T.C
KARABÜK UNIVERSITY
INSTITUTE OF SOCIAL SCIENCES
DEPARTMENT OF INTERNATIONAL POLITICAL ECONOMY

WATER PROBLEMS IN THE MIDDLE EAST: THE CASES OF ISRAEL, PALESTINE, JORDAN AND LEBANON

MASTER'S THESIS

Prepared by

Rejab SALGAM

Thesis Supervisor
Assist. Prof. Dr. Umut KEDIKLI

KARABUK
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THESIS APPROVAL PAGE

To Karabuk University Directorate of Institute of Social Sciences

This thesis entitled "**Water Problems in the Middle East: The Cases of Israel, Palestine, Jordan and Lebanon**" submitted by **Rejab Saban Am Salgam** was examined and accepted/rejected by the Thesis Board unanimously/by majority as a MA / Ph.D. thesis.

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DECLARATION

I hereby declare that this thesis is the result of my own work and all information included has been obtained and expounded in accordance with the academic rules and ethical policy specified by the institute. Besides, I declare that all the statements, results, materials, not orginal to this thesis have been cited and referenced literally.

Without being bound by a particular time, I accept all moral and legal consequences of any detection contrary to the aforementioned statement.

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Signature :

FOREWORD

I am deeply thankful to Allah for blessing me capable of carrying out this work. It is my immense pleasure, and duty to express my sincere gratitude to Assist. Prof. Dr. Umut KEDIKLI, karabuk universityUniversity for direct supervision, selection of subject, his helpful suggestions, careful guidance, valuable comments during the course of the experimental work and revision of the manuscript.

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Also, I wish to thank deeply my family, specially my mother for their support and helps during the course of the study.

ABSTRACT

The water is one of the most important renewable nature resources on the Earth Planet and the most important characteristic as a chemical compound is its stability. The available quantities of this compound that existed on the earth surface is the same from hundreds of years. The total amount of the water is approximated about 1360 billion cubic meter. Also, 97% of this quantity is existed in the seas and oceans and 2% is frozen in ice sheet. The brackish waters represent the main resource of the freshwater through the hydrological cycle. Everyday about 875 billion cubic meter is evaporated from the water surfaces because of the heating energy which reach to the earth with the solar energy. The winds is moving the wet steamed air to another places with a minimum temperature where it condenses again and fall on the form of rains and snow and compensate the part the expended by the human.

Most of the Middle East areas suffer from the scarcity of waters and this belongs to their location in the dry and semi-dry region of the globe. Through the population growth at the Arab Countries, the scarcity of waters problem is increasing as a logical result of demand increase on waters to fulfill the domestic, industrial and agricultural needs. The water problem at the Middle East and especially at the Arab Countries is not just limited on the scarcity of water but it is extended to include the type of waters which declines to become not good to be used for many reasons. The water problems extend to include all the water resources at the Middle East and especially at the Arab Countries where the great Arab rivers such as Nile and Euphrates flow from non-Arab Countries and flow to take place in Arab Countries. Also, it must be optimal exploit for underground waters and rains and establish water desalination projects in addition to huge investments by employing great technology. Thus, the water problem becomes multi-dimensional and need to be deal with by advanced institutions which may not be available until now.

Our study deal with this problem from different perspectives starting from the geographical facts in addition to the followed considerations of international low to start across a sequential incarnation process to the all sides and considerations of the subject including political, economic and technical subjects and ends with anticipating the future of water.

Keywords: Water Problems, Middle East, Arab Counteries.

ÖZET

Su, Dünya gezegeninde bulunan yenilenebilir doğal kaynakların en önemlilerinden bir tanesi olmakla birlikte kimyasal bir bileşen olarak en önemli özelliği kararlılığıdır. Bu bileşiğin toprak yüzeyinde bulunan kullanılabilir mevcut miktarı yüzyıllardır aynıdır. Toplam su miktarı yaklaşık 1360 milyar metreküp civarındadır. Aynı zamanda bu miktarın %97'si denizlerde ve okyanuslarda bulunurken %2'si ise buz tabakalarında donmuş haldedir. Hafif tuzlu sular, hidrolojik çevrim sonucunda tatlı suların ana kaynağını oluşturmaktadır. Her gün yaklaşık 875 milyar metreküp su, su yüzeylerinden, güneş enerjisinin dünyaya ulaşmasının ortaya çıkardığı reaksiyon sonucunda oluşan ısı enerjisi dolayısıyla buharlaşmaktadır. Rüzgarlar, ıslak buharlaşmış havayı, tekrar yoğunlaşacağı ve yağmur ve kar şeklinde tekrar dünyaya düşeceği e insanlar tarafından tüketilmiş olan bir kısmını telafi edeceği daha düşük sıcaklıkta başka yerlere sürükleyecektir.

Ortadoğu'da yer alan çoğu bölge suların azlığından dolayı mağdur durumdadır ve bunun sebebi de lokasyon olarak buraların, küremizin kuru ve yarı kuru bölgelerine denk gelmesidir. Arap ülkelerindeki nüfus artışının da beraberinde getirdiği sorunlar ile su kıtlığı sorunu, yerel, endüstriyel ve tarımsal ihtiyaçların karşılanmasında sürekli artan ve gayet mantıksal bir talep ortaya koymaktadır. Ortadoğu'da ve özellikle de Arap ülkelerindeki su sorunu sadece su kıtlığı ile sınırlı olmayıp aynı zamanda suyun türünden de kaynaklanmakta olup bazı su türleri çok sayıda amaç için kullanılmaya uygun durumda değildir. Ayrıca, Nil ve Fırat gibi büyük Arap nehirlerinin yollarına Arap olmayan ülkelerden başlıyor olması ve sonradan Arap ülkelerine girmesi de mevcut su sorunlarını daha da derinleştirmektedir. Aynı zamanda, ciddi büyüklükte teknolojiler kullanılarak yapılacak devasa yatırımlara ilaveten yer altı sularının ve yağmurların doğru kullanılması ve tuz arındırma projelerinin işlevselleştirilmesi ile daha faydalı çalışmalar yapılabilecektir. Dolayısıyla, su sorunu çok boyutlu bir hale gelmekte ve hâlihazırda mevcut olmayan konusunda uzman kurum ve kuruluşlar tarafından ele alınması gereken bir mesele olmaktadır.

Çalışmamız, bu sorunu coğrafi gerçeklerden başlamak suretiyle farklı perspektiflerden ele almakta olup buna ilaveten tüm taraflara birbirini takip eden bir canlanma ve vücut bulma süreci sonrasında uluslararası anlamda bir bilinç oluşturmakta ve suyun geleceğine bir yön vermek ve gerekli öngörülerde bulunmak sonucuna ulaşması istenen politik, ekonomik ve teknik mevzulara değinmektedir.

Anahtar kelimeler: Su Sorunları, Ortadoğu, Arap ülkeleri

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LIST OF ABBREVIATIONS

CDR	Council for Development and Reconstruction
EU	European union
LARI	Lebanese Agricultural Research Institute
MCM	Million Cubic Meters
MEW	Ministry of Energy and Water
UN	United Nations
USA	United States of America

SUBJECT OF THE RESEARCH

This study aims to study the water problems in the Middle East in details where the study displays the water problems which exist in the Middle East by reaching into many resources, electronic workshops and statistics which distribute by the statistical centers in the Middle East countries. Also, the study subject interests especially by the water problems in Jordan, Lebanon, Palestine and Israel and the water policies that practiced by Israel and effect negatively on the Palestinian people and also on the two surrounding countries Jordan and Lebanon.

THE IMPORTANCE OF THE STUDY

As the study addresses a vital and strategic topic which touch the people day life in the Middle East directly and determines its relations and future in its land and it has special importance which can be summarized as follow:

1. This study gives a clear image about the water resources in the Middle East and its associated problems.
2. Give clear image on the Israeli policy on waters in Palestine to know and recognize its goals and means and place suitable strategy to face it.
3. The contribution in the provision of the relevant employees and students by scientific materials about the water situation in the Middle East.
4. Display the fact of the Israeli water policy as one of the most important water crises reasons in the surrounding countries.

METHODS OF THE RESEARCH

The researcher depended in his study on varied and comprehensive official data which include the resources, Arabic and foreign references, books, workshops, the provisions of the water agreements and the studies of the scientific centers and

others. As well as, take benefit from the university theses which associated to this topic.

HYPOTHESIS OF THE RESEARCH

This study must check the following hypotheses and the extent of their correctness and consistency with reality and include:

1. The climatic conditions with lack of rains and water resources contributed in increasing the size of the water crisis.
2. There is aggression by Israel on the Palestinians water rights and the water borders of some countries such as Jordan and Lebanon.
3. The Israeli resettlement in Gaza represents one of the water crisis in Palestine.
4. The Israeli water policy configures a real threat on the Palestinian people at their land.

SCOPE AND DIFFICULTIES

The researcher faced many problems and difficulties when preparing this study including the problems which associated with collecting the scientific material and also with the political situation in the study region and the policy of geographical separation which applied by Israel. As well as, the difficulties of reconciling between the different information resources about the same topic. The difficulties in associating and analyzing the variables to reach into results and also difficulties in preparing the maps, images, and statistics associate with the study, information and necessary data to accomplish the study.

PREFACE

Currently, the Eastern Mediterranean region which consists of Palestine and Israel consumes virtually the whole available freshwater. In the next thirty years, the population of these two states will double. Through the same period of time, the major regional droughts are expected to happen. The more important issue is that the region is free of any regional and institutional framework which take into consideration the supporting of the local and international society in order to formulate and support the joint water resource.

David Brooks in his keynote at the second conference of the Israeli-Palestinian International Academic Conference on Water in Antalya, Turkey 2004, stated that "One could place the Israeli-Palestinian situation in a good news-bad news framework". The good news is that Israeli-Palestinian water problems can be committed by administrative will. The bad news is that they can only be committed by administrative will. The water managers around the world provide performance standard that accepted universally to manage the groundwater. Through the design, the water resources institutions take into consideration the sustainability of water resources, transferability, effectiveness and impartiality. The correct sustainability represents the equilibrium between the existing and the future use. The quality and the distribution of the groundwater must be measured and it is not enough to measure the inflow and outflow. Transferability is the ability of the organizational structure to promote comparatively the transaction of the free market which can specify the resources according to the greatest economic use (David Brooks, 2004: 4-6).

