

4.1.2 Structured interview:

The data collected based on the structured interview conducted with different sectors that related to water sector or concerned on investment in this sector (see section 4.3)

4.1.3 Data analysis:

Data was analyzed using the Statistical Package for the Social Science (hereinafter referred to as SPSS), to obtain the optimal contract for desalination plant in the Gaza strip

4.1.4 Outcome Result:

Based on data analysis, the structural framework of the optimal contract decided for Gaza strip

4.1.5 Conclusions and recommendations:

The research work was finished by the conclusions and recommendation to support the research results to go further public private partnership in desalination plant in the Gaza strip.

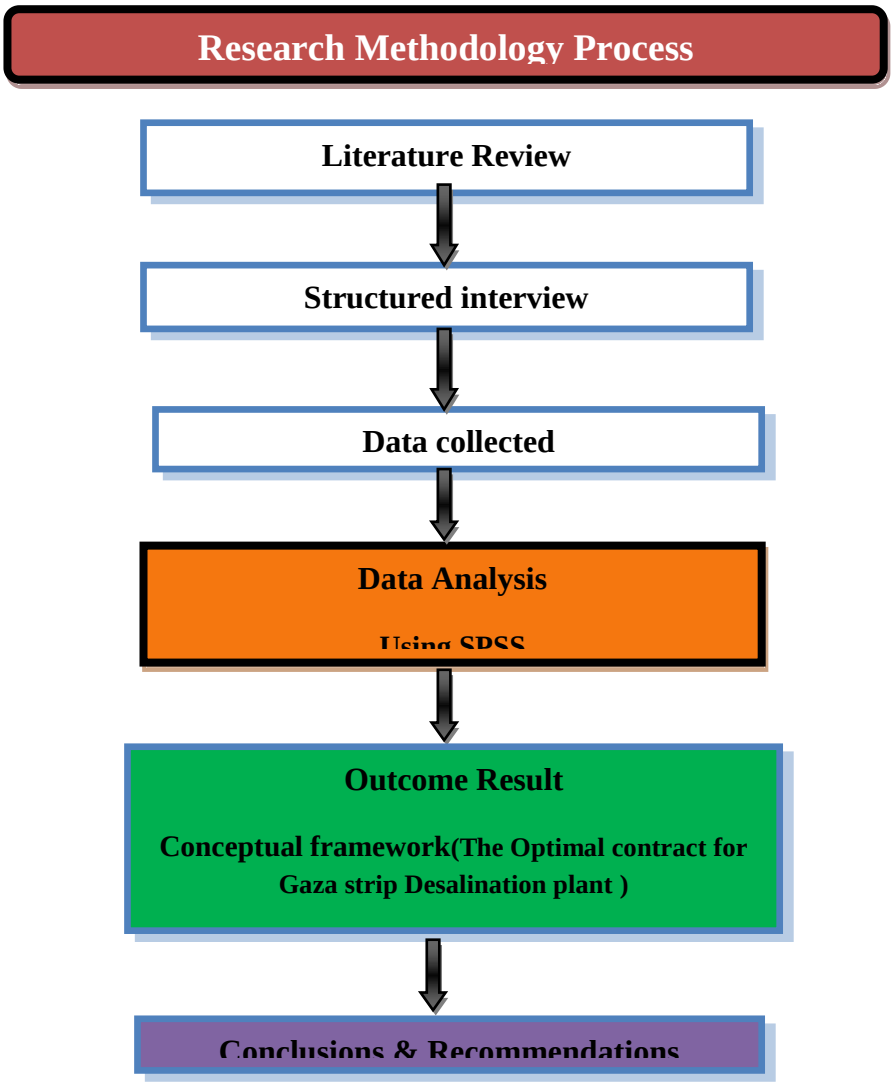

Figure (4.1): Research Methodology Process.

4.2 Data collection:

In this research, we use the primary data collected directly from the structured interview in addition to secondary data that collected from several sources such as scientific journals and academic magazines, thesis and scientific research text books and research papers, annual reports, news, Internet articles and websites, where these sources help in preparing the structured interview.

The data collected from the structured interview, which targeted to different stakeholders whose concern about water sector projects (will discuss in the next section). Also the data collection will be analysis through EXCEL sheet and main program Statistical Package for Social Sciences (SPSS) to determine the optimum contracting model and its criteria.

4.3. Population and Sample Size:

We have determined the population in this study using basically the local sources of data available in the reports and water management-related institutions. Also the local expert we have interviewed at the pilot phase provide us with the names and addresses of the organisations that are concern with the desalination and water management.

In total 40 interview structured was made, 30 questionnaire was with 75% response rate, were distributed as 25 respondents from the public organizations and experts, 5 respondents of the private sector, and

the donor apologies. Figure 4.2 shows the sample distribution taking into account different types of stakeholders

Figure (4.2): The sample distribution of different types of stakeholders.

1. **Government institutions:** Which is divided into two parts : Central government, such as Palestinian Water Authority (PWA), Water Sector Regulatory Council (WSRC), Ministry of Finance, Environmental Quality Authority, Ministry of Works - Tenders Department, Ministry of Agriculture. Local government, such as Municipalities (Gaza Municipality Nablus Municipality,Ya'bad Municipality)
2. **Non-private institutions:**Which is divided into two parts: profitable institutions such as Coastal Municipalities Water Utility (CMWU) and non-profit institutions called Non-governmental organization(NGOs) such as Palestinian Hydrology Group (PHG), Agricultural Development

Association (PARC) and Water and Environmental Development Organization (WEDO).

3. **Donors**:such as World Bank, JAIKA …etc.
4. **Private sector**: such as Palestine Development and Investment Ltd (PADICO), Technical Company for Engineering Consultancy, Association of Banks …etc.
5. **Experts**

4.4 Structured Interview Design and Content:

The structured interview was divided into two parts. The first part was oriented to the public sector and expert members to identify the needs of the public organizations from the desalination plants,the form of the PPP contraction and the specificities of the private partner, which finally lead to the selection of the optimal contract for the water sector project and determining the extent of private sector involvement and the nature of this participation,this structured interview is designed to include five indicators related to, financial matter, technical matters, institutional matters, and environment and social matters where these indicators evaluated according to different contracting model. (See Appendix A and B)

The second part targeted the private-sector to determine the desirability of the private to be involved in such project,the nature of this participation and what are the restrictions that prevent them from participating. (See Appendix C)

4.5 Data measurement and analysis:

Data collected from the structured interview, will be analyzed using the Statistical Package for Social Science (SPSS).

Two major statistical tools are employed in the analytical part:

1- Average weighting rate.
2- Average.

4.5.1 Average weighting rate:

This tool used to weighing the sustainability of each five indicators; financial matters, technical matters, institutional matters, social matters, and environmental matters based on ranking method that assign according to its importance in infrastructure projects such as desalination plant.

Therefore, the process of ranking was listed as 1= unimportant, 2= less important 3= moderately important 4= important 5= extremely important.

The processing of weighted average will be analysis individual because the indicators are different component of each other.As a result,during this process, the variation of different values in the indicators and their impact on the process of selecting the suitable contract for the desalination plant in the Gaza Strip will be appear.

4.5.2 Average tool:

This method is used to compute the arithmetic mean of the data collected during the structured interview based on the weighted average.

This process shows the highest average rate of each five indicators (where these include items). Also used through assessment process of these indicators and PPP types to select the optimal contract for the desalination plant.

4.6 The adopted methodology mechanism to reach to the optimal contract:

First: we will use an extensive literature review to abstract the most well-known PPP contacts that fit the Palestinian reality.

Second: we will use a five-criteria classification (sustainability) to classify each of the PPP contracts based on it.

Third: each of the classification (sustainability) criterion will be given a weight which is accounted using the respondnets answers who were asked to rate each of the criterion using a scale from 1 to 5 (high value is better).

Fourth: by multiplying each of the contract degree with the wighting average of the classification criterion, then we will have an average value for each of the PPP contracts based on the five sustainability criteria.

Fifth: by analysis process that will explained in detail in the next chapter, the optimal contract for desalination plant in Gaza strip will be determine.

Chapter Five

Results and Discussion

5.1 General:

Here, we analyze the collected data using the SPSS program in order to provide types of assessments. First, assessment of the importance rate for the sustainability of each of the five indicators: financial sustainability, technical sustainability, institutional sustainability, socio-economic sustainability and environment sustainability. Second, assessment of the sustainability of each of five indicators: financial, technical institutional, socioeconomic and environment.Third, assessment for the different contracting models based on the sustainability indicators. Finally, overall assessment of the different contracting models in order to determine the most optimal contract for seawater desalination in Palestine.

5.2 Weighting Rate for Each Type of Sustainability:

The respondents was asked to evaluate the five sustainability factors on a scale from 1 to 5, in order to give a weight for each of them. This is important later in this research to know which is the most proper PPP based on the five sustainability factors. In other words, it is expected that the relative importance for the sustainability factors is not the same for the respondents, therefore we asked the respondents to scale them. . Table 5.1

shows the result of different types of sustainability against to the weighting rate of importance.

Table (5.1): The importance of each type of sustainability methods using weighting average

Type of Sustainability	Weighted average	Weighted average %
Financial viability	0.82	82%
Institutional viability	0.76	76%
Technical viability	0.72	72%
Socio- Economic viability	0.62	62%
Environmental viability	0.59	59%

From table (5.1), 82% of the respondents evaluate the financial viability as the highest priority when selecting the PPP contract for the desalination plant. This might be explained by the high expected cost for the desalination plants due to the complex technology required and the needed related infrastructure.

The second priority was given to the institutional viability with 76%. This is related to the importance of having a clear institutional framework to organize the PPP projects and to ensure that such projects are profitable for the private sector. Due to the political situation in Palestine, many of the organizations classify the importance of laws and regulations in high priority.

The technical viability evaluated in the third priority with a 72%. As we have explained previously that the desalination projects requires complex or heavy technologies, therefore is very important that the private partner has the technical knowledge to implement the desalination plant.

However, socio-economic and environment viabilities are classified in the fourth and fifth priorities with 62% and 59% respectively.

5.3 Evaluation of the five sustainability indicators:

As we have mentioned previously that the evaluation process for the expected desalination plant will be based on five types of sustainability: Financial, Technical, Institutional, Socio-economic and environmental sustainability.

Here we describe the five sustainability indicators:

5.3.1. Financial viability analysis:

It refers to the financial analysis of the prospective PPP project along the project life time or value chain, including the establishment phase, operation, maintenance, etc.. This indicator is important to prepare for a financial plan which describes or evaluates the ability of the PPP members to mobilize the needed fund for the prospected PPP project. The analysis of financial viability for desalination projects enables decision makers or related organisaitons to determine the optimal contract which the project costs will be optimally covered.

The financial viability is determined using three main items:

1. The financial capacity to afford the capital cost of desalination (design, construct).
2. The Annual operation and maintenance cost

3. The level of recovery cost (the income from the desalinated water cost (revenues) and issues related to tariffs).

5.3.1.1. Assessment of Financial Capacity to Afford the Capital Cost of Desalination:

Figure 5.1 shows the analysis of data concern with the financial capacity for each of the suggested PPP projects (Traditional contract, Service and Management contract, Lease contract, Joint venture contract, Green field contract (concession contract) and divestiture contract).

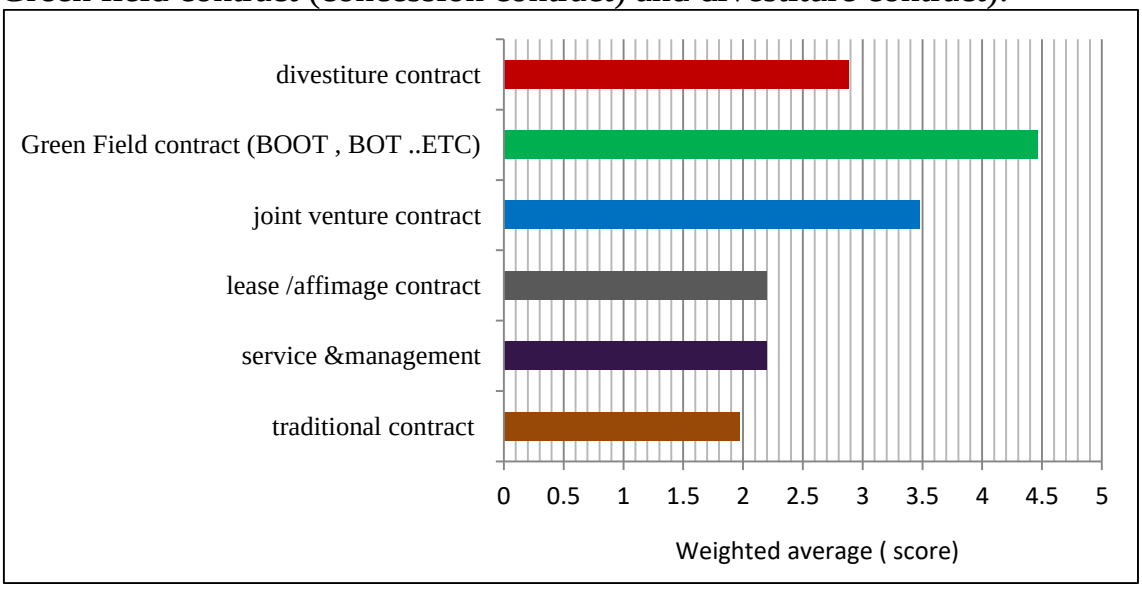

Figure (5.1): Financial capacity to afford the capital cost of desalination (design, construct).