The effectiveness can be defined as the process of maximizing the benefits in terms of equity and cost with the equitable distribution and the defense on the resources. These criteria and standards can be successfully managed when the political body is a single political body. There may be water basins inside that political body opposing for water distributions but there are perfect and well-

accepted structures of governance, decision and worries for conjunctive use. When the institutional structure of the water resources are in the design phase for transboundary water basins and aquifers, the other components which must be taken into account are in the management and political functionality of the transboundary co-riparian bodies, the comparative organizational, economic, military parity between the two (or more) bodies, the level of trust and assurance between the states and the unity of persistence and idea.

The development of the institutional structure in order to accommodate all the market sectors in the Middle East is considered a difficult mission because of the political and social divisions. In the highlight of water related urgency problems in the region, we do not have enough information about the past and adamantly preserving accusatory stances. Palestine and Israel get the waters from the same well (David Brooks, 2004: 4-6)..

INTRODUCTION

Most of the countries at the Middle East suffer from water crisis in spite of their location which lead to great problems and may contribute negatively on the climate and on all sides of water using. Actually, per capita share of the waters have been decreased in some countries to 170 cubic meters per year. This is unfortunate because this ratio is considered less than the internationally recognized ratio which is amounted about 1000 cubic meters. Less per capita share effect negatively on the food production and effect on the economic development and also, social instability and all of these problems are known and suffered by most of the Middle East countries (Haskins, Dold & Clarke, 2010).

The most important driving forces that determine the increased needs of the waters at the Middle East is the lack of foods as compared with the rapid increase of the population. The Middle East countries are highly depend on food importing accompanied with increasing of population and oil prices from many years. The bill of food is increased by 17 times from 1970 until 2000 with increasing percentage amounted of 10 percent annually (Hakimian, 2003; Molden, 2007; Hemson et al., 2008). Actually the North African and Middle East countries suffer from lack of water. This region includes about 6.3% of the world population but it only includes about 1.4% of the world renewable freshwater. Therefore, there were many attempts to address the lack of waters problems at this region. Allan (1997) stated that the Middle East region is depleted its water resources and it is difficult to fulfill the needs of water in house, food and municipal industries. The highly imports of the food is considered the most important indicators to the lack of waters as the food production is considered the most consumer of waters. Moreover, the water consumption in the agriculture increased than the waters consumed at the municipal and industrial production by 10 times combined. As it is known that the freshwater is highly effected by the population increase, it must be a perfect policy to balance the water consumption at the Middle East. The problems is worst in the Arab

countries region which is rich of oil resources. This can be an alarm for the whole researchers and academic persons who live at this region. Thus, there are main reasons that encourage the educated people to the legal and illegal immigration towards the developed countries such as Europe. As well as, many countries at the Middle East failed because of the field in their development plans such as Iraq, Egypt, Tunisia and Libya. Many other countries face serious problems but they are in live until now such as Yemen and Syria. Nevertheless, other countries at the region are going well in order to success their development plans.

The water crisis at the Middle East has many reasons including the variability of rainfall which effect negatively on the agriculture, underground water and grazing. Also, there is one additional problem which is the increase of the population. The studies and the statistics referred that population of the Middle East will increase 183 million people during the period between 2001 and 2025. This increase will cause pressure increase on the resources of water (Roud-Fahimi, Creel & De Souza, 2002). We as well as, the water resources at the Middle East are shared by many countries which differ in their policies to manage and share their water resources. The improvement of life quality and the economic growth lead to increase the water consumption. Moreover, the water conversion and management from one side led to the emergence of many problems and conflicts for instance the Arab Israeli conflict. Finally, the lack of technology and correct management lead to increase the water problems (Khinsee, 2005).

In order to balance the water shortage, several countries in the Middle East adopted new technologies to manage and balance this shortage of waters. These countries try to identify and manage new resources and develop despite their limited water resources. There are many attempts by the countries at the Middle East in order to achieve the greatest benefit of the available waters such as desalination of wastewater, fix and reuse it with the continuous use of the old methods for example collecting the rain waters on the surfaces and Transform the flux into cabinets. The other method that used to take benefit of the existed water is the sequential use of waters which include capturing and fix the water which have been used in specific sector and direct them into other use such as the use of water for domestic and then in the industry and later in the agriculture. Also, the desalination is the other technique that is used in the araba countries. The other technique is the trading of waters from one place to another by the shape and pipeline of water in spite of their

effect on the hydrology and ecosystems (Roudi-Fahimi, Creel & De Souza, 2002; Wolf, 1996). Moreover, there are several studies that implemented in order to deal with the waters needs and associated projects in the middle east for example Al-Rubay'e (2002), Kally (1991), Kally and Fishelson (1993) and Shaded (1999).

It is clarified that there are many strategies that take care of managing the requests on waters and include several steps as follow:

1. Relocation of water in order to fulfill the city needs and the urban places but it may damage the food security and the livelihoods of farmers.
2. Less Water-Intensive Crops: many countries may turn out to produce products less dependent on waters and sell their products in order to import the required products. So, this way may be used to preserve the water resources. Nevertheless, many countries see that the process of producing their cereals by themselves is a proud production. Actually, the financial surplus is invested by many Arab countries in order to produce the cereal. Government of Qatar invest much of its money in producing the rice and wheat in Sudan (Muhamad, 2011).
3. Effective Technologies: it is scientifically proven that the use of drip irrigation can reduce the consumption of water between 30 and 70 percent and increase the production by 20 and 90 percent if compared with the conventional irrigation methods. There are another method which is the use of crops that suite with the water regions and the use of drip irrigation technique.
4. Delivery efficacies which includes fixing the leaked distribution systems, expanding the sewage pipes, connecting water connections and decrease the use of waters.
5. The public education that includes the local society in order to accept the new water systems.
6. Countries may adopt many methods in order to decrease the water consumption such as encourage the religious men in the mosques and charges to expand the speech to decrease the water consumption.
7. Economic Consideration: at the present time several countries are striking gathered water tariffs on people.
8. Water Recycle: the policies of imposing prices on water consumption lead to decrease the consumption of water. For instance, the steel mill in Jordan has

decreased the request on water from 450 cubic meter to 20 cubic meter when the cooling water is recycled.

9. Organizational reforms: there are many reforms may be introduced to manage the consumption of water such as entering the public and private sector to manage the consumption of water.
10. Reducing the growth of population: there are policies can be applied in order to reduce the growth of population and enhancing the life of people and this is done by the United Nations International conference on Population and Development (Roudi-Fahimi, Creel, & De Souza, 2002; Economic and Social Commission for Western Asia, 2003).

Actually, the first international conference about using icebergs for the purpose of obtaining fresh water held at Iowa State University, Iowa, USA, 2-6 October, 1977. The main purpose of this conference is to review the possibilities on using Antarctica's ice as a source of freshwater to the arid regions for example Arabian Peninsula. Antarctica embraces 80% of world's ice and expanses to almost three quarters of the Earth's freshwater (Manley, 1979). Prince Mohammed Al-Faisal of Saudi Arabia deliberated the icebergs of Antarctica as a freshwater source to Saudi Arabia. The Economic expectations presented that operative costs of water from icebergs provided to Saudi Arabia associates favorably with water created by desalination (Al-Faisal, 1977). Preceding points have lectured methods to solve the lack of freshwater within the MENA countries in terms of rain, rivers, lakes, springs and groundwater assets. However, it did not go more to the adjacent countries which have extra of water for example Russia, North and South Pools (A'ib, 2009; Lewis, 2000).

1. CHAPTER ONE: GEOGRAPHY AND HYDROLOGY OF THE EASTERN MEDITERRANEAN

1.1 Geography

The area of New Jersey State is the equivalent to the area of Palestine and Israel, the israeli population number is approzimated about 6.7 million while the areas of Palestine; Gaza Strip and West Bank population is approximated about 1.4 million and 2.4 million, correspondingly. The region of Israel is amounted about 22,072 sq. km)whereas the landmass of Gaza Strip and West Bank 365 and 5,970 sq. km respectively (Alfarra, A and S. Lubad, 2004).

1.2 Climate and Population

Palestine and Israel locate in the eastern Mediterranean located in the transitional area between arid climates and Mediterranean subtropical. The population of this region is clearly knowledgeable by the scarce water resources at this region. The Palestinian and Israel community yearly consume all the available shared freshwater at this region. The number of population in Palestine is yearly growing about 4.0% while the Israel population is growing a bit more modest at 2.0%. Despite that Israel has achieved the best irrigation process at the world, it will pass in a pressure on the available water resources in 2025 (Alfarra, A and S. Lubad 2004). The process of distributing the water resources requires accurate policy and the water crisis requires accurate through in terms of managing the water resources at the Middle East.

Israel is distributed into four regions as follow:

- **The Coastal Plain:** it locates on the Mediterranean Sea and it is extended from the borders of Lebanese in north of Lebanese until Gaza Strip which locates in the south. Its width is approximately 40 km and then it is borrowed to the north and become about 5 km at the Lebanese borders.
- **Central highlands:** The hills and mounts of Upper Galilee and Lower Galilee are located at its north and in its south the hills of Samaria are located with a number of small and fertile valleys and we find in the south of

Jerusalem the Judean Hills. The highlands which locate at the center of the country is amounted about 610 m and reach to its highest level in Merwan Mountain where it reaches to 1209 m in the Galilee bear to Safad. The highlands are intersected by many mountains from the east to west and the largest one is Jezreel which is also known as Marj Ben Amer or the Esdraelon plain.

- **The Jordan Valley groove:** it is small part of the greatest groove which is extennding betwen Syria and the east of Africa on a distance of 6500 km in israel. It is prevailing on Jordan valley and the lake of Tiberias (which is also known as Galilee) and the Dead Sea.
- **The Negev Desert:** it is extended on a distance approximated as 12000 square km which is more than a half of Sirael region. Geologically, it is considered an addition to the desert of Sinai and configures a triangle shape. Its immoral is located in the north close to Beersheba and the Dead Sea and the south of Jewish Hill while its head is located in the southern part of the state in Aylet. In other word, it is parallel to the desert of Negev and the other regions in the country where its lands is in the west and the hills rise in the center with the existing of Nahal Harava on its border in the east.

In 2004, the total cultivated region of Israel is approximated about 428000 hactar where 43 percent of them locate in the governorates of Jerusalem and the South, 42 percent of them in the Governorates of north and Haifa and 13 percent in the governorates of Central and Tel Aviv. Besides, 75 percent of the cultivated part has been used by the local groups and 1 percent by the further Jewish farmers and 15 percent by the non-Jewish farmers. In 2005, the agricultural areas are concealed 392000 ha including 317000 ha for the annual crops and 75000 ha for the permanent crops.

1.3 The Watershed of the Eastern Mediterranean

Figure 1 explains the watershed of the region, the main water pipes which include the National Water Carrier and the regions of Gaza Strip and West Bank.

Figure 1: Main water pipelines watershed of the West Bank and Gaza Strip (Hussein, 2001)

1.4 Hydrology

1.4.1 Fresh Water Supply

The region includes three main freshwater resources including the Coastal Aquifer, the Jordan River Basin, and the Mountain Aquifer.

The Jordan River Basin: Figure 2 explains the Basin of Jordan River. It includes two distinct parts which is Upper Jordan (north of Lake Kinneret or Sea of Galilee) and Lower Jordan (south of Lake Kinneret to the Dead Sea).

Except the Litani River which locates in south of Lebanon, the river of Dan and Kinneret lake that locate entirely inside the internationally acknowledged borders of Israel. The entire streams and rivers that feed the Jordan River are co-riparian and trans-boundary.

The main streams of the Upper Jordan include the follows:

- The Dan River that upsurges in Israel and has a yearly flow rate amounted of 250 MCM.
- The Hatzbani River that upsurges in Lebanon and acquittals 150 MCM/year.
- The Banias River that increases in the Golan Heights and acquittals 150 MCM/year.

At the end, the whole of these rivers drain in Kinneret Lake. Jordan River Basin intersects with Yarmuk River at 10 kilometers to the south of the lake. Despite that the Israeli, Jordanian and Syrian withdrawal decreased the contribution of the Yarmuk River it is annually contribute about 400 MCM. Yarmuk River configures the current borders between Syria and Jordan and when it once joined the Jordanian border it configures the borders between Israel and the West Bank (Hussein. A 2001). The basin is completed by many small valleys and tributaries and small rivers which pour during the winter season.

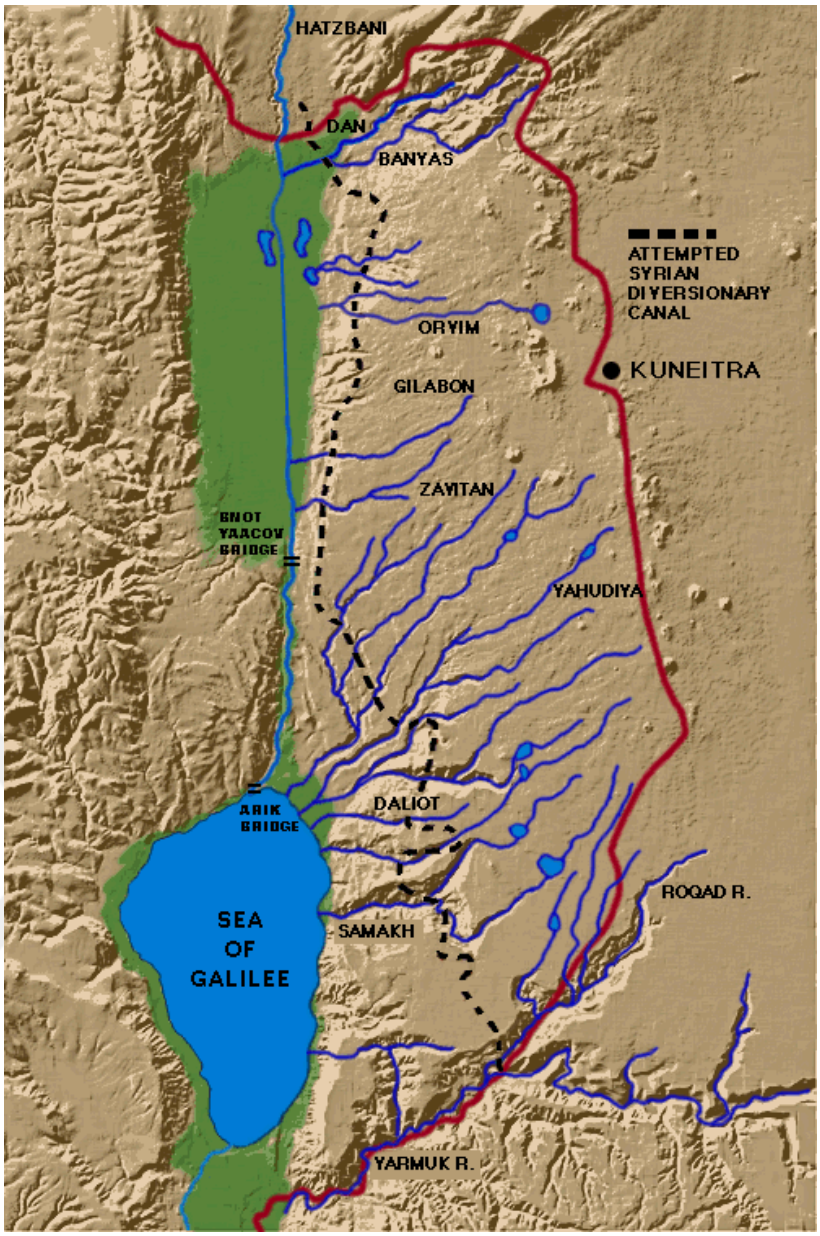

Figure 2: Ancient riverbeds that only flow during winterthat complete the basin

(Reprinted from "Peace with the Golan: Water Issues of the Golan Heights" http://www.golan.org.il/water.html)

The Coastal Aquifer: The Coastal Aquifer, which is mainly configured from the gravel and stone delivers Israel's best compactly inhabited area comprising the major city, Tel Aviv) with 15% of the country entire source of the freshwater, or 280 MCM yearly. The seaside qualifier is accurately separated into two basins of the sub-qualifier where Israel is supplied by waters from the northern qualifier class and Gaza from the south. Gaza magnets about 50 MCM yearly from the 'sub-aquifer'. The quantity of the coastal qualifier is 3-5 meter overhead the sea level at the normal

status and because of the increasing pumping, its quantity now does not exceed one meter above the sea level. Currently, the level of chloride is rised from 100 ppm in the 1970's to 155 ppm.

The Mountain Aquifer: The Mountain Aquifer comprises of karstic, mineral foundations through renew regions typically beside the higher inclines of the mountain and edges at levels beyond 500 meters beyond sea level. The aquifer of mountain which locate mainly in the West Bank pipes a yearly overall of 650 MCM and it is consisting of three separate basins:

The Western Aquifer: The Western Aquifer (named The Yarkon-Taninim Aquifer in Israel) delivers more than half of the entire income of the Aquifer (about 350 MCM/year). These flows of aquifer to the west of Israel. Fourty MCM of this water is brackish water. The Western Aquifer is considered the main three basins, some 6,000 km^2. The uncovered replacement region shields about 1800 km^2 of which 1400 km^2 (78%) lie inside the West Bank. The yearly rejuvenate that consuming by Israel is 344 MCM or 91% of the recharge whereas the Palestinian people consumes about 22 MCM or 6% of the recharge.

The North-Eastern Aquifer: The North-Eastern Aquifer streams around 130 MCM/year of that 70 MCM are salty. The main stream of the North-Eastern Aquifer is north by northeast and increases through Israel as the Ma'ayan Harod Springs. The North-Eastern Aquifer involves of two covering sub-aquifers: the Eocene limestone aquifer frequently denoted to as the Nablus-Jenin-Gilboa basin, and the deeper limestone-dolomite Cenomanian aquifer that is further creative. The North-Eastern Aquifer includes 1044 km2 and rain revives a normal size of 145 MCM. The area of recharge is entirely locates at the West Bank while the aquifer locates mainly in the West Bank. The normal discharge spirals locate inside Israel in the valleys of Yezre'el (Marj Bani Amr) and Beit She'an (Beisan).

The Eastern Aquifer: this aquifer is the single basin Mountain Aquifer structure which locate and increases completely in the West Bank. This qualifier discharge around 150 MCM/year and supplies the whole water which is consumptive by the Palestinians and Jewish colonizers who live in the West Bank. The area of this aquifer is approximated about 3,080 km^2. The eastern aquifer is considered the most asymmetrical and dramatic basin. It extends from the top of the mountain at 600-800 meters overhead the sea level to the Jordan (Syrian-African) Rift at 350-400 meters under sea level. Despite that the evaporation rate is the most rate in the world which

reach to 3000mm yearly by the average precipitation volume is 172 MCM which recharges the groundwater. These groundwater discharge a large number of salt springs and high distribute at the Dead Sea region. The water quantity which abstracted from the eastern aquifer consumed by the Palestinians is approximated nearly 69 MCM or 43% of preoccupied water while additional 40 MCM or 25% are expended through Israelis inside the 'green line' (region described as a global border before June of 1967).

The available freshwater that consume by the Palestinian, Israelis and Israeli colonizers in the West Bank in 1995 is shown in Table 1.

Evaporation and Recharge: The mountain groundwater can be recharged only by the rains. The amount of the yearly infiltration volume is around 600 MCM/year. Nevertheless, the amounts of the falling rains are varying and differs between 600 mm in the mounts to 100 mm in the arid Valley of Jordan. Annual precipitation rate is less than cold evaporation rates (Hamad Waed, 2005).