The Green field contract got the highest score in regarding with its ability to provide the financial capacity, for the Joint venture contract and divestiture contract is classified second and third in the their ability to mobilize the needed resources for the desalination project. However, lease /Affermage contract, service &management contract, and traditional contract got low evaluations in regards with their financial affordability.

This is because these contracts based mainly on the funding from the public scotor which might be not the optimal choice for the public sector in Palestine who sufferes from a severe financial crise since more than 10 years.

5.3.1.2. Assessment of the annual operation and maintenance cost:

The operation and maintenance costs are divided into:

- Fixed cost: They are not relatedwith the production size (for example,salaries, renewal license costs, research and development costs, and insurance).
- Variable cost: They are associated with the size of production (raw materials, fuel, transportation costs and shipping of raw materials, and taxes)

Figure 5.2 shows the respondents evaluation for the operation and maintenance costs.

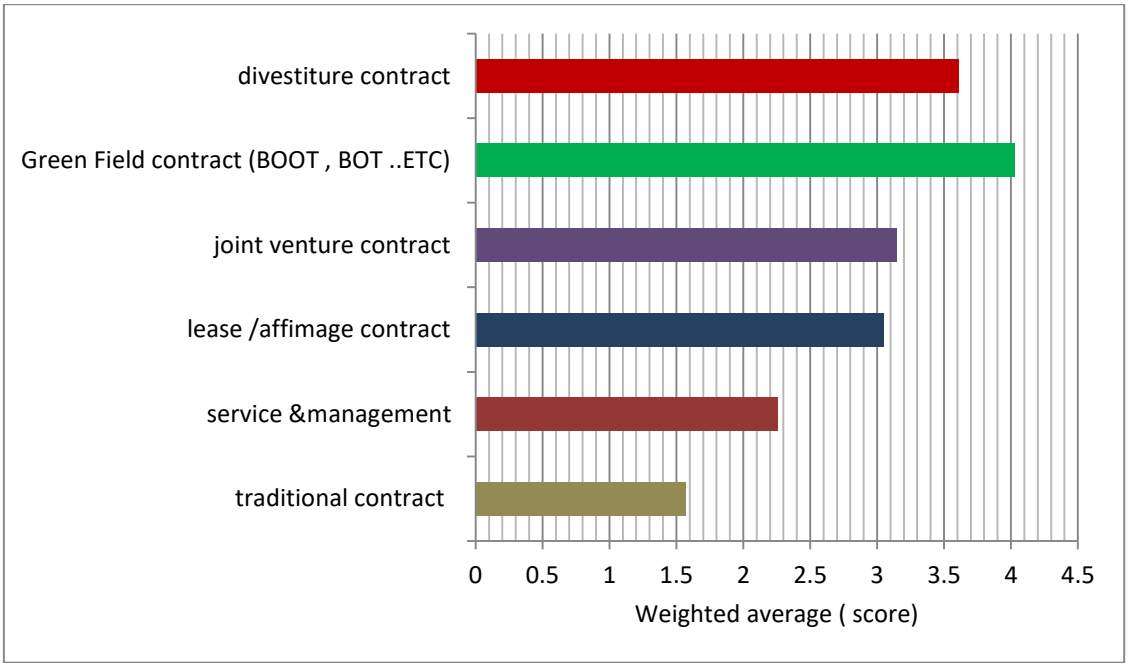

Figure (5.2): Annual operation and maintenance cost for Desalination plant.

Also Green Field contract is classified in the highest priority for the stakeholders, followed by divestiture contract, Joint venture contract, lease/ Affermage contract respectively.Service, management and traditional contracts are classified the lowest.

5.3.1.3. The Level of cost recovery:

It expalins the difference between the outcome from the desalinated water cost and expenditure during the construction, operation and maintenance period.This item express the success and continuity of the project.Through the analysis process, the optimum contract is that whichachieves the level of cost recovery of the project (capital cost, operation and maintenance cost).

Figure 5.3 show the result of this item against the different types of contracts.

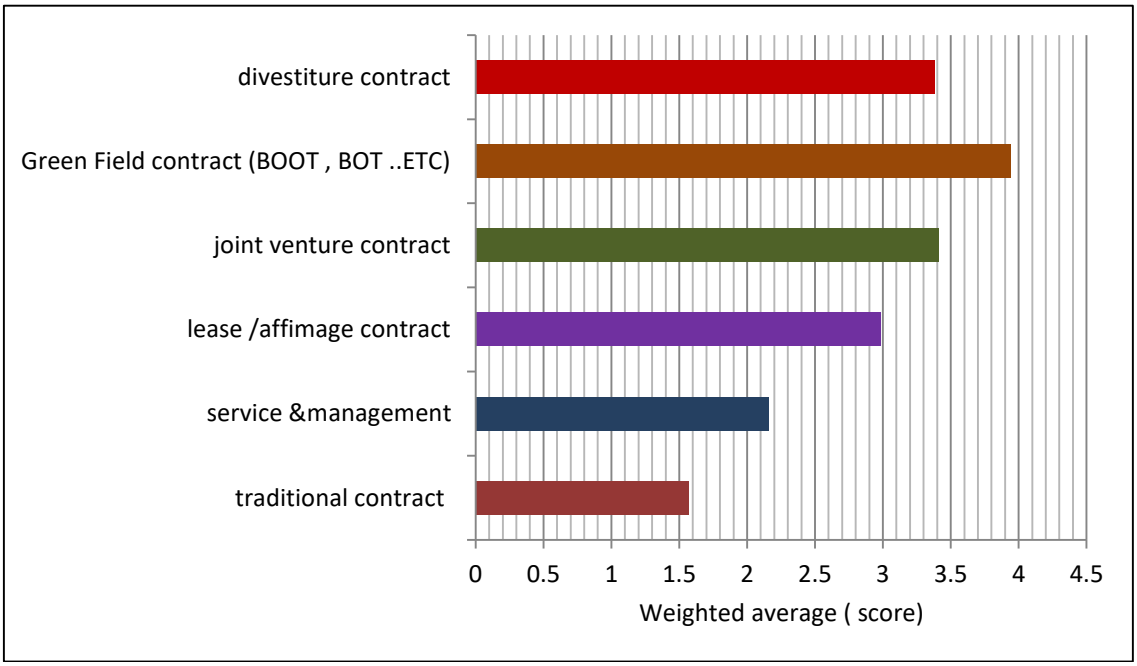

Figure (5.3): The level of cost recovery.

Also here the Green field contract is the first option for the respondents, followed by Joint venture contract, divestiture contract,lease/ Affermage contract respectively. The cooperation with the private sector in Green field contract is a a good strategy to recover the investment costs than the public sector not being able to recover thrigh public property.

After analysis the financial viability , the final result found in the three items that the Green field contract is classified at the highest priority than other contracts . The final Result refering to the structure of this contract which acheive financial sustainability of the desalination plant in Gaza strip and simulates the current situation in Gaza strip, where through Green field contract the private sector will carry the financial burden and mitigate them on the palestainan goverment .

5.3.2. Technical Viability Analysis:

The possible technical issues that might face a PPP project are:

1. The determinaiton of the the project requirement
2. Process and technology status that used in desalination
3. Management of the desalination process (construct, operate, maintain)
4. Evaluation of the desalination performance through operation period
5. The duration of the desalination project

5.3.2.1 Determination of the Project Requirement:

Amongs the technical issues in the preparation stages are the selection of employees, equipments, raw materials and transportation. The main objective here is to identify the contract form that alignement with the project requirement. Figure 5.4 provide the classification or evaluation of the PPP contractin regards with the project requiremnts of the technical issues.

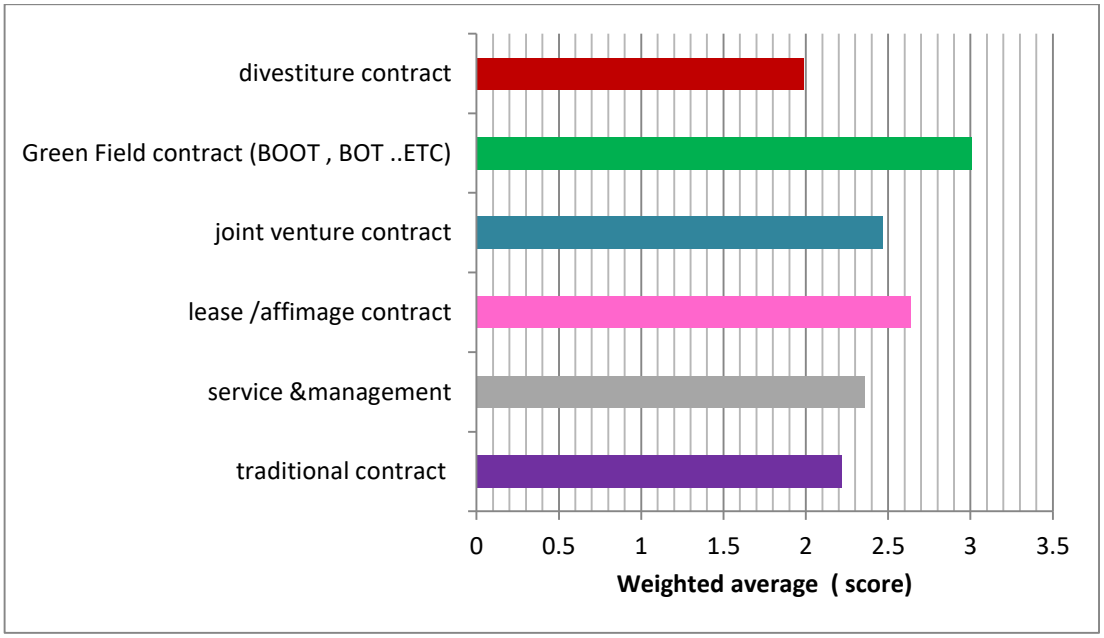

Figure (5.4): Determine the project requirement.

Result shows that Green field contract stay the optimal choice among the respondents to commit with the project requirements along the construction, operation and maintenance, followed by lease /Affermage contract, Joint venture contract , service and management contract and traditional contract respectively.

5.3.2.2 The Process and Technological Status:

Regrding the process and technological status, Figure 5.5.show the most preferred contract. It shows that the Green Field contract , divestiture contract, and joint venture contract are ckassified first, second and third respectively. This might be explained by the technical capabilities of the private firms which seen the most qualified organization for the provisition of such technical needs.