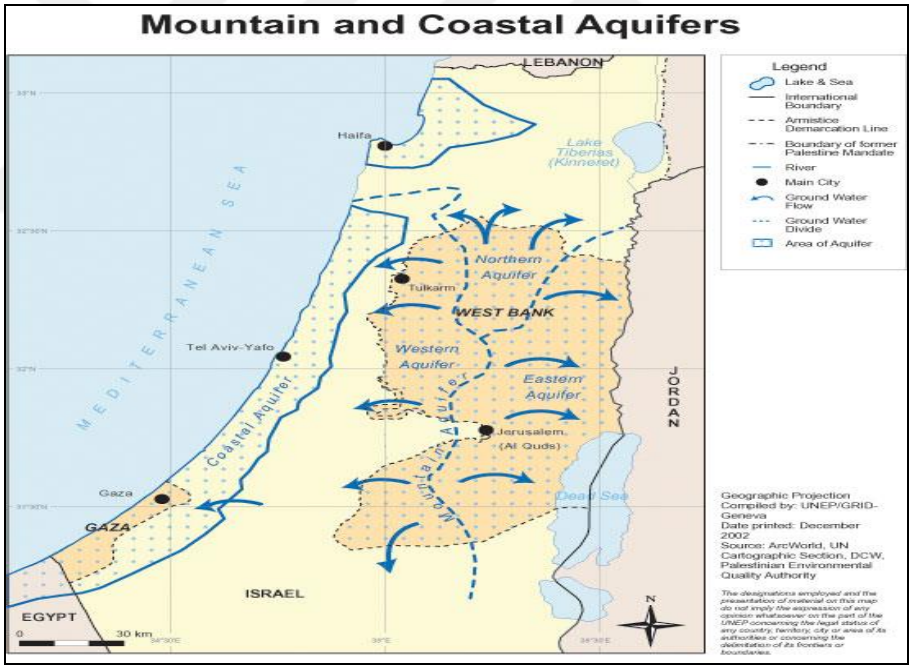

Figure 3: Mountain and coastal aquifers ((Hamad Waed, 2005)

Table 1: Summary of Fresh Water Availability and Use in MCM/year in 1995(Hamad Waed, 2005)

Source	annual recharge	used by Israel	used by settlers	used by Palestinians	total use
Western Aquifer	362	344	10	22	376
Eastern Aquifer	172	40	50	70	160
North-Eastern Aquifer	145	105	5	30	140
Coastal Aquifer	250	260	0	0	260
Gaza Sub-Aquifer	55	0	0	110	110
Jordan River Basin	1311	685	20	0	705
TOTAL	2295	1434	85	232	

1.5 The Hydrologic Cycle

It is necessary to place the rainfall in its place at the hydrologic cycle because the unique resource to recharge the groundwater is the rain. The hydrologic cycle can be defined as a complex network of the continuous flows or the flows of waters between the waters stocks, the main stocks or a network of the continuous flows. The energy that causes the evaporation is caused by the sun and the water vapor is mixing in the atmosphere and thus initiatives the cycle against the gravity pull. The balance of water equation (Harte, 1985) for the land (opposite to the sea) is conveyed by $P_L=E_{LS} + E_{LL} + R$: while P_L= precipitation rate on land; E_{LS}= rate of evapotranspiration from land of water which descent as rain on the sea; E_{LL}=rate of evapotranspiration from land of water that waterfalls as rain on the land: R=rate of runoff from land to sea. The overflow towards the sea is insignificant. Overflow to the sea is insignificant, in specific in the Mountain Aquifer area. The average of water balance in specific region is effected by the evapotranspiration. The ranges of temperature in the region, the evaporation rates and the average of yearly precipitation is shown in Table 2. The region is considered one of the highest evapotranspiration degrees in the world and the most water scarce in the world (Ibrahim 2004).

Table 2: Summary of Average Precipitation, Evapotranspiration and Temperatures (Ibrahim 2004)

Region	Annual rainfall (mm)	Annual evapotranspiration (mm)	Daily temperature (^{0}c)	Annual temperature range (^{0}c)
Coastal Plain	400-600	1700	19	13-26
Mountains	500-700	1850	17	8.5-22
Jordan Valley	50-150	2300	23	11-40

Mekorot and the National Water Carrier Mekorot, in Hebrew means "sources" and true to its moniker, Mekorot is the resorce of water Israelis which has been changed to supplied water since 1937. Mekorot supplies about 80% of the total water and about 90% of Israel's drinking water as it provides around 1004 MCM/yearly to Israel and munches around 6% of Israel's electrical power. The water supplier system of Mekorot involves the following (Ibrahim, 2004):

- 800 driving positions
- 1,200 shafts
- 3,050 drives
- 10,500 km. of large-diameter pipes
- 570 concrete and steel reservoirs
- 95 earthen reservoirs
- 6 laboratories

Mekorot's crown accomplishment is the National Water Carrier. The propelling capability of this system is 72,000 cubic meter/hour and the entire lift of 400 meters at the Sapir Pumping Station on the southern beach of Lake Kinneret needs numerous of the major distance centrifugal drives in the world. The process of pumping water from Kinneret Lake to the densely populated areas in Israel is the main purpose of this project. The area of this Lake is around 170 sq. km comprising 4,000 MCM of water. Figure 4 explains the national Water Carrier.

Figure 4: The National Water Carrier (Shareef, 1997)

The National Water Carrier conatin an original plan that accomplished in 1953 when the jordanean government configured the borders between Syria and Israel which is called to draw the water of the Jordan River overhead Lake Kinneret at about the level of the sea. However, Syria and UN opposition ordered Israel from distracting Jordan River water. This decision has a significant economic impact where it forced Israel from pumping the whole of its water out of Kinneret Lake at a promotion of –100 to –120 meters under the level of sea. The comparative place of Lake Kinneret and its promotion is shown in Figure 5.

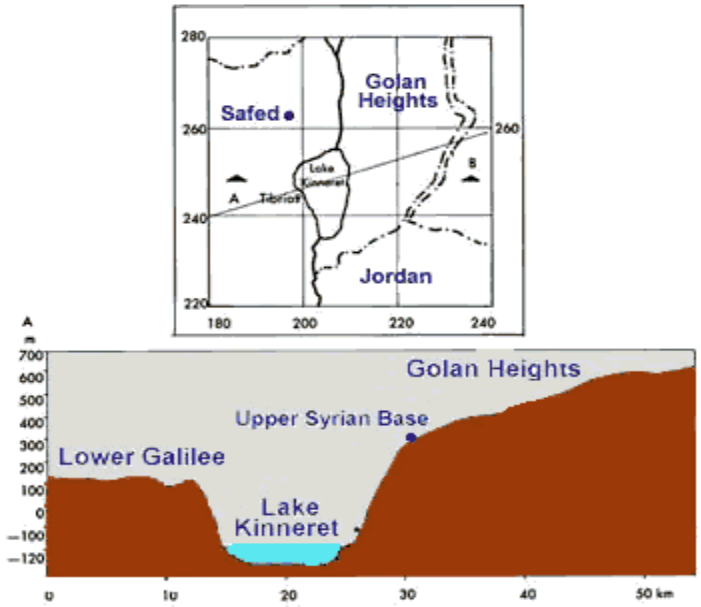

Figure 5: The elevation and comparative location of Lake Kinneret (Shareef, 1997)

1.6 Desalinated Water

The desalination of the water in the region is divided into two section namely brackish desalination and Seawater desalination. The prices of the brackish waters which are used for the irrigation purposes about $0.20-$0.50/m or incompletely the cost of presently pumped, piped and supplied freshwater to Israeli farmhouses (this thesis will address the cost of the delivered waters to Palestine at another section). The main resources of the water in the southern Israel is the desalinated waters (the largest city in southern of Israel is Eilat where its population is about 40,000 people) (Rashed .A 2005)..

1.7 The Ashkelon Desalination Plant

On 9 of February 2006, Israel has inaugurated the final phase of the factory in Ashkelon which locates to the south of the Mediterranean coast of Israel. Currently, this project is considered the largest project of water desalination in the world which produce about 110 MCM/yearly. Its total capacity covers about 6% of the whole Israel demand for drink water. This project decrease the salinity of water from 40,750 TDS to <40 TDS (a 99.9% salinity reduction). Since the increasing use of reverse osmosis technology and increasing the use of efficiency energy, the cost of

desalinated sweaters is less expensive than they years ago. The cost of constructing the plant in Ashkelon is about 250 million dollar. The total income through the contract time is amounted of 825 million dollar.

The contract which belong to Ashkelon project is given in September 2011 after the provision of a series of tending process started in July of the previous year and it is the first project which followed by a series of projects to desalinate the seawater. The franchise was awarded on a build and operate basis and the plant will be transferred to the Israeli Government after 25 years. At the beginning, it is supposed to produce only 50 million m^3/yr burt after that, there negotiations have been signed in order to double the output. The second contract is signed after one year of the first contract and the work procedure consisted on three phases. Ashkelon project will contribute by all of is energy will itself contribute 25% of the primary target in the master plan of the Israeli government (Rashed .A 2005).

1.8 Proposals for Desalinated Water in Israel

Since the inauguration of Ashkelon project, Israel's National Water Company Mekorot operates on 29 plant in order to desalinate the water inside Israel and produces about 114 MCM/year of the treated water for the drinking purposes and about 22.5 MCM/year for irrigation purposes. In 2010 many projects have been implemented to construct water desalination projects which reached to cover about 20% of the total demand for waters.

1.9 Plans for Desalinated Seawater in Gaza

Gaza contains two small plants which have been implemented to provide Gaza with waters, the first one implemented by the Austrian government with capability of providing O.2 MCM/year and the second one constructed by the French government with capability to provide about 0.5 MCM/year. Both of these plants will be ready to provide 2.0 MCM/year and 1.0 MCM/year. Moreover, US Agency for International Development is created a larger plant for water desalination with capability of 22MCM/year and the maximum capability of the project in 2020 is amounted of 55 MCM/year.

1.10 The Cost of Desalinated Seawater

Since the development where the world witnesses these days and the use of advanced technologies, the process of desalinated is not a hard process. The Eilat-Ashkelon Pipeline Corporation (EAPC), which lies about 700m north of the present Israel Electrical Company power station uses developed SWRO (Reverse Osmosis) technique and state-of-the-art energy recovery systems to decrease the operating cost and helping to accomplish one of the least water costs ($0.527/m³) ever existing for this type of operation (Rashed .A 2005). The cost for desalinating the sweater is about $0.80/$m^3$. Water desalination process will be described in details at the next chapter because it is configured great importance and considered a significant element for any comprehensive plan to manage the waters in the region. The pilot projects of water desalination in Israel is illustrated in Figure 6.

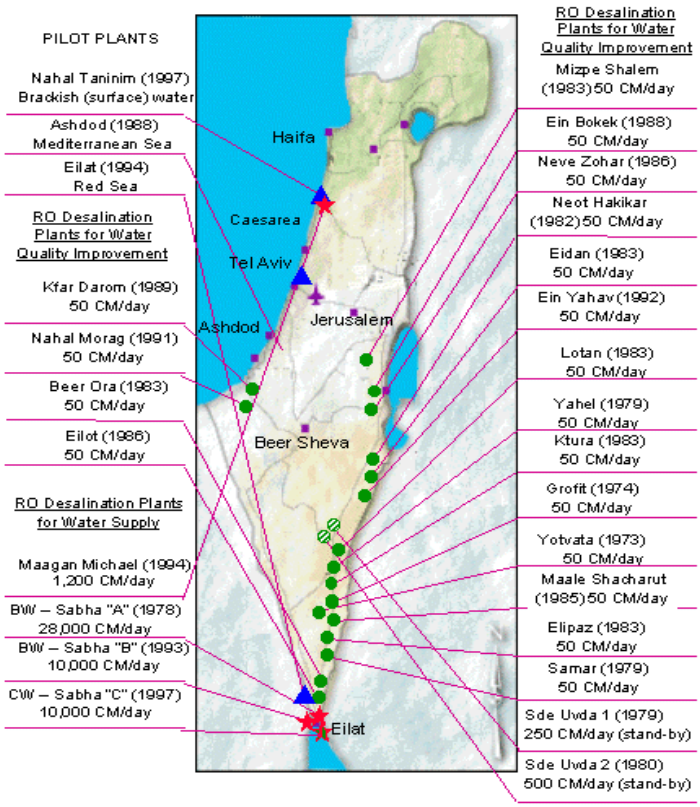

Figure 6: Pilot projects of water desalination undertaken by Israel currently(Rashed .A 2005).

1.11 Projections for Desalinated Seawater in Israel

The main plan of Israeli government is to create master plans for desalination and reclamation of water which aim to get 1,467 MCM of desalinated and reclaimed waters in each year.

Table 3: Projections for Desalinated Growth inside Israel 2002-2010 (Yroham, 2012)

YEAR	Fresh	Reclaimed	Desalinated	Brackish	Required Supplement
2002	1,467	298	0	166	35
2005	1,467	403	355	166	26
2010	1,467	509	500	140	-75

1.12 Projected Population Growth

During the next thirty years, the population in the region will be doubled. The curve of growing population between Israel and Palestine is shown in Figure 7 and Figure 8 respectively.

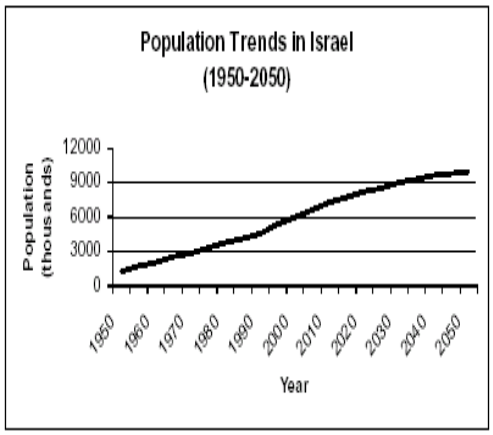

Figure 7: the growing of population in Israel through many years (Yroham, 2012)

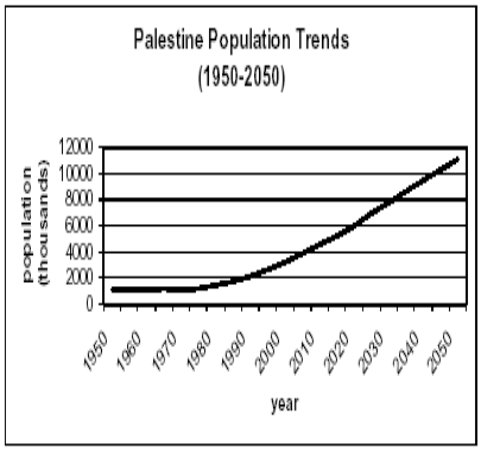

Figure 8: the growing of population in Palestine through many years (Yroham, 2012)

These numbers comprise the natural increase of population and medium irregular immigration. Table 4 and Table 5 explains the population projections depending on per capita income in each water sectors. The simply important rise each one is in the manufacturing area at the Palestinian people that delivers for a 9% growing in manufacturing use for water each one from 2010 to 2020. It is an important to use the statistic per capita use of cultivated water at the Israeli people.

1.13 Population and Water Demand

The entire demand on water of the Palestinian and Israeli people is amounted of 3051 MCM and it is expected to become about 3943 MCM in 2020. The water management on water demand is configured a significant factor in order to manage the water resources at specific region. The water consumption projections and depict of population projection for both the Palestinian and Israeli people from 2010-2020 is illustrated in Table 4 and Table 5 respectively (Rashed .A 2005).

Table 4: Palestinian Population Projections and Water Consumption Patterns measured in MCM (Rashed .A 2005)

YEAR	Population	Gaza	West Bank	Domestic	Agriculture	Industrial	Total
2000	3,160,000	1,140,000	2,020,000	263	217	18	498
2010	4,930,000	1,870,000	3,060,000	484	305	37	826
2020	6,580,000	2,620,000	3,960,000	787	415	61	1263

Table 5: Israeli Population Projections and Water Consumption Patterns measured in MCM (Rashed .A 2005)

YEAR	Population	Domestic	Agriculture	Industrial	Environment and Storage	Total
2000	6,498,000	690	1,010	129	26	1855
2010	7,300,000	886	1,122	167	50	2225
2020	8,600,000	1000	1,350	230	100	2680

1.14 Economic and Agriculture

The gross domestic product of Israel is amounted 161.8 billion dollar in 2007 and in 2005 the agriculture represented less than 2 percent of the gross domestic product as showed in Table 6. The number of population who they economically effective are amounted 2.95 million population 57 of them are male and 43 are female. In the agriculture sector there are about 64000 people are economically effective 80 percent of them are male and 20 percent of them are female. The value of the agricultural exports (fresh and canned) in 2005 is amounted 1680 million dollar which equal to 4.6 percent from the exports of the country. While the value of fresh exports is

amounted 1024 million dollar to the European Union firstly whereas the export of the food products are amounted 656 million dollar. In addition, agricultural inputs are exported and its value is amounted 1900 million dollar. Thus, this value reflects the results of the advanced agricultural industry which created advanced industry with industrial inputs and the direct experience in the agriculture field configures diagnosis to develop and design the new technological inputs. The agriculture field in Israel is mainly based on the collaborative collections which based on the governmental lands which rent by long-term contracts. The history of some of these collections belong to the early 20th century.

Table 6: The percentages of the lands and population in each governorate in 2004 (Muhamad, A. 2011)

The governorate	Area (%)	Population (%)
Jerusalem	3.0	12.1
North	20.7	17
Haifa	4	12.4
Ventral	6	23.5
Tel Aviv	`0.8	17.1
South	65.5	14.3

Whereas the Palestinian agriculture sector witnesses a significant decline where the last report of Central Bureau of Statistics of Palestine for 2013 stated that the agriculture sector contributes about 4.1% in the gross domestic product and this is considered small contribution as compared with the contribution of other sectors. The indicator of the added value for the agricultural sector is amounted 308.3 million dollar for 2013 with decline approximated about 9.1% from 2012. This reflects the weakness of the productivity according to increase the production inputs which effects negatively on the profitability.

The number of workers in the agriculture field is decreased to reach into 84.1 thousand worker in 2013 by decline with rate of 7.7% as compared with 2012. This refers on leaving many famers and especially the young famers the agriculture sector to another sectors which are little risks and more profit or they found themselves in the unemployment field which configures approximated about 23.4% of the workforce in 2013. Also, the average of the daily wage for the agricultural worker is

the least as compared with other sectors where the average of the daily wage is amounted 40.2 shekel and this number is interpreted by the statistics which mention that 73.3% of the agricultural workforce which work in the agriculture field is family workforce that practice the agriculture as style of life. However, the average of the daily wage is still high as compared with the low agricultural income (Muhamad, A. 2011).

In general vision, we can take a look for the most important economic indicators that associated with the sectors, we can take a compare look between the agricultural sector and other sectors for 2013 as in Table 7.

One of the most important characteristics which make the investment in the agricultural field is real challenge is the characteristic of dispersion and fragmentation of holdings whether it is plant, animal or mixed which increase the production cost for the agricultural unit. The process of using the technology is determined widely both mechanical, biological and chemical. Nevertheless, 22 percent of these holdings are considered a resource of unique income for many Palestinian families. Thus, many people are attend to collect these holdings within companies for a possible solution to solve the depression problem. However, most of the marketing strategies in Palestine are traditional in terms of the occupation control on the marketing channels from internal and external standards and flood the Palestinian markets by the Israeli products which are governmentally supported. In spite of the existing of national strategy for export, there is weakness in the export movement resulted from the decline of production and the services of post-harvest including the sorting, graduation, packing and cooling. Also, there is not central incomes in the central markets in order to protect these products for suitable period of time until the marketing. Despite the seasonal characteristics of the agricultural product and its varied where many people see that it is considered strength point resulted from the climate and geographical diversity for the Palestine regions, there determinations for the product exchange according to the existing of barriers which cut the communication with cities and lead to price differences for the same product in different regions. This is in its turn led to vibrate the agricultural income.