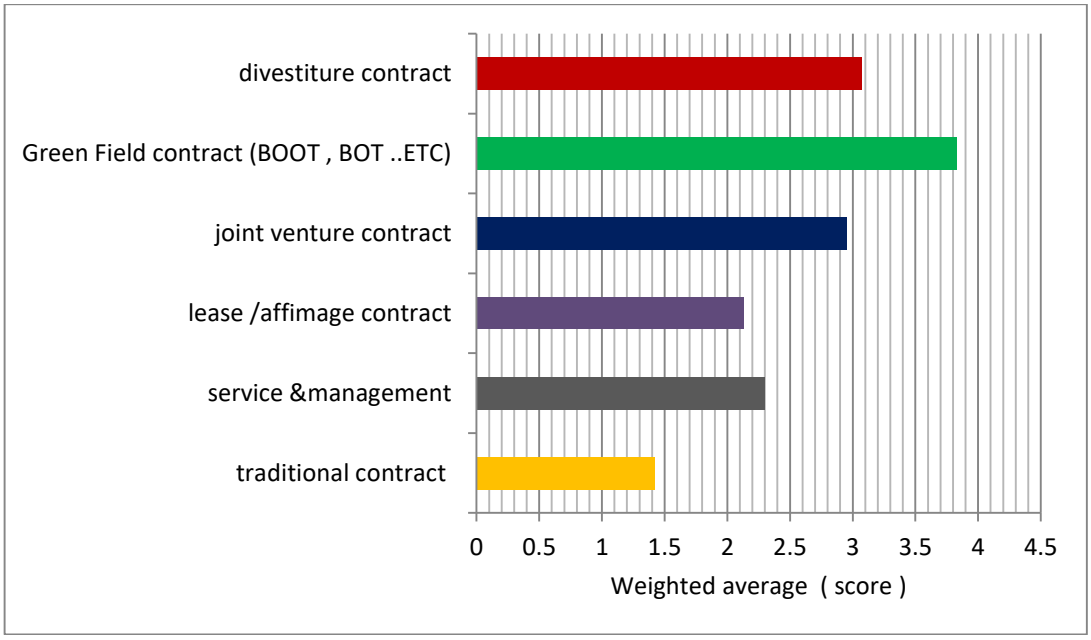

Figure (5.5): Process and the technology status that used in desalination.

5.3.2.3 Management requirments in the desalination process:

This item refers to which contract is more efficientin providing the experience in project management during the construction, operation and maintenance period (see Figure 5.6).

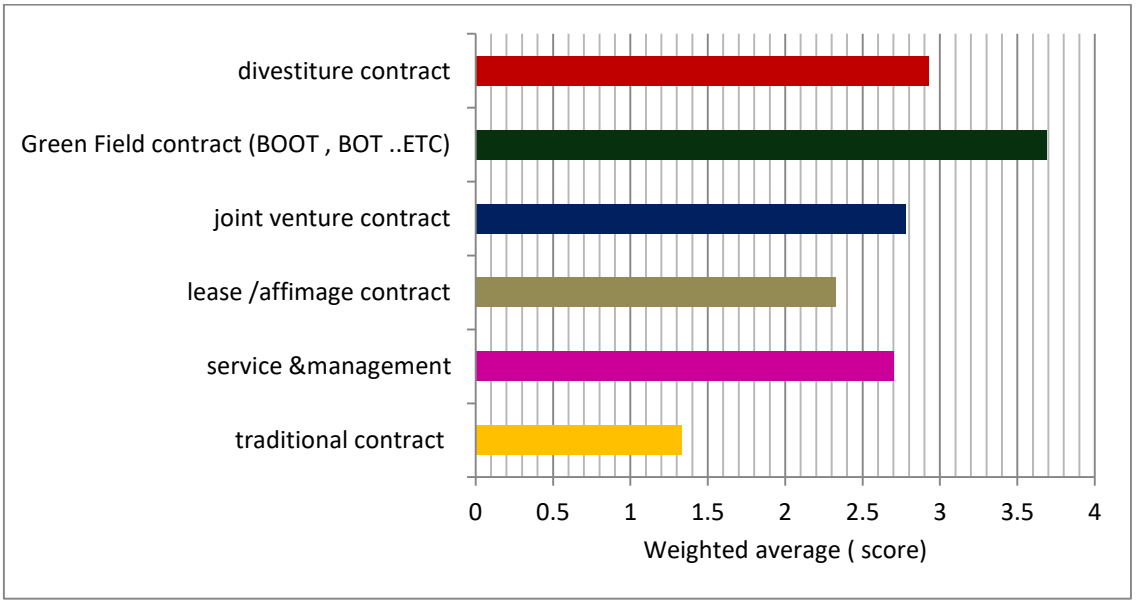

Figure (5.6): Management of the desalination process.

Also here theGreen Field contract is classified as a first choice for PPP in desalinationplant. This might be explained by the fact that private sector has more management skills in regrds with the public sector which suffers frombureacratuc issues and instability in regards with the managemenet structure.

5.3.2.4 Evaluation of the desalination performance during the operation period:

This item is intended to match the required specifications of desalinated water with water standard, public satisfaction and easy access to the service. (See Figure 5.7)

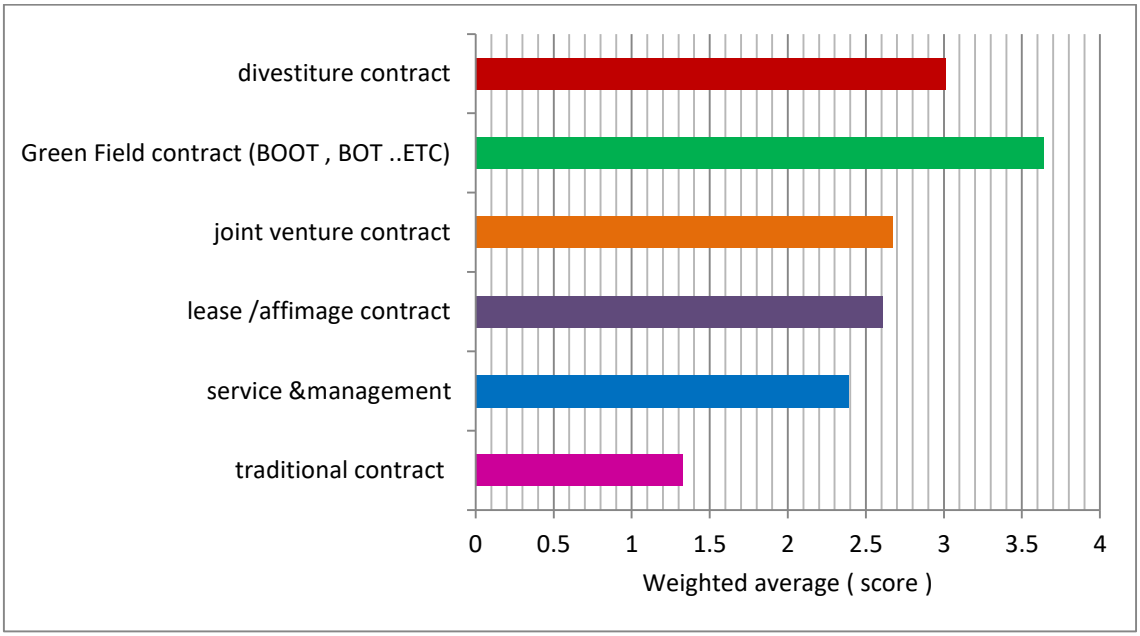

Figure (5.7): Evaluation of the Desalination performance during the operation period.

Figure 5.7 above shows that the respondents choose the Green Field contract at first priority that achieves this items and most suitable in Gaza strip followed by divestiture contract, joint venture contract, lease/

Affermage contract, service &management contract , and ftraditional contract respectively.

5.3.2.5 Evaluation of the desalination project based on its duration:

In this part we are interest in determining the PPP project based on its project duration needed for both operation and maintenance and to recover the value of the original investment. According to Figure 5.8, the green field contract has the first option to achieve the optimum duration of desalination plant and deal with time limitations .

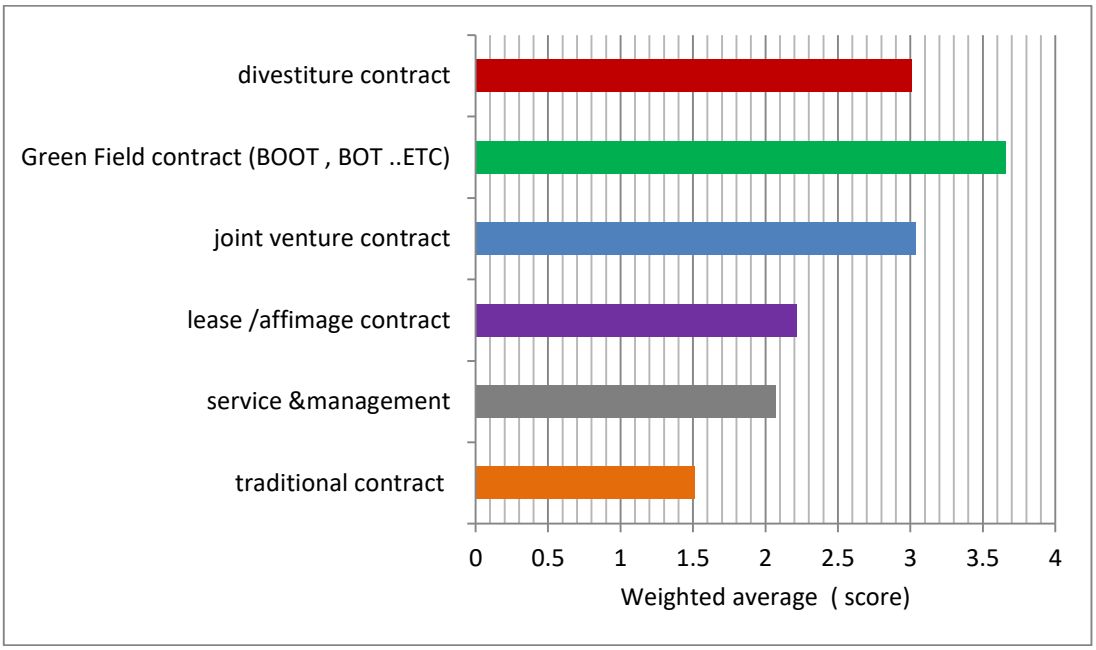

Figure (5.8): Duration of the Desalination plant.

By the end of the analysis process, the technical viability evaluated to find out that the decision-makers tend to participate the private sector effectively in technical matters for the desalination project than public sector , where this showed in the five items, by the Green field, joint

venture and divestiture contracts taking the highest values compared with the other contracts.

5.3.3. Institutional Viability Analysis:

It is intended to measurethe degree to which there isan institutional framework (laws, regulations, political support,etc) for the PPP. This includes:

1. The availability and complexity Legal structure for the PPP in desalination project.
2. The optimum model to attract investors to participate in the desalinationprojects.

5.3.3.1 The availability and complexity of the legal structure for PPP in desalination project:

This item will be analyze to choose the suitable contract where the legal structure of this contract has the ability to organize the investment process and carrying the risks related to desalination project Such as financial, social and environmental aspects of the Project ..etc (See Figure5.9).

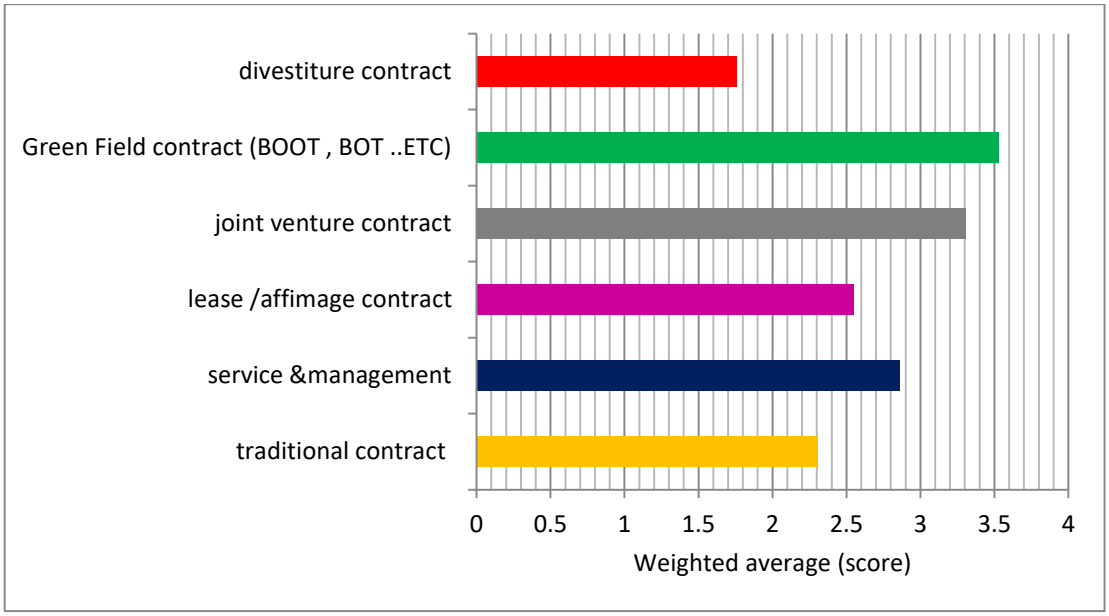

Figure (5.9): The availability and complexity of the legal structure of the desalination project.