Table 7: The most important economic activities and their characteristics fro 2013 (Libiszewski S., 2015)

The indicator	Agriculture	Industry	Construction	Wholesale and retail trade	Transportation and store	Information and communication	Services and other Branches
The percentage of contribution from the local product (%)	4.1	15.7	10.8	17.2	1.7	5.9	44.6
The added value (in million dollar)	308.3	1171.1	801.3	1284.4	126.8	441.9	3321.8
The share of the individual from the added value (dollar/worker)	3665.9	11549.3	10273.1	8938.1	2849.4	56653.8	10303.3
Number of workers (in thousands)	84.1	101.4	78	143.7	44.5	7.8	322.4
The average of daily wage(shekel)	40.2	69	79.2	58.1	52.6	95.1	93.1

1.15 Irrigation Development

Israel since the fiftieth of the last century and their extensive efforts in the field of irrigation are continuous and researches concluded that the use of waters in the compact irrigation is more effective than the surface irrigation and the industry of irrigation equipment has been established and they developed advanced techniques in terms of drip irrigation (above and under the earth), valves and automatic controlling devices, automatic filtering and loess discharge spray and minimum sprinklers, sprays with low discharge. These techniques control on most of the irrigation processes by the automatic control valves. Because of the earth is divided into blocks and the topographic circumstances, merely few areas can be watered by the possible

systems including the axial irrigation and the invented irrigation is enjoyed by international famous and more than 80% of its production is exported.

In 2004 only 225000 ha is equipped for irrigation in Israel while the localized irrigation and most of it is based on drip irrigation is fulfilling 75 percent from the whole irrigated areas as in Figure 9. In the past fifty years, the annual average of water used is decreased from each hectare from 8000 cubic meter into 5000 cubic meter while the agriculture is spread in the driest areas in the south.

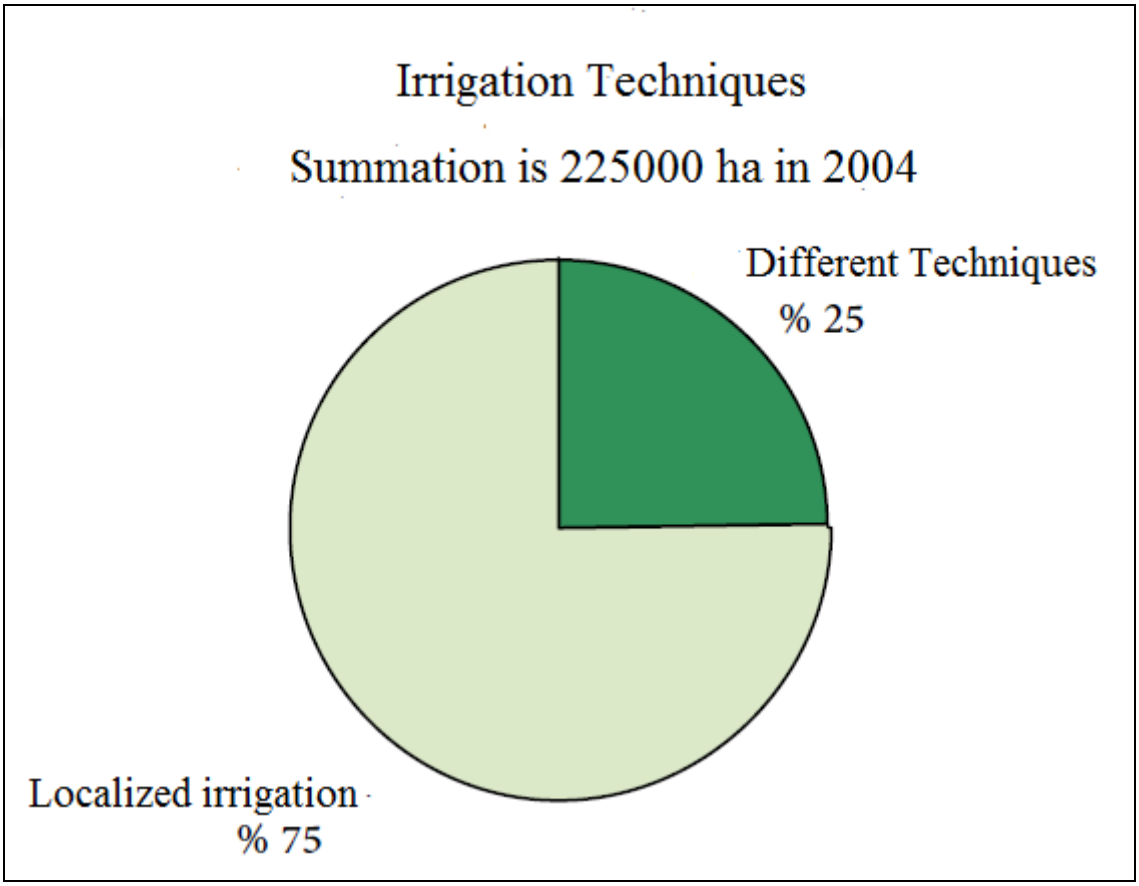

Figure 9: Irrigation Techniques (Ministry of Agriculture and Rural Development, 2006)

The production in the highlight of the protected conditions is the main way which depended by the Israeli farmers to guarantee during the year a permanent supply for high quality products with keeping the use of chemical materials in its least limit. So, the total area which covered by greenhouses, shaded houses and towers are increased from 900 ha in the eighties to about 6800 ha in 2005 with 4000 ha is specialized for potatoes and 2800 ha to cultivate decorative plants. This represents annual growth average ranging between 5 and 8 percent. The average of the agriculture size which

produces the vegetables is amounted 4 ha and that produce the flowers is amounted 1.2 ha.

The irrigation problem in Palestine is started effectively after the establishment of Israel state in 1948 and its enable to control the Palestinian water resources and according to its increasing need for waters, its ambition appeared to control the irrigation resources of Palestine and the surrounding Arab countries. So, the conflicts because of the waters started where the water became one of the most important conflict dominions for Israeli and Palestinian conflict. Since the establishment of Israel it sought to draw its political borders in the consistency with the security and water system and in order to secure its water resources, Israel fought many wars which through it is enabled to occupy the shores of the Sea of Galilee and the streams of Jordan River. As well as, it is participated in the triple attack on Egypt in 1956 in order to reach into Suez Canal. Also, it is swept the south of Lebanon in 1982 to control The Litany River.

The Israeli policy aimed to exploit the water resources in the region and use them as a mean to develop the settlement and exploit the land and resources where it used the political and military means in order to achieve the water control and the uniqueness in the water resources in the whole region. This policy is implemented in a region which is characterized by the water scarcity. There is no doubt that the water resources are considered one of the most important foundations which must be available to achieve the security and stability for any country or political regime. The inability of any state to protect their natural potentials including the waters as the case in Palestine will lead to loss the geographical entity for that state or a part of its strategic policy at least.

Israel started most of its projects and water planning which are based on extensive and deep studies by the Jewish companies and agencies after 1948 directly. Moreover, some of these projects and plans are prior to this date in order to control the water resources and implement the energy projects and water storage. The water factor with the security and settlement factors are configured the most important pillars for the establishment of Israel state based on expansion and occupation. Israel has implemented its geopolitical plans to control the water resources through the political control based on finding the strategic relationship with the great states such as the United States to guarantee the support and help. Also, through the military strategy which is necessary to control the water resources and follow by the use of

military power. This is implemented after the nationalization of the whole water resources in 1949 and considers them a property to the state.

The Israelis and their thinkers have associated the future of Israel by the water resources where many water experts pointed that the safety borders in Israel must be water borders. Thus, the process of compacting between the security and waters factors is clear from their applied policy in the region. Therefore, the strategic planning to control the water resource in the region is a part of the geopolitical strategy for Israel which cannot be waived (Ministry of Agriculture and Rural Development, 2006).

1.16 Israeli Policy and the Water Situation in Palestine

1.16.1 The economic and development Dimensions of Water Crisis in Palestine

Through the clarity of the water problem geographically, historically and politically, we find that the economic dimension is also clearly manifested through the Israeli gains in controlling and exploiting the Arab water resources. Israel is considered the economic dimension of waters is a part of compressive economic strategy. As well as, it is considered a part of comprehensive and integrated concept for the economic resource policy. Therefore, the possibility of Israel to give up of the area which is occupied in 1967 in many areas of Palestinian, Lebanon and Syria are considered to give up from the strategic war spoils from the economic corner.

The agriculture sector is considered one of the most important economic activities in Palestine and the water policy of Israel led to reduce the cultivated area in the occupied regions through following the policy of confiscation of the lands and completely control the water resources of Palestine in order to reduce the agriculture sector as it is considered one of the most important sector for the Palestine economic income and thus, they can achieve the compact process between the Israeli and Palestinian economics and control this economic and become complementary to the Israeli economic and not a competitor. The economic dimension of the waters is clarified in the Arab and Israeli conflict as stated by "Menachem Begin" who is the previous Israeli prime minister in 1990. The process of obtaining of an opportunity to invest the Litani waters can achieve annual profits approximated by two billion dollar and may reach to billion dollars later. Israel in its policy aim to achieve three main goals in the economic field as follow (Statistics of Bureau Central, 2006).

- Provides Israel by additional water resources from the Palestinian lands.
- Controlling on how to use the Palestinian people and use him as a pressure mean to achieve political gains in Palestine.
- Provide the necessary waters to develop the infrastructure for the settlements with low prices.