As described in Figure 5.9 above the Green field contract takes the highest score that means the respondents gathers that this contract can controls on its conditions and has the flexibility to satisfy both partners. followed by the Joint venture contract, service &management contract, lease /Affermage contract, traditional contract respectively.

5.3.3.2 The optimum model to attract investors to participate in desalination plant:

The results of the analysis for this item was find out as shown in Figure (5.10).

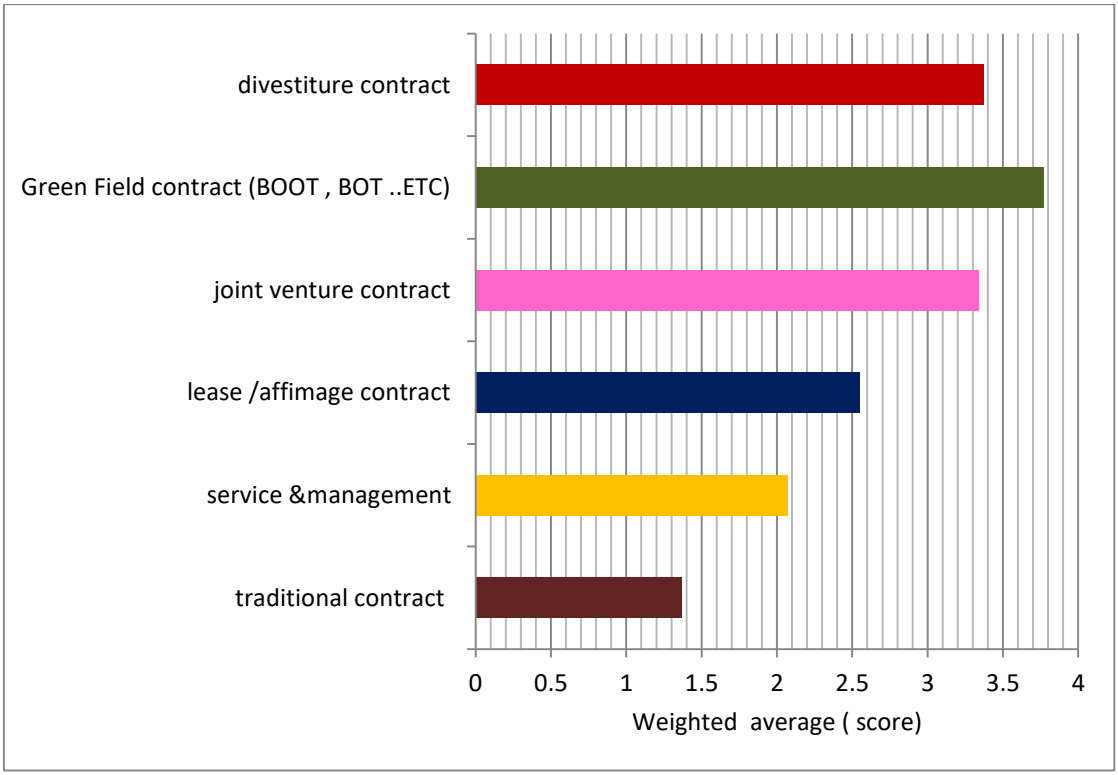

Figure (5.10): The optimum model to attract investors to participate in desalination plant .

As described in the Figure 5.10, the analysis process lead to green field contract with high score as the optimal contract to attracts investors to participate in the desalination plant and rising up the economic development. This is followed respectively by divestiture contract, joint venture contract, lease /Affermagecontract, service &management contract and traditional contract.

Finally, under the stream of the analysis of the institutional viability, decision-makers, preference to the all types of PPP contracts to involvement in investment projects such as desalination, where these contracts committed with laws and regulation and organize the establishment and operation process of desalination plant regardless to the variance of the structure of the PPP types.

5.3.4. Socio-Economic Viability Analysis:

The socio-economicviability considered one of the most fundamental indicators for the success and continuity of any project ,where it depends on the acceptance of the society about the investment project. This indicator is classifiedin two main items:

1. The interaciton between the PPP desalination project and the social life of the citizens.
2. Public satisfaction for thePPP desalination process.

5.3.4.1 The interaction between the PPP desalination project and the social life of the citizens:

As known desalination projects is vital project which effect positively on the economic development, especially on the social aspects of the citizens such as raise the standard of living, create job opportunities, and design aesthetic outlook around the desalination etc. So according to analysis process for this items , the results found Figure (5.11) below that the Green Field contract have the highest priority among the respondents to achieves this point , followedby service &management contract, joint venture contract,lease /affermagecontract, traditional contract and divestiture contractrespictevely.

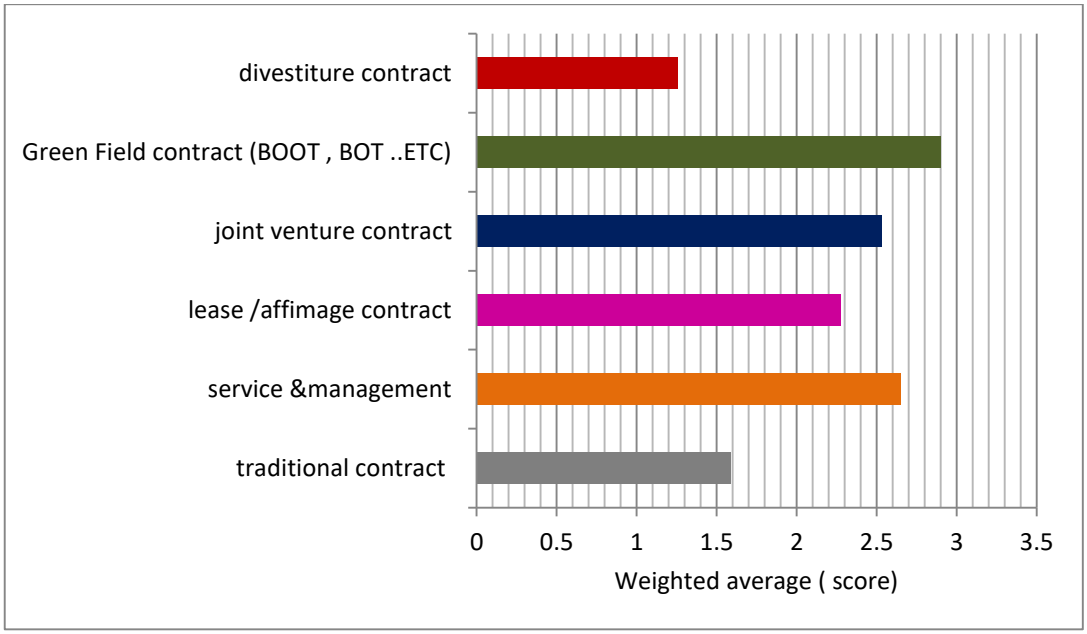

Figure (5.11): The interaciton between the PPP desalination project and the social life of the citizens.

5.3.4.2 Public satisfaction about the desalinationPPPproject:

Under the stream of the analysis process , the results of this item show in figure (5.12).

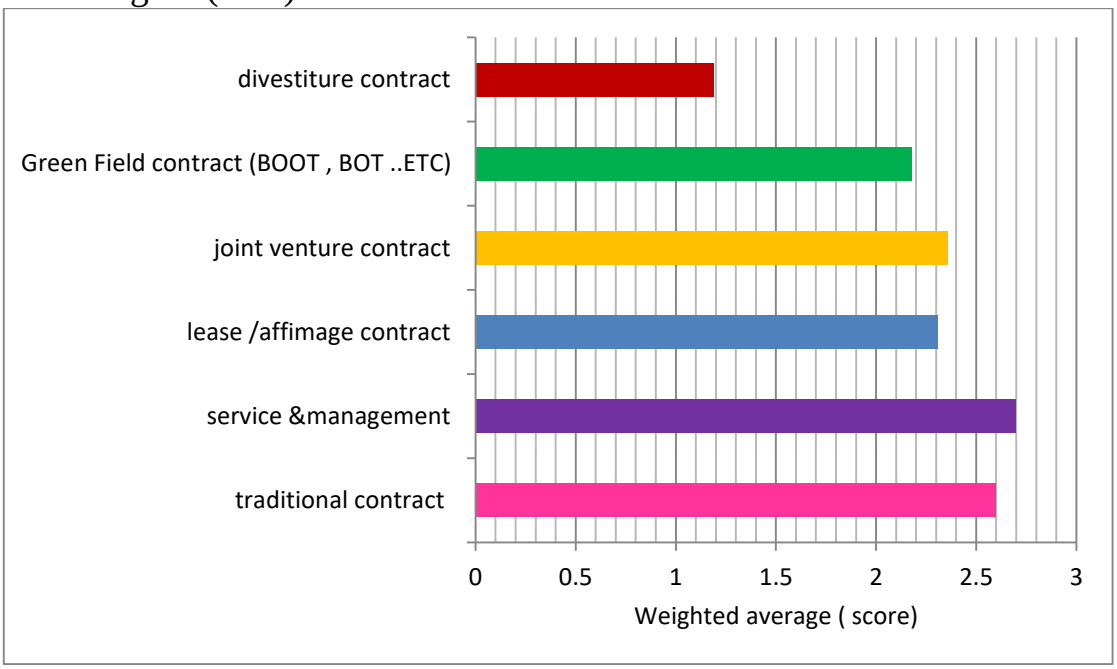

Figure (5.12): Public satisfaction about the desalination PPP project.

As described in Figure (5.12) the stakeholders preferred PPP contraction ,because the public sector concerns about the public satifiction than private sector whose in general concens about the revenues from the investment .So the results appered that the service and management contract and traditional contract take the highest scores than other contracts ,where the public sector is the major charge in these contracts .While others contracts followed respectively, depend on proportion of the private sector participation, Joint venture contract, lease /Affermagecontract, Green Field contract .

At the end , socio-economic viability analysis, two major points were discussed with different result for both. Despite that ,the private sector involvement is not a obstruction to satisfy the citizens , so if there is supervision and control from the public sector on the private sector work ,where they ensure the provision of good service the impact of these investment service projects on social life as desalination plant; raise the standard of living and the economy of the country... etc, especially in the Gaza Strip, which needs to revive economic and social life

5.3.5. Environment Viability Analysis:

The analysis is concern with the interaction between desalination project and the surrounded environment. The analysis process in this indicator is based on two items:

1. Assessing the effect of desalination project on the environment.
2. Reduce the negative impacts of desalination process

5.3.5.1 Assessing the effect of desalination project on the environment:

As shown in the Figure 5.13 below, the green field contract takes the first option for the respondents followed by joint venture contract, traditional contract, lease /Affermage contract, service &management contract and divestiture contract respectively.

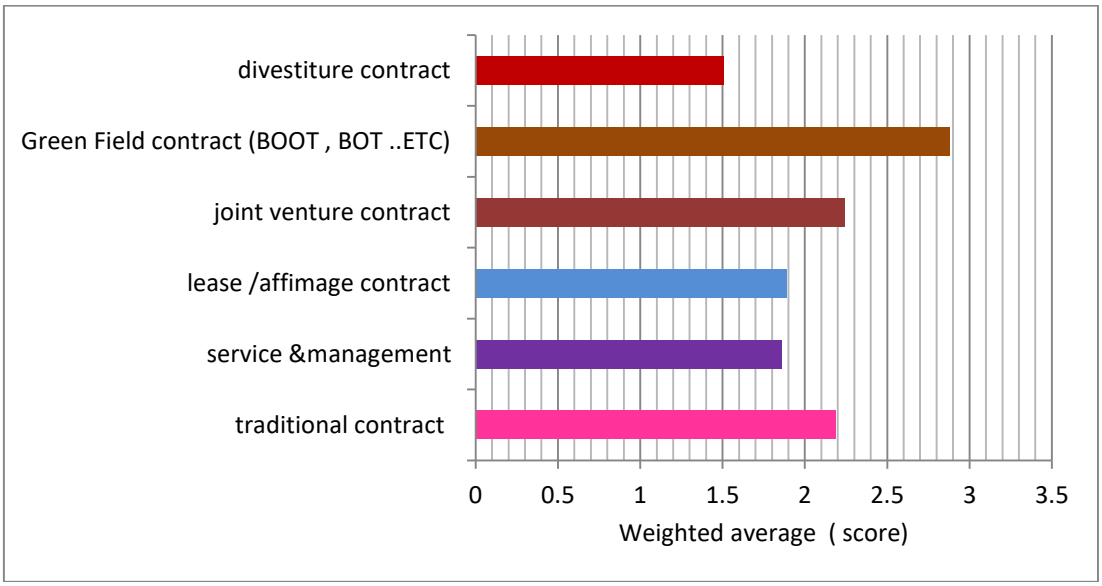

Figure (5.13): Assessment of the environmental impacts for desalination project.

5.3.5.2 Reduce the negative impacts of the desalination process:

This item will be analyzed based on different types of contracts to decide the optimal contract that reduce the negative impact on the environment . (Figure 5.14)

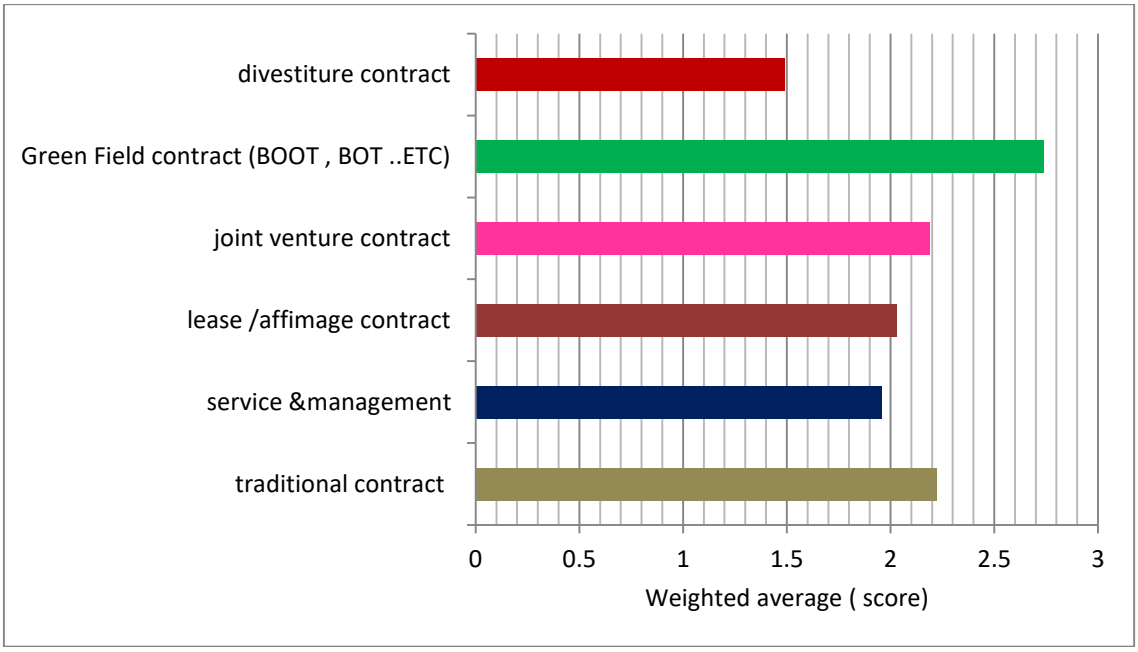

Figure (5.14): Reduce the negative impacts of the desalination process.

Figure (5.14) above show that the green field contract is in the highest priority for the respondents to reduce the negative impacts of desalination process and conserve the surrounding environment, where the private sector has the sufficent experience to deal with environment problems. It is followed by the traditional contract , joint venture contract, lease /affermage contract, and service & management contract.

5.4 Evaluation of thedifferentcontractingmodelsbased on the types of sustainability:

5.4.1 Evaluation of the traditional contract:

The traditional contract will be analyzed or evaluatedindividually based on different types of sustainability. Figure (5.15) shows that the environmental and socio-economic factors havethehighestevaluation. This might be related to the nature of the traditional contract which provided by

the public sector who mainly concen in improving the social welfare of the citizens, and socioeconomic and environmental issues lie in the core of public concern. Institutional viability came in third stage to regulate the responsibilities between partners and committed each partners of its duties, and financial and technical viabilities followed to ensure the project progress.

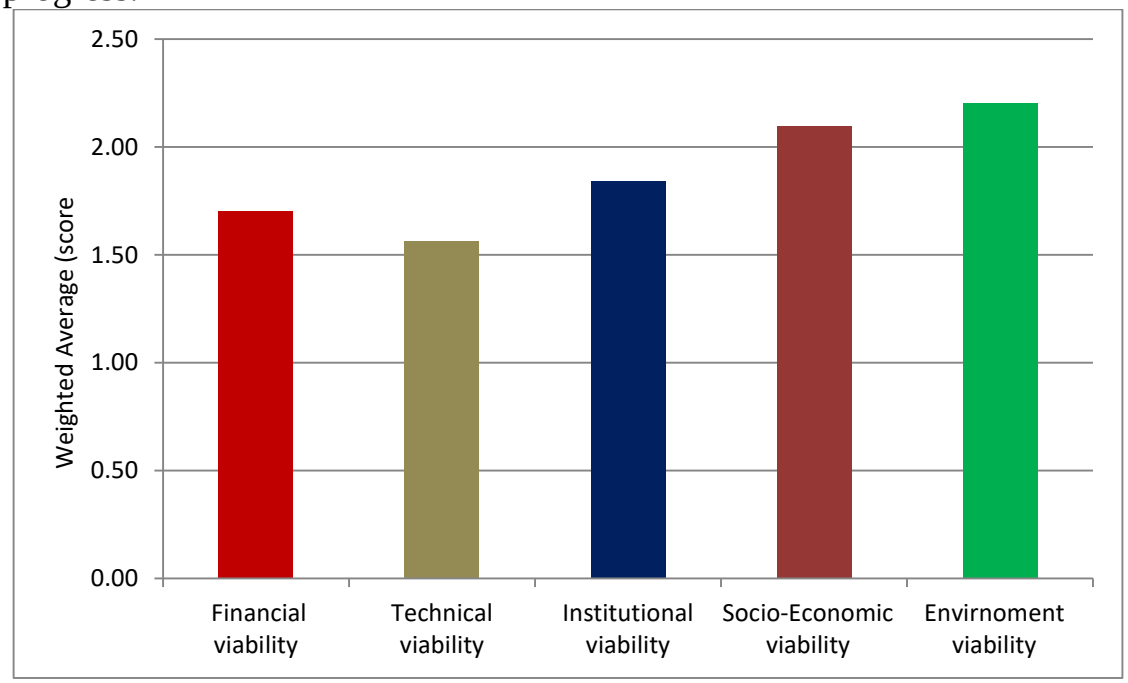

Figure (5.15): The weighted average of traditional contract based on the sustainability indicators.

5.4.2. Evaluation of the service and management contract:

The service and managementcontract will be analyzed to figure out the evaluation of each sustainability factor. Figure (5.16) shows that the socio-economic factor is also classified as a first priority in the service and management contract, followed by the institutional and technical, financial and environment viabilities.

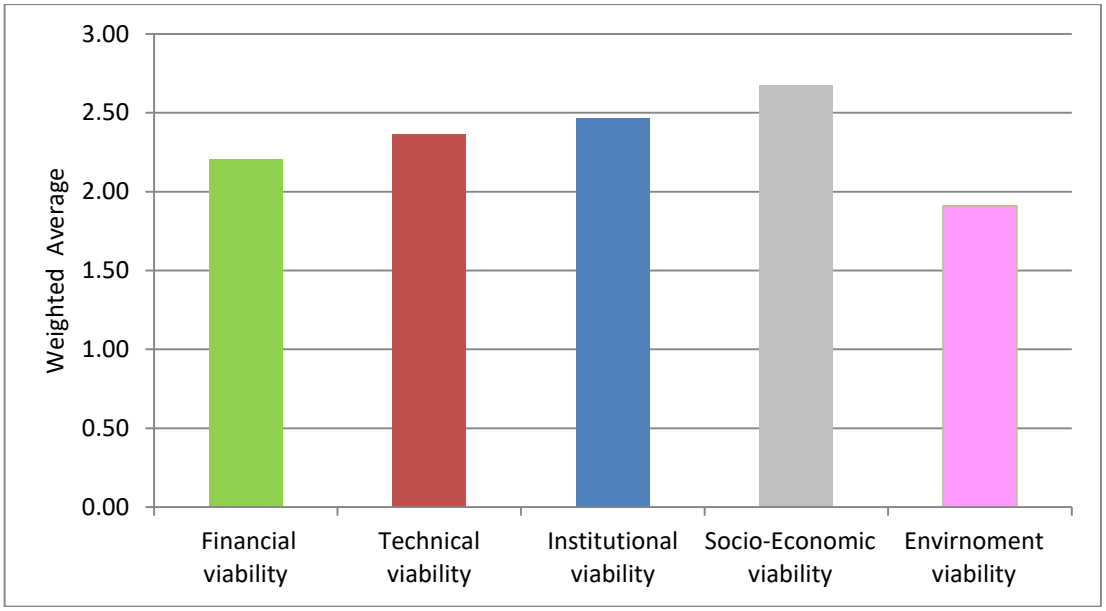

Figure (5.16): The weighted average of the service and management contract based on the sustainability indicators.

The public sector has the control over the management and service contrct, which means that it will be concern with the social and political related issues like the socio-economic and institutional issues. This contract has the same scenario with traditional contract but, what distinguishes from the traditional contract is utilized to manage or operate part or whole the project .

5.4.3 Evaluation of the lease and affermage contract:

The lease and affermagecontract will be analyzed against each type of sustainability. Figure (5.17) shows that the financial and institutional viabilities got the highest score, which make this contract different from the previous contracts . This might be explained by the nature of this type of contract where the private sector lease the facility from the public sector for operation and maintenance process against fixed fee and subject to the public regulation. Thus the legal and fininaicalissues is crucial for the

private sector to be involved in such PPP projects. This contract depends on the profit from the operation process, which used to cover the lease value, so if the performance of the service is good and satisfy the citizens, the private sector will be able to pay the lease value to government or the public sector who in charge of service and gains some revenues.

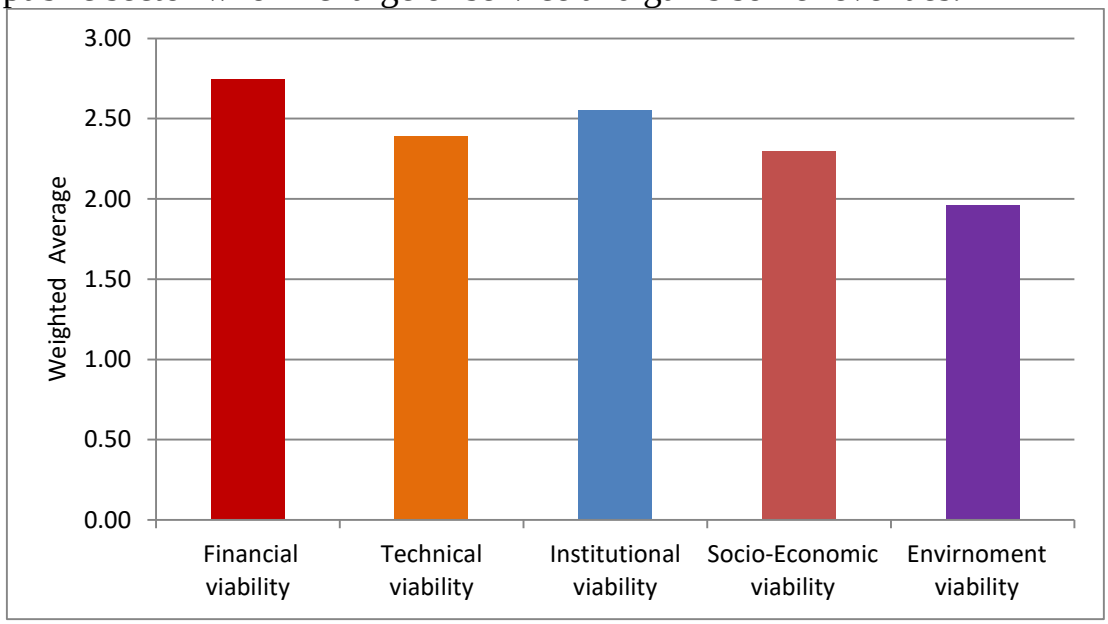

Figure (5.17): The weighted average oftheAffermagecontractbased on the sustainability indicators.

5.4.4. Evaluation of the Joint venture contract:

The Joint venture contract will be analyzed individually against eachtype of sustainability (see Figure (5.18)).