Any development process depends on three major factors where the human in his experience and knowledge represents one of the most important factors in addition to the lands and waters. So, in Palestine we find that the human lives under the occupation and the same for the whole natural resources including the lands and waters where they are subject to control and exploitation by the Israeli government according to what the resource configure of basics for the sovereignty, independence and development and what represents of possibilities to overcome of the dependence to the Israeli economic. Currently Israel controls on wide areas of Palestine and many of these areas were owned by the Palestinian farmers and exploited them in the agriculture which caused the obstacles to the economic development in Palestine. The Israel water policy is caused a significant decline to the agriculture field where the contribution of the agriculture sector in 1966 were equal to 40% from the total of gross domestic product. This production ratio is highly declined after the occupation and the control of Israel on most of the water resources in Palestine to reach into 33% in the early seventh decade of the last century. Also, the contribution of the agriculture sector in the gross domestic product is registered highly decline to reach into 18.33% in 1989. As well as, the contribution reached to 6% with the beginning of 1995. Table 8 explains the importance of the agriculture sector on both the Palestinian and Israeli economic in 2005 (Statistics of Bureau Central, 2006).

Table 8: The economic importance of the agriculture sector in Israel and Palestine (Statistics of Bureau Central, 2006).

The contribution of agriculture in the gross domestic product	Israel	Palestine
	3%	17.2%
The percentage of the workforce to the total workforce	4%	26.3%
The percentage of the agricultural products from the total of exports	2.5	10%

It is clear from Table 8 that the percentage of the workers in the Palestinian agriculture sector is highly greater than the case of Israel and also, for the agricultural exports and the reflection of that on the gross domestic product of the agriculture and its contribution in the whole gross domestic product. The Palestinian lands are clearly restricted because of the Israeli water policy which declined the quantity of waters that specialized to Palestinian people in Gaza Strip from 180 thousand acres in 1967 to 143 thousand acres in 1996 and less than 100 thousand acres after 2003. While in West Bank was worst because of declining the population growth where the agricultural lands are declined from 27% from the total cultivated areas in 1967 to 4% in 2000 which led to transform about 32% of the Palestinian workforce in the West Bank and Gaza Strip into workers in the Israeli market.

In case if Israel, it is achieved developmental and economic revolution where the cultivated areas are increased from 300000 acres in 1949 to 4.7 million acres in 1985 because of increasing the quantity of the irrigation equipment's which available from 350 million m^3 to 1920 million m^3 for the same period of time. The occupation of more Arab cities is contributed to expand these area where more water resources and the lands which can be exploited agriculturally especially in the north of Palestine.

1.17 The dimensions of Arab and Israeli conflict on waters

1.17.1 The spatial distribution of the water conflict

In spite of the lack of connection of Israeli water resources with the political borders, the basin of Jordan river and its northern streams configure the basic of the Israel ambitions according to the nature of geographical and hydrographic data which its characterized with taking into account the extension of the geography conflict on the water resources to include more wide areas where its borders reach to the Nile, Tigris and Euphrates rivers and the plant rivers and the most important of them to Israel is Litany River in addition to the aquifer basins in each of the Palestinians areas.

The old and modern documents and plans of Israel on Litany River Basin clarifies the clear focus on this resource where Israel worked on controlling the streams if this river as it is considered an important section from the waters system of the region and because of more than one country is participated in the basin of this river, it is configured a continuous conflict status where Israel covets to the waters of this river

and its close geographical position to this place and the same with Litany and Yarmouk River and the streams of Syrian and Lebanese waters.

Israel gave special importance into Litany River as it is considered an important water storage. As well as, it represents a political borders from the north and also, it provides the Basin of Jordan River with high quantities of waters. Israel presented a desire in controlling the waters of Litany River through the American-Israeli water projects as clear in the texts of the projects to each of both Rotenberg, Eunides, Laudermilk, Savage, Hesse, Gordon Caleb and Johnston. The beginning of Israeli exploitation of Litany River in 1967 where it is entered to the south of Lebanon and occupied this area in order to control on most of the streams of Jordan river and convert the streams of Wazzani River in Lebanon to its lands. Moreover, Israel converted the stream of Dardarah in Marjayoun area and exploit its waters. After 1978, Israel started the pumping of Litany River into the Lake of Tiberias with quantity of 150 million m^3 of waters. It was expected that the quantity of the waters that converted into Lake Tiberias will reach to 450 million m^3 of waters. The continuous of Israeli waters exploitation and its entered into Lebanon lands in order to secure the water resources after the withdrawal from the south of Lebanon will lead to continue the water conflict in the future.

1.18 The Future of Water Conflict and the Possibilities of Developing the Armed Conflicts

The water configures the issue of difference and conflicting in addition to its consideration as economic, social and legal case where it is a security and strategic case which associate with the lives of the people of the region and may cause conflicts and wars in the future because of the problems of borders, occupation, resettlement and expansion.

Israel used the military power in order to achieve its goals in the expansion and settlement since the beginning of 1948 and until the current time. At the end of 1967, it is occupied most of the lands that necessary to implement its expansion projects and controlled the lands of Wet Bank which is considered the main source to feed the aquifer waters in the Palestinian coasts. As well as, it is controlled on an important part of Jordan River streams and its tributaries including Syrian Golan Heights and the slopes of Sheikh Mount which have great importance in feeding the resources of

the water region. As well as, it is occupied the Egyptian Sinai and controlled on the waters and southern rivers of Lebanon and controlled them.

The waters will stay the axes of consideration of the region states and their relationships with each other and represent a shape of collaboration, participation, friction, tension, or even the use of power and enter into armed conflicts. The reasons of the conflicts in the future between Israel and surrounding Arab countries may belong to the following reasons:

- **The resources of Arab waters streams**: the streams of the Arab waters locate outside of their lands where the streams of the main rivers in the Arab countries locate outside of their political borders such as Euphrates, Nile, and Tigris which make greatest of the Arab water sources outside of their control area and under the influence of other countries which can be used as a political and economic pressure tool against the Arab countries especially that Israel may use its influence at these countries to achieve its water interests against the Arab countries where Israel seeks from a long time in order to archive the thought of changing the streams of Nile. This mater is refused by the Egyptian side completely as it is considered a violation on the Egyptian sovereignty on its resources while Israel sees that it may achieve to its water security.
- **The Israeli attacks on the Arab waters**: Israel did not stop by making the water of Palestinian lands which occupied in 1967 to be on their own but it works on controlling the Arab streams of waters and contain the largest available water incomes in the surrounding countries whether they are in the southern part of Lebanon or the waters of Jordan river basin. This policy will reflect negatively on the people of the region countries because of the inflation in the population growth and increase the water consumption.

One of the most important Israel attack on the Arab waters is what Israel did of destroying for the organization of Arab project to exploit the water of Jordan river basin and its streams in 1965 where Israel is considered the project as a declaration of war by the Arab countries. As well as, Israel destroyed the equipment and stations of converting the Lebanese waters in the Wazani River during the Israeli attack on Lebanon. The water crisis at the Jordan river basin is considered complex problem especially that Israel work by its water policy on the depletion of water resources of Palestine and the Arab countries and make high damages in the economics of the

region countries. So, the water resources are considered the more important reason in the conflicts and wars which happened previously. Jordan water basin represents one of the most important conflicts areas as it is directly associated by the core of the conflict with the direction relationship between Israel, Jordan, Syria and Lebanon in addition to the occupied lands of Palestine in 1967.

2. CHAPTER TWO: WATER DEMAND AND WATER CONSUMPTION IN ISRAEL AND PALESTINE

The passage of waters in Palestine and Israel pass in crisis where some experts considered it as very dangerous crisis and it threats the Israeli economic in an unprecedented image and this crisis is increased in the last years because of the lack of waters and the continuous of extra withdrawal from the water store in the containers of natural waters. As well as, in the Israeli conferences recently, there are many researches appeared which associate to this crisis. At this chapter, we will try to highlight the dimension of this crisis and the volume of water quantity in Israel and Palestine and the consumption ways, the water resources and the suggested solutions and we depended on many Israel and Palestinian resources.

2.1 Palestinian Consumption

According to the world health organization, currently the Palestinian people get his per capita of waters daily. In spite of that 66% of the Palestinian people consume about 50 liters/day, the consumption of the Palestinian for water is about 70 liters/day.

2.2 Israeli Consumption

In contrast, the average of water consumption for the Israeli people is about 300 liters/day. As well as, if we take into consideration the consumption of the industrial waters by the Israeli people, the average of water consumption for the Israeli people is five times greater than the Palestinian consumption of waters. Moreover, the water consumption in Israel is divided into three division which are domestic consumption and consists 20% of the consumed waters annually, the agricultural consumption and includes the largest consumption ratio in the country which amounted 75% and the industrial consumption and consists of 5% of the consumption. While the domestic consumption includes the consumption in the drink waters, it is necessary to make the waters which reach to the houses with high quality and the water which used in the industry must be like this quality or more because they may use in the chemical interactions while the water which used in the agriculture can be less quality.

Table 9 represents the withdrawal waters from the different water resources which calculated by millions of cubic meter while Table 10 explains the quantities of water consumption in different facilities which also calculated by millions of cubic meter.
At the end of 1990 the Central Intelegence Agency of America is issued a report about the water situation in Israel which include 170 page, the following numbers are shown about the water consumption in Israel as showed in Table 11. While about the current water deficit, it is about 1600 million cube.

Table 9: The weight of water for 1984/1985 (Damashkeya Ghassan, 1994)

Lake of Tiberias	610
Flood water	90
Reclaimed wastewater	60
Coast aquifer	455
Mountain aquifer	740
The other aquifer of Galilee, Carmel and the Negev	190
Summation	**2145**

Table 10: The waters which used in different facilities (Damashkeya Ghassan, 1994)

Agriculture	1450
Domestic use	425
Industry	105
The population of occupied area	165
Summation	**2145**

Table 11: Water consumption in Israel currently (Damashkeya Ghassan, 1994)

Agriculture	1300 million cube
Domestic use	495 million cube
Industry	107 million cube
Summation	**1902** million cube

2.3 Sewage Connections

In Palestine, the percentage of people who connected to the sewage system is 45.8% generally: 34.6% inside West Bank and 66.3% in Gaza while in Israel 95% of the wholly produced sewage is collected centrally in one sewage system.