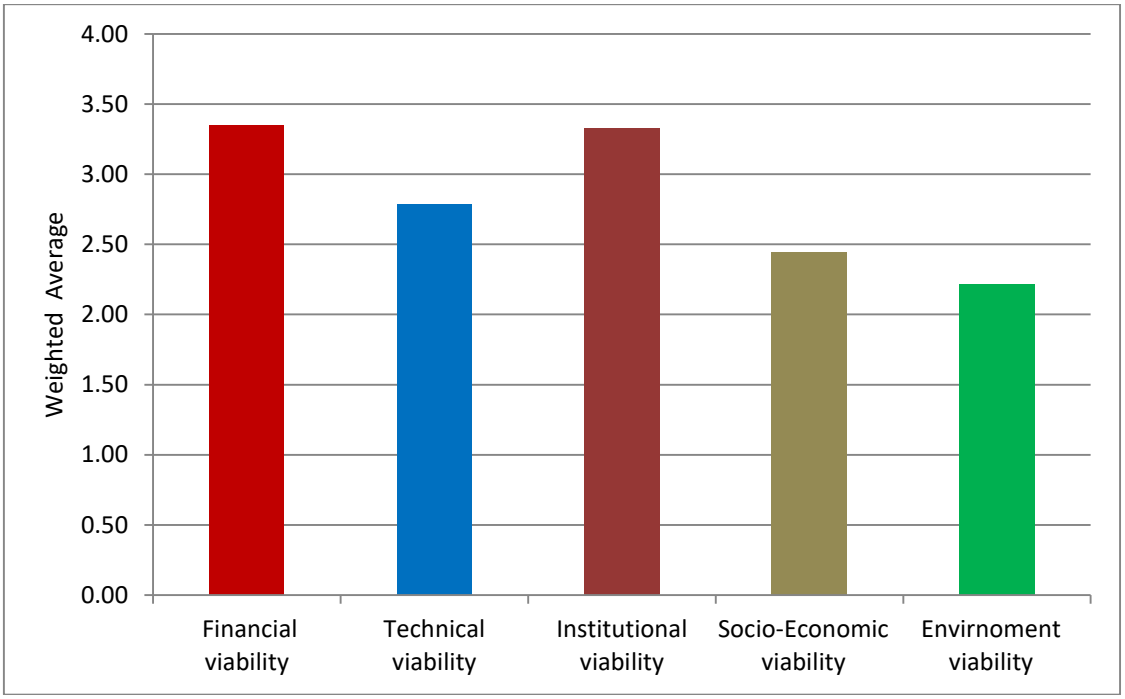

Figure (5.18): The weighted average ofthe joint venture contract based on the sustainability indicators.

As describe above ,Results show that the financial and institutional viabilities have the highest weighting average in comparision other sustainability factors.Joint venture contract based on the sharing of responsibilities between the private and the public sectors with equal proportion or with agreed proportion for the establishment and operation of the service project.Therefore,the financial, legal and institutional matters mustmanefists themselves.

5.4.5. Evaluation of the Green field contract:

The Green Field contract is also analyzed against each type of sustainability (see Figure (5.19)).

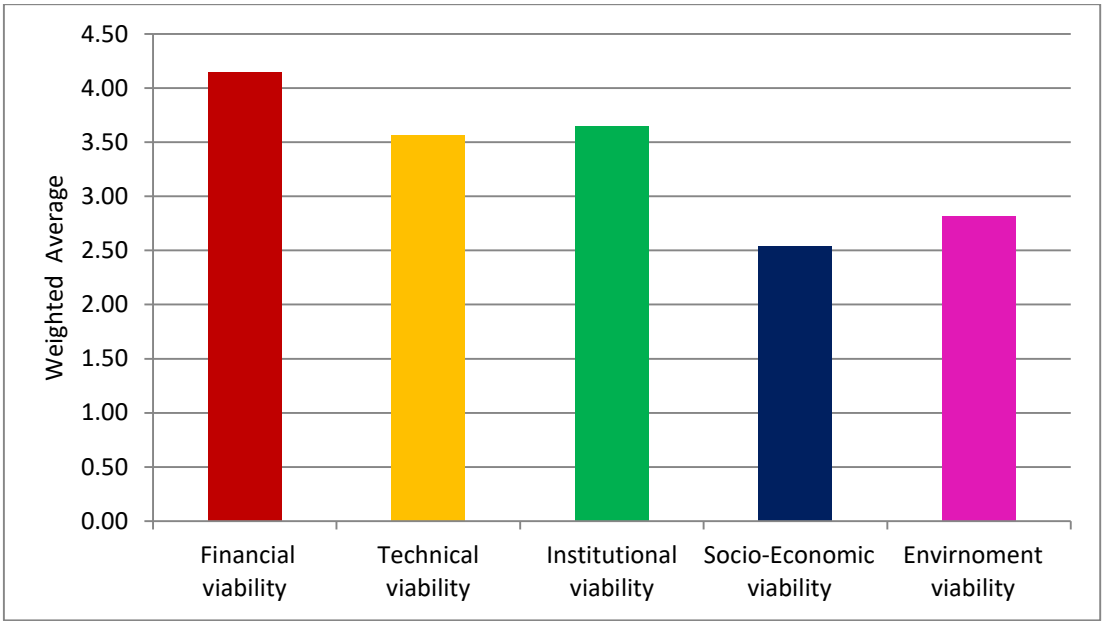

Figure (5.19): The weighted average of the green field contract based on the sustainability indicators.

The Results shows in Figure (5.19) above denot that the financial viability got the highest weighted average, followed by the institutional and technical viabilities ,finally the environmental and socio-economic viabilities. This refers to the nature of the greenfield contract or concession where the private sector involve in the project works from the establishment point to the end and through the operation process, which means thatthe private sector should be concern with the financial and technical matters and carries the project riskswithout any participation from the public sector in the project duties. The role of the public sector is concern mainly withthe supervision and provide the regulation and the standard for the provided service.

5.4.6 Evaluation of the divestiture contract:

The divestiture contract will be analyzed against each type of sustainability. Figure (5.20) represents the evaluation output. The financial viability got the highest score followed by institutional and technical viability. The divestiture contract is completely different from other contracts since it is a commercial contract based on purchase of assets of the utility or service from governments, which explains the concern of the private sector in the financial issues.

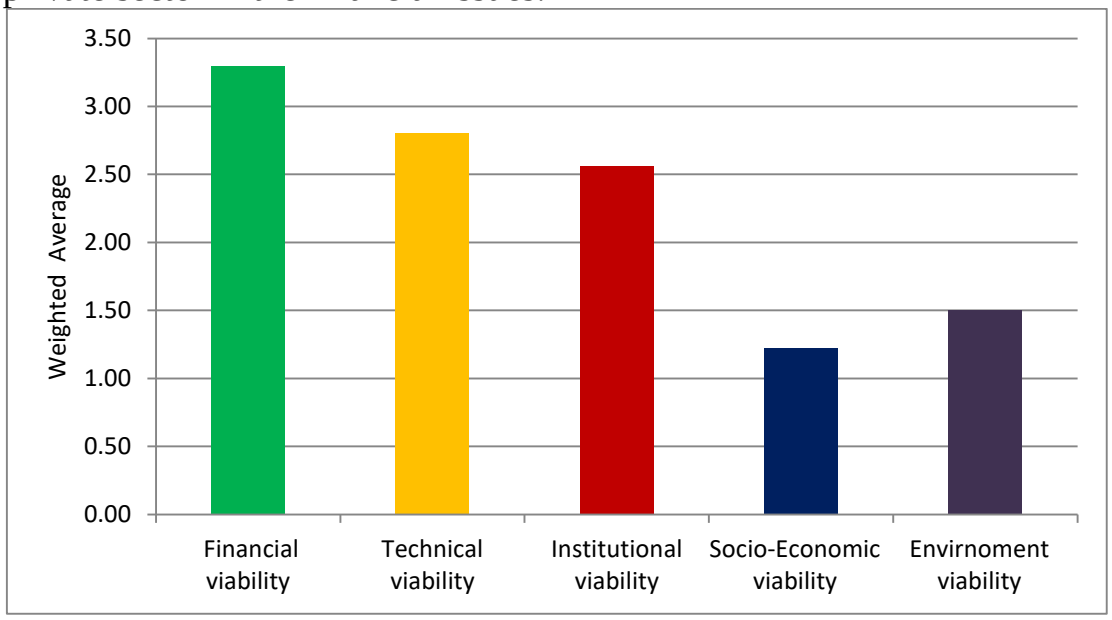

Figure (5.20): The weighted average of the divstature contract based on the sustainability indicators.

5.4.7 Overall evaluation of the different contracting model:

Here in this part we present the overall evaluation of each type of contracts against the five sustainability factors(see Figure 5.21).

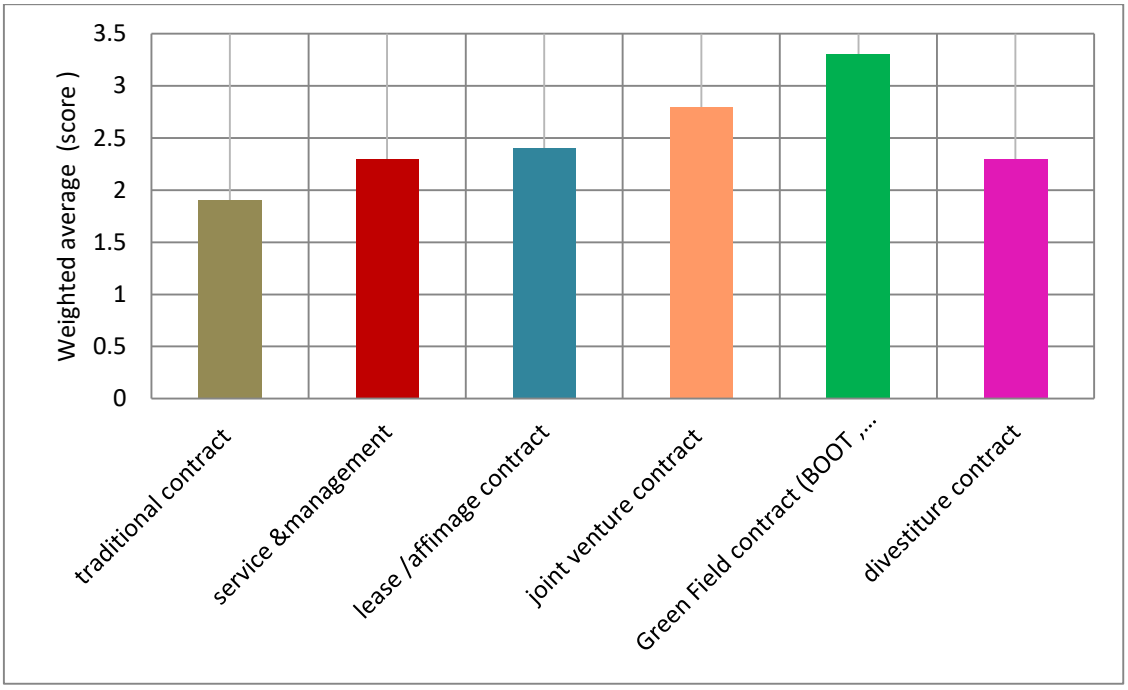

Figure (5.21): The evaluation of the different contracting models for the desalination plant based on sustainability.

As shown above the concession contract (Green field) got the highest weighted average among the other contracts. Concession contract (greenfield) has different typesas mentioned in chapter two,Build-Operate-Transfer (BOT) is one of the most well-known contract type and most frequently used especially in developing countries. It's an arrangement stand on build the service or the project and operate it by the private sector against revenues gains during the contract period that extend between 25-30 years.At the end of the contract period , the service transfer to the public sector (see figure 5.22 below).

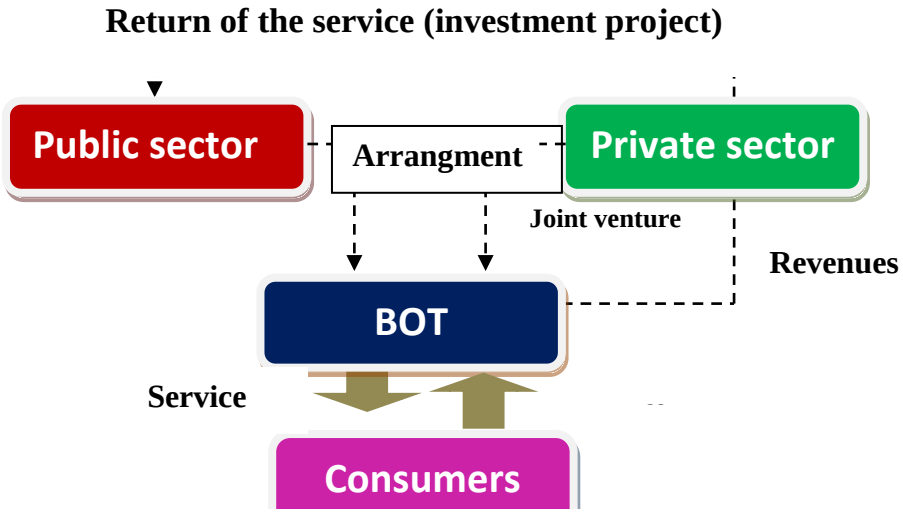

Figure (5.22): BOT contract structure

The private sector provide the financial resources and reduce the financial burden on the public budget also private sector operate the service, thus the efficiency is expected to be improved, and affect positively on the satisfaction of the consumers and on the sustainablity of desalination.In addition BOT would help to facilitate the transfer of technology between countries such as the technology used in the desalination plant.

Figure (5.23) below describes the general framework of the concession contract based on thefive main components: financial, institutional, technical, environmental and social matters.

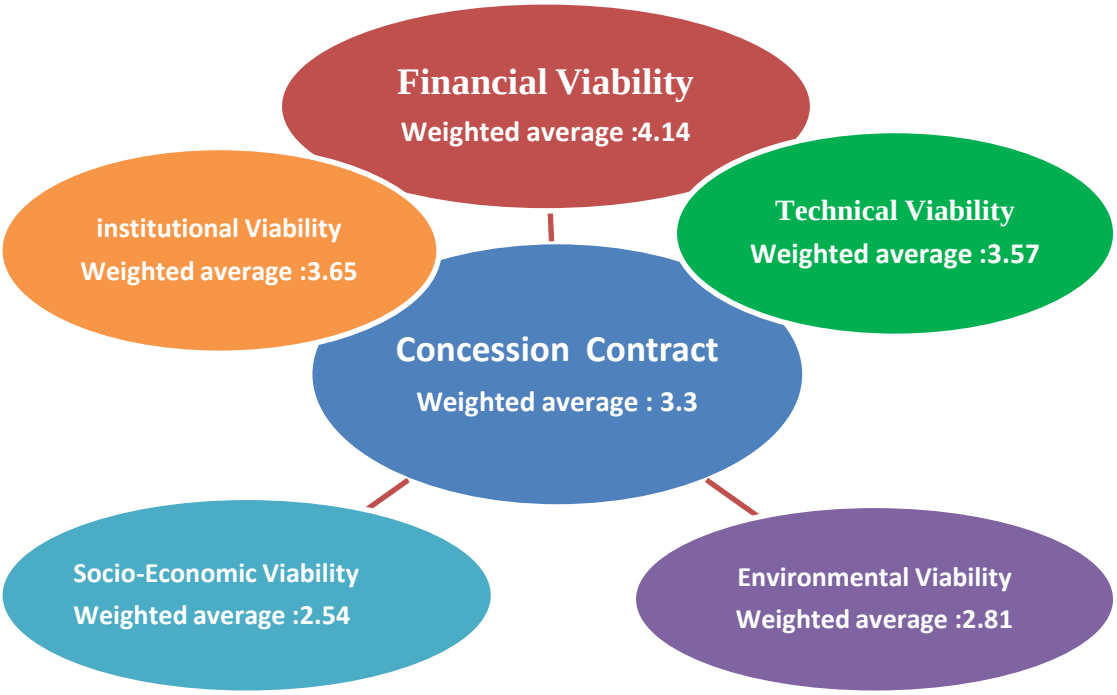

Figure (5.23): The framework of concession contract (Green field contract).

As shown above, the structural framework of the concession contract distributed based on the effect of each components on the contract with weighted averages close to each other and without matching any of these components. Therefore, the structure of this contract holds the private sector fully responsible for any project , which is appropriate for raising the level of economic growth in countries especially in developing countries that have financial deficit to build infrastructure projects such as the desalination plant in the Gaza Strip.It needs large funding .technical and institutional techniques, such as the management and operation of desalination plants and carried the risks resulting from the project Such as preserving the environment, continuity of the project, satisfaction of citizens, and the political situation as in the Gaza Strip.

Concession contract, especially BOT contract has long experience in desalination plant and its play effective role in water infrastructure as mentioned in chapter two, compared with the previous types of contract.

The traditional contract can be a good option for governments have Adequate budget to bear the financial burden, Technical and institutional techniques for the establishment and operation of such a large scale project like desalination plants.If not, it will be bad choice. Besides.,service and management contract the same scenario, but it's dedicated for a certain stage, which means managing a particular part of the service under the supervision of the public sector.In addition , lease and affermage contract dedicated for operation and maintenance process only and is considered a good option for this stage where the governments didn't have enough capacity to operate the project and gave up its responsibilities for this stage and lies in the private sector.

Joint venture contract, follow as a second option for desalination plants as shown from figure 5.22 where its principle stand on sharing all the tasks of the project such as desalination.

However, this option depends on the nature and the capacity of the governments to sharing with private sector all theresponsibilities of a large scale project such as desalination or not.

The divestiture contract was considered by decision-makers as being excluded because it is based on the purchase of the assets of the service and its control.This means the cancellation of any interference by the public sector with this service. This is totally unacceptable because water is a public property and not exclusive to anyone.

Chapter six

Conclusion and Recommendation

6.1. Research Conclusion:

- This research focuses on determining the optimal contract for desalination plant in Palestine and the extent to which the private sector might be involved either in establishing, operating and/or preserving the sustainability of the desalination plant .
- This was enabled by collecting data through using interviews structures that targeted with a sample of organizations in the field of water sector in West Bank and Gaza Strip.
- The selection process for the optimal PPP contract was based on five indicators: financial, institutional, technical, socio-economic, and environmental viabilities.
- After analyzing the data using the software SPSS, we found that the concession contract (Green field contract) is the most optimal choice (best) for the respondents with a 3.3/5 weighted average .
- The concession contract has the elasticity and the specificities to handle with the possible political, economic and social challenges that might face the desalination project in Palestine .

6.2. Research Recommendation:

- Choosing PPP in vital projects, especially as a desalination project in the Gaza Strip, will improve efficiency of service, raise the sustainability of the project, increase the economic growth in Gaza Strip and raise life standards through creating job opportunities…etc.
- Monitoring and earning the knowledge through PPP has positive effect on service where the private sector can bring the required technology for desalination project and enable the stakeholders in Gaza Strip to face the challenges and control of the difficulties in the stages of the project
- Selecting the appropriate contracting models for a infrastructure project , should consider the following issues; financing requirements the legal, regulatory, institutional frameworks, technical requirements, stakeholder concerns, the customer's needs from the service and the environment matters.
- Creating a clear and transparent process between public and private sectors will affect the success of PPP .
- Concession contract (Green field contract) / BOT approach, proves a successful experience in developing and financing infrastructure projects as a desalination plant, especially developing countries which has financial deficit and lack of technical matters such as Palestine, Gaza Strip.

- Attracting the private sector to involvement in infrastructure project in developing countries, especially in Palestine, Gaza strip support in the following fields:
  - Social environment: The government improves the social environment by taking into account of citizens' concerns and to disseminate sufficient awareness about desalinated water to satisfy the citizens.
  - Financial environment: through gives the private sector guarantees, for example the revenue through the investment process a gainst the financial risks that the private sector will involved in such larg and risky project as desalination project.
  - Legal Environment:The government ensures laws and legislations facilitated the investment process for the private sector. Besides, the contracting models must be clear and strict to guarantee the rights of the parties involved in the desalination project and follow and commitment with the conditions and standards of the public sector for desalinated water.
  - Political environment:It is possible for the government to seek the support of insurance companies such Multilateral Investment Guarantee Agency (MIGA), followed to world bank and export credit agency (ECAs) that could cover certain political risks.

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Appendix (A)

I: Interview Structure for public sector organization and expert members

رتب العناصر الاتية اعتمادا على اهميتها في مشاريع البنية التحتية (محطات التحلية المياه)

بحيث

1= مهم جدا ، 2= مهم ، 3= معتدل الاهمية ، 4= اقل اهمية ، 5= متدني الاهمية

*** الامور المالية**

*** الامور الفنية**

***الامور االمؤسسية (السياسات ، القوانين)**

***الامور الاجتماعية**

***الامور البيئية**

Appendix B :

Interview Structure for public sector orgnazation and expert members

برايك ماهو العقد المفضللمشروع محطة تحليةمياه في غزة وذلك لكل نقطة من النقاط المذكوره ادناه والتي تندرج تحت بند من البنود الاتية مع تقييم البنود وايضاح السبب بحيث يتم تقييم بترتيب العقود بحسب الافضليه من (6-1) ((حيث رقم 6 يمثل اعلى قيمة ورقم 1 اقل قيمة))	عقد تقليدي (Traditional contract) العقد المتعارف عليه والذي يتم به اختيار المقاول من خلال عملية العطاء	عقد الخدمة والادارة (Service &Management contract) العقد الذي يتم من خلاله الاتفاق مع شركة خاصة لادارة جزء من االمنشاة	عقد الايجار (Lease/Affermage contract) العقد الذي يتم به تأجير المنشاة لشركة خاصة لادارة المرحلة التشغيلية وصيانة المنشاة	عقد الشراكة Joint venture contract العقدالذي يتم من خلاله ادخال شركة خاصة تساهم بنسبة قد تصل الى 50% من اعباء واعمال المشروع كشريك ثان	عقد الامتياز Concession /Greenfieldcontract) BOT العقد الذي يتم من خلاله توكيل شركة خاصة بتحمل الأعباء والتكاليف للمشروع خلال فترة البناء والتشغيل الى فترة متفق عليها ثم ارجاعه للمالك الاصلي للمشروع ولكن تحت اشراف الجهة المسؤولة عن المشروع	عقد الخصخصة (Divestiture Contract) بيع اصول المنشاة او المشروع للقطاع الخاص بحيث له المسؤولية المطلقة عليه
البند الاول : الامور المالية						
التكاليف الاستثمارية للمشروع						
التكاليف التشغيلية للمشروع						
العائد المادي لتحقيق مستوى استرداد الاستثمار						
تقييم البند بحيث يتم ترتيب العقود من ناحيه الافضليه (6-1)	1	4	3	5	2	**6**
الرجاء ذكر سبب التقييم						
البند الثاني : الامور الفنية						
تحديد احتياجات المشروع الخدماتي : موظفين ، الالات ، مواد : وسائل نقل وغيرها						

تحديد اسلوب اقتناء التكنولوجيا ومدى المعرفة بالتطورات التكنولوجية المستخدمة للمشروع : يقصد بها نوع التكنولوجيا المستخدمة للمشروع ومدى المعرفة بها						
ادارة المشروع خلال فترة الانشاء او التشغيل : يقصد بها الخبرة الكافية في مجال ادارة المشروع الخدماتي						
تقييم جودة الخدمة : يقصد بها مطابقة للمعايير والمواصفات المطلوبة .بالاضافة ارضاء الجمهور وسهولة الوصول للخدمة						
الفترة الزمنية : يقصد بها الفترة الزمنية لانشاء المشروع وتنفيذه وتشغيله وصيانتةبالاضافة الفترة الزمنية الفترة الزمنية اللازمة لاسترداد قيمة الاستثمار الاصلي						
تقييم البند بحيث يتم ترتيب العقود من ناحيه الافضليه (1-6)						
الرجاء ذكر سبب التقييم						
البند الثالث: الامور القانونية						
الهيكل القانوني للمشاريع الخدماتية لتنظيم عملية الاستثمار وتحمل مخاطرها من نواحي تحمل اعباء التكاليف للمشروع وتقديم الخدمة بافضل جودة وسعر مناسب للجمهور والمحافظة على البيئة المحيطة						
النموذج الامثل لجذب الاستثمارات ورؤوس الاموال لتطوير مجال مشاريع خدماتيه و مدى اهمية خصخصة المشاريع في هذا المجال للدفع في التطور السريع في مثل هذه النوعيه من						

المشاريع						
تقييم البند بحيث يتم ترتيب العقود من ناحيه الافضليه (1-6)						
الرجاء ذكر سبب التقييم						
البند الرابع : الامور الاجتماعية						
الاثار المترتبة على الحياة الاجتماعية للمواطنين من خلال هذه المشاريع الخدماتية : يقصد بها تعزيز رفاهيه المستخدمين والسكان من خلال توفير مصادر اضافيه للمياه من خلال المشاريع الخدميه بسعر معقول مما يزيد من تحسين نوعيه حياه السكان امكانيه اقامه مشاريع مرتبطه بمشاريع خدماتيه مما يوفر فرص عمل اضافيه وبالتالي رفع مستوى حياه السكان اجتماعيا واقتصاديا						
مدى تقبل المواطنين لهذه المشاريع الخدماتية						
تقييم البند بحيث يتم ترتيب العقود من ناحيه الافضليه (1-6)						
الرجاء ذكر سبب التقييم						
البند الخامس : الامور البيئية						
تقييم الاثر البيئي للمشروع						
معالجة الاثار السلبية للمشروع الخدماتي						
تقييم البند بحيث يتم ترتيب العقود من ناحيه الافضليه (1-6)						
الرجاء ذكر سبب التقييم						

Apendiex (C)

Interview Structure for private sector

- **هل سبق وساهمت في مشاريع خدماتيةاستثمارية في مجال البنية التحتية ؟**

نعم ○ لا ○

- **اذا كانت الاجابة بنعم ماهي نوع المساهمة ؟**

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

- **ما هي الدوافع التي تجذبك لمثل هذه المشاريع(بنية تحتية) ؟**

1. **طبيعة الاستثمار (ذا عائد مالي جيد)**
2. **مناخ الاستثمار في الدولة (الاستقرار السياسي ، القوانين المفروضة على الاستثمار**
3. **القدرة على تنفيذ او مشاركة بمثل هذه المشاريع**
4. **تعميق علاقات الترابط الاقتصادي مابين القطاع العام والخاص**
5. **غير ذلك**

- **ماهي الخدمات التي يمكن ان تقدمها للمسؤول عن هذه المشاريع الخدماتية استثمارية (بنية تحتية) عند مشاركتك فيها (سابقا او مستقبلا)؟**

1. **خدمات مالية**
2. **خدمات تشغيلية**
3. **خدمات ادارية**

4. **خدمات اجتماعية**
5. **خدمات بيئية**

- **. هل أنت مهتم بدخول مشاريع خدماتيةاستثمارية في مجال البنية التحتية ضمن عقود الآتية مع ذكر السبب ؟**

نوع العقد	**عقد تقليدي (Traditional contract)** العقد المتعارف عليه والذي يتم به اختيار المقاول من خلال عملية العطاء	**عقد الخدمة والادارة (Service &Management contract)** العقد الذي يتم من خلاله الاتفاق مع شركة خاصة لادارة جزء من االمنشاة	**عقد الايجار (Lease/Affermage contract)** العقد الذي يتم به تأجير المنشاة لشركة خاصة لادارة المرحلة التشغيلية وصيانة المنشاة	**عقد الشراكة Joint venture contract** العقدالذي يتم من خلاله ادخال شركة خاصة تساهم بنسبة قد تصل الى 50% من اعباء واعمال المشروع كشريك ثان	**عقد الامتياز Concession /Greenfieldcontract) BOT** العقد الذي يتم من خلاله توكيل شركة خاصة بتحمل الأعباء والتكاليف للمشروع خلال فترة البناء والتشغيل الى فترة متفق عليها ثم ارجاعه للمالك الاصلي للمشروع ولكن تحت اشراف الجهة المسؤولة عن المشروع	**عقد الخصخصة (Divestiture Contract)** بيع اصول المنشاة او المشروع للقطاع الخاص بحيث له المسؤولية المطلقة عليه
مهتم / غير مهتم مع ترتيب الافضلية						
السبب						

- **ماهي المعوقات / المشاكل التي واجهتك خلال مشاركتك في مشاريع خدماتية استثمارية (بنية تحتية)؟**

1. **معوقات قانونية وتشريعية**
2. **معوقات ادارية**
3. **عوائق سياسية**
4. **معوقات فنية (كفاءات ، تقنيات)**
5. **معوقات مالية**

- **بعد مشاركتك في المشاريع الخدماتيةاستثمارية (بنية تحتية)؛ ماهو انطباعك عن هذه التجربة ؟**

1. **جيدة جدا**
2. **جيدة**
3. **لاباس بها**
4. **سيئة**
5. **غير ذلك**

- **ما هي رؤيتك للمشاريع الخدماتية استثمارية في مجال البنية التحتيةالحالية؟**

1. **مشجعة**
2. **مرضية**
3. **غير مشجعة**
4. **غير ذلك**

- **اذا كانت اجابتك غير مشجعة ؛ هل لديك الاقتراحات او ملاحظات التي تود اضافتها لتعميق الترابط الاقتصادي الاستثماري ما بين القطاع العام والخاص في مثل هذه المشاريع ؟**

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Appendix (D)

Desalination Technology

Desalination refers to the process that removed dissolved salt and other mineral from saline water to produce two streams- one with a low concentrate called treated water and it can be acceptable to drink and the other more concentrated stream called brine(Bhabha Atomic Research Centre, 2010);(Krishna, 2008);(WABAG , 2010);(American Membrane Technology Association, 2016)

Desalination process used two main types of technologies based on thermal and membrane systems ;Within those two types, there are sub-categories as shown in (Table 3.1)(Krishna, 2008);(WABAG , 2010);(American Membrane Technology Association, 2016).

Thermal Technology	
Name	**Description**
Multi-Stage Flash Distillation (MSF)	• Process have a series stages where the saline water being heated under high pressure and then led into a series of effects where pressure reduced causing rapidly water to boil (flash) • For large-scale desalination plants
Multi-Effect Distillation (MED)	• Used a series of vessels (effects) and it's based on evaporation and condensation principles with low pressure (>0.3 bar) • Represents the most economic distillation process with respect to energy efficiency • For medium-sized to large plants.
Vapor Compression Distillation (VCD)	• Used thermal energy with medium-pressure steam (>3 bar) • Used for small- to large-scale
	• The process operates at low temperatures with high thermal efficiency

Mechanical Vapor Compression (MED-MVC)	• Represents an economic alternative in the evaporation technology • Used for small and medium-sized plants in stand-alone operation.
Membrane Technology	
Name	**Description**
Reverse osmosis (RO) &Nanofiltration (NF)	• Processes use semi permeable membranes and pressure to separate salts from water • Operating pressures for RO and NF are approximately between 3.4 to 68 bar
Electrodialysis (ED) &Electrodialysis Reversal (EDR)	• process used An electrical potential to move salts through a membrane, where ions flow through ion selective membranes to electrodes of opposite charge in ED system, but ,in EDR systems, the polarity of the electrodes is reversed periodically. Ion-transfer anion and cation membranes separate the ions in the feed water. • used primarily in waters with low total dissolved solids (TDS)
Forward osmosis (FO)	• New commercial technology of desalination process • Its principle depends on a salt concentration gradient (osmotic pressure) to drive through a synthetic membrane.
Membrane Distillation (MD)	• A hybrid process of RO and distillation where its principle is based on the difference in vapor pressure of the water through the membrane.

MSF and RO are the most popular desalination technologies where MSF is preferred in arid regions with fuel availability at low cost whilst RO installed in regions that suffer of potable water and have good-quality seawater(Xavier Bernat, Oriol Gibert, Roger Guiu, Joana Tobella & Carlos Campos, 2011).

Membrane systems typically use less energy than thermal which depend on heat where the first one depend on pressure and membrane. But overallDesalination remains energy intensive, however, the future cost of desalination will continue to rise depending on the cost of both energy and the desalination technology(Xavier Bernat, Oriol Gibert, Roger Guiu, Joana Tobella & Carlos Campos, 2011).

جامعة النجاح الوطنية
كلية الدراسات العليا

أثر مشاركة القطاع الخاص من خلال أنماط العقود المختلفة في ديمومية محطات التحلية

إعداد
آية هشام حسن عبيسي

إشراف
د. عبد الفتاح حسن
د. رابح مرار

قدمت هذه الأطروحة استكمالا لمتطلبات الحصول على درجة الماجستير في هندسة المياه والبيئة بكلية الدراسات العليا في جامعة النجاح الوطنية، نابلس، فلسطين.
2017م

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الملخص

يعاني قطاع غزة من نقص في المياه لعدة أسباب من بينها الظروف السياسية والنمو السكاني وتغير المناخ والاستغلال المفرط ،وغيرها من الاسباب الاخرى. لذلك تعد محطات تحلية مياه البحر احد مصادر المياه البديلة في قطاع غزة لتلبية احتياجات السكان من المياه اللازمة لحياتهم اليومية. حيث يعود السبب الرئيسي للجوء الى محطات التحلية هو ارتفاع مستوى الملوحة بشكل مستمر على مدى العقدين الماضيين، حيث تجاوز مستوى الملوحة في قطاع غزة معايير منظمة الصحة العالمية . بالاضافة إلى إن موقع قطاع غزة الذي يمتد على طول ساحل البحر المتوسط، يلعب دورا هاما في جعل محطة التحلية خيارا ممكنا و جيد للحصول على مياه صالحة لشرب.

وبالنظر الى الوضع الاقتصادي والسياسي السيء الذي يعاني منه قطاع غزة بسبب الحروب الثلاثة التي شنها الاحتلال الاسرئيلي على القطاع غزة، مما سبب دمارا للبنية التحتية والحصار الذي يفرضه الاحتلال الاسرائيلي على قطاع غزة الى يومنا هذا. فان انشاء وتشغيل محطة تحلية على نطاق واسع وشراء تكنولوجيا المستخدمة لمحطة التحلية يشكل عبئا ماليا كبيرا على الحكومة الفلسطينية بالإضافة إلى الحاجة إلى تقنيات وكوادر ذوي خبرة وكفاءات عالية لإدارة وتشغيل محطة التحلية.

لذلك توجهت الحكومة نحو مصطلح الشراكة مابين القطاعين العام والخاص (PPP)، مما يعني إشراك القطاع الخاص في إنشاء وتشغيل محطات التحلية من خلال انماط عقود مختلفة.

الهدف الرئيسي من هذا هو تقييم عقود الشراكة مابين القطاع العام والخاص لمشاريع تحلية المياه في فلسطين من حيث الكفاءة والاستدامة.

المنهجية المعتمدة لاختيار العقد الأمثل للشراكة بين القطاعين العام والخاص قامت على مراجعة مستفيضة للمؤلفات التي تتعلق بشراكة مابين القطاع العام والخاص لاستخراج انماط عقود الشراكة الشائعة، وعلى عدة اجتماعات مع خبراء لديهم خلفية جيدة عن عملية التحلية وعقود الشراكة بين القطاعين العام والخاص والاستدامة ... الخ لإيجاد أداة مفيدة لجمع البيانات التي تتعلق بعقود الشراكة والتي تم توصل اليها عن طريق مقابلة منظمة تستهدف منظمات مختلفة ذات صلة بقطاع المياه أو لديها اهتمامات بمشاريع البنية التحتية.

من خلال عملية تحليل البيانات باستخدام برنامج إحصائي يسمى SPSS تم تقييم ثلاث نقاط رئيسية وهي :

1. تقييم معدل أهمية استدامة التي تشمل خمس مؤشرات (الجدوى المالية،الجدوى التقنية، الجدوى المؤسسية، الجدوى الاجتماعية، الجدوى البيئية) وفقا لمحطة تحلية المياه في فلسطين.
2. تقييم خمس انواع من الاستدامة مؤشرات (الجدوى المالية،الجدوى التقنية، الجدوى المؤسسية، الجدوى الاجتماعية، الجدوى البيئية) التي تؤثر على الإطار الهيكلي لعقود الشراكة بين القطاعين العام والخاص.
3. تقييم انماط عقود الشراكة مابين القطاع العام والخاص.

اظهرت نتيجة عملية التحليل من خلال عملية التقييم الشامل لعقود الشراكة بين القطاعين العام والخاص، ان عقد الامتياز بمتوسط المرجح 3.3 هو العقد الأمثل لمحطة التحلية والذي يحاكي واقع البنية التحتية في فلسطين الذي يحقق استدامة محطة التحلية ويحسن من كفاءة الخدمة لحصول على رضا المواطنين وتلبية احتياجاتهم من المياه الصالحة لشرب.