2.4 Overdrawn Water and Unaccounted-for Water

The waters which consumed by the Palestinian people especially in Gaza and West Bank exceed the natural rate of replenishment that resulted in degradation in the underground waters and decrease in the necessary waters for health, industry and agriculture. Due to the lack of infrastructure in West Bank and Gaza, the part of the lost water is 50% in Gaza and 40% in West Bank. Usually these waters are lost because of problems in the transferred pipes.

2.5 Water Withdrawals in Palestine

The overall demand on water in Gaza about 125 MCM and in West Bank is 120 MCM. The Palestinian people are prohibited to develop their water resources since the Israeli occupation on Gaza and West Bank in 1967. Though Palestinian withdrawal has raised modestly from about 200 MCM/year in 1967 to 240 MCM/year in 2000, the number of population is nearly tripled in the same period of time. It means that the Palestine water withdrawal in 2000 stood at 107 to 120 percent of its 1967 level, the Palestinian population in 2000 was nearly 300% its 1967 level. Therefore a considerable decline in overweight per capita withdrawal (Hussein A. 2001). The total water demand in Gaza and West Bank is illustrated in Table 12.

Table 12: Water Demand in the West Bank and Gaza Hussein A. 2001)

	WEST BANK	**GAZA**
Number of wells	305	3,855
Total well discharge	58 MCM	122 MCM
Number of springs	126	0
Total spring discharge	25 MCM	0
Mekorot water	32 MCM	5 MCM
Total Available	116 MCM	244 MCM

2.6 Water Suppliers to the West Bank and Populations Served Mekorot, Jerusalem and Palestinian councils

The West Bank contains three main water providers including Mekorot, the Municipality of Jerusalem, the Palestinian municipal village councils and water facilities of the West Bank (Hussein A. 2001).

Mekorot supplies about 11% from the waters come to the West Bank and its waters come from resources inside Israel. Also, it provide about 15% of the waters to the West Bank from sources inside the West Bank. While the Municipality of Jerusalem provides about 1% of the West Bank waters and its resources locate inside the West Bank. Finally, the Municipalities and Village Councils of the West Bank supply around 16% of the West Bank waters and its resources locate inside the West Bank. Table 13 clarifies the West Bank regions, the population who are served/not served by one of the three suppliers and the number of served/not served villages. The West Bank contains 179 villages which are not received their waters by pipes but they receive the waters by tanks and cisterns (Hussein A. 2001).

Table 13: The Distribution of Water provide in the West Bank by Population and Number of Localities Served (Hussein A. 2001)

District	Population Served			Number of Villages Served		
	Served	Unserved	Total	Served	Unserved	Total
Jenin	112,923	65,247	178,170	34	41	75
Tulkarem	86,452	23,858	110,310	15	23	38
Qalqilia	50,497	14,891	65,388	16	17	33
Salfit	33,100	11,174	44,274	14	7	21
Tubas	22,578	8,931	31,509	7	2	9
Nablus	178,137	139,798	217,935	32	24	56
Ramallah	225,873	8,517	234,390	85	8	93
Jerusalem	254,387	0	254,387	23	0	23
Jericho	27,599	484	28,083	12	1	13
Bethlehem	110,430	2,583	113,013	40	10	50
Hebron	276,085	18,031	294,116	51	46	97
TOTAL	**1,378,061**	**293,514**	**1,571,575**	**329**	**179**	**508**

2.7 Water Tankers

There are numerous regions in the West Bank where their water resources are cut off for two or three weeks during the summer season especially these sources which stream from the Israeli lands (Hussein A. 2001). Thus, when these resources are not available, there are tankers sale the domestic use waters to people with price (more details about the price of the waters will be described later). Table 14 illustrated an informative influence of the absence of piped water in stress times. It must be mentioned that the average cost of the piped waters to the consumers is amounted between \$1.00-\$1.50/m^3.

Table 14: The Price of Water Sold by Tank Vendors in Different Districts of the West Bank 2003 (Khinsee, 2005)

District	**Cost per CM (\$ at March, 2003 exchange)**
Bethlehem	4.90
Hebron	3.63
Jenin	2.56
Nablus	2.99
Qalqilia	2.35
Ramallah	4.91
Salfit	4.70
Tubas	2.35
Tulkarem	3.20

Table 15 illustrates a depiction of the local water distributions in Palestine. The following steps include a more detailed information about the water distribution in Palestine according to the details of Palestinian Water Authority.

Table 15: Domestic Water Allocations in Palestine 2005 (Khinsee, 2005)

Governorate	Water Supply for Domestic Sector MCM	Population 2004	Daily Allocation per capita L/c/d
Palestinian Territory	142.85	3,637,529	107.5
West Bank	73.02	2,055,227	97.3
Jenin	4.93	246,685	54.7
Tubas	0.69	45,168	41.8
Tulkarem	6.67	162,936	112.1
Nablus	9.84	317,331	84.9
Qalkiliya	3.96	90,960	119.2
Salfit	1.67	60,132	76
Ramallah/El-Bireh	13.19	270,678	133.4
Jericho	3.09	40,909	206.8
Jerusalem	6.79	144,597	128.6
Bethlehem	12.39	169,190	200.5
Hebron	9.80	506,641	53
Gaza Strip	69.83	1,337,236	143

2.8 Brief Survey of Gaza, WEST Bank and Israel

2.8.1 Gaza

The resources of all water resources in Gaza is from Gaza Coastal Aquifer. At the current time, Karen Assaf is a manager of the Department of Water Planning at the Ministry of Planning and International Cooperation working in the Palestinian Water Authority. She wrote about the current situation of water in Gaza and said "Gaza contains on a large number of wells reach to 3000 well but most of these wells are shallow wells and can be used only for agricultural and domestic use, it can be said that the water situation in Gaza is very bad and many people dogged their wells inside the living rooms in order to reach the shallow waters. The reached water is moderate salinity and only 12% of the waters in Gaza is actually appropriate to drink consistent with the criteria of World Health Organization" (Hussein.A 2001). The distribution of the wells in Gaza are illustrated in Figure 10.

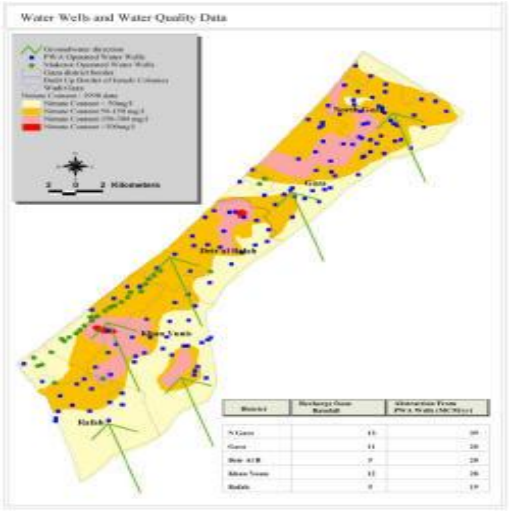

Figure 10: The distribution of wells in Gaza (Hussein, 2001)

2.8.2 Population

Gaza is considered one of the most populous cities in the Northern Hemisphere with 3,500 people per sq. km and the total population is about 1.4 million people. It is supposed that the number of population will be increased to become 2.3 million in the next ten years and according to that the density of population will be increased to become 5,800 people per sq.km.

Gaza is considered arid region with an area about 360 sq. km in size and thus it has problem of size, unemployment and poverty. The per capita income in Gaza is about $600/year and the unemployment percentage is 50%. Therefore, the percentage of people who live under the poverty line is approximated to 81 %.(Hussein. A 2001).

2.8.3 The West Bank Size, Geography and Ethnicity

The size of the West Bank is fairly a bit greater than Gaza where its size is around 5,860 sq. km. the West Bank is topographically diverse and landlocked city. It geographic shape is considered the lowest place on the earth, the Dead Sea at –408 meters, and its maximum fact is overhead 1,000 meters of the sea level. The number of Jewish settlers who live in the West Bank is about 187,000 and its whole population is about 2.4 million people. The percentage of Christian people who live in the West Bank is 8% and contains Jewish with percentage of 7% and the rest of people are Muslim. While percentage of Muslim who live in Gaza about 99.7%.

2.8.4 Unemployment and Poverty

The per capita in the West Bank is $800/year and there is about 59% of the people live under the poverty line while the unemployment percentage is 27% (A.R.I.J.2005). The political overview of the West Bank is illustrated in Figure 11.

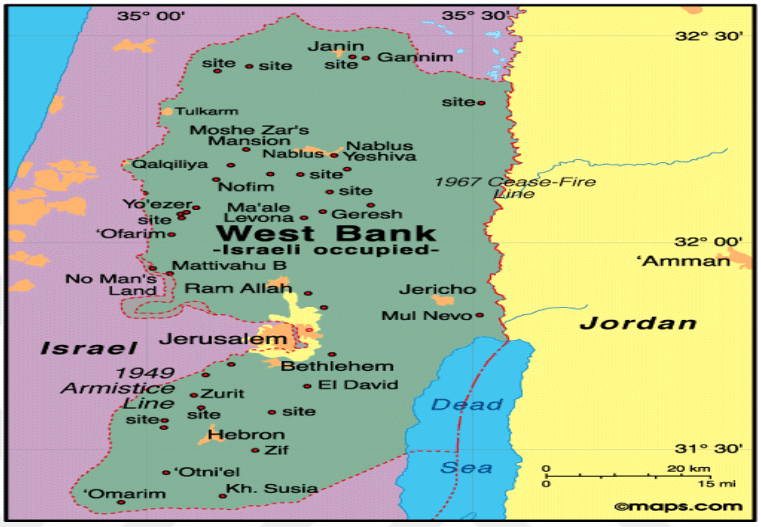

Figure 11: The political overview in the West Bank (A.R.I.J.2005).

The total of the groundwater that is used in the West Bank is amounted of 679 MCM where the percentage of the groundwater that used by Palestinian people is 19.6% and Israel use about 56.6% and there is 23% of these water are used by the Jewish settlers live in the west bank. It must be mentioned that the number of Palestinian people who live the west bank is about 1.8 million while the number of Jewish settlers who live in the west bank is about 187,000. An overview of the Jewish settlements that existed in the West Bank is illustrated in Figure 12.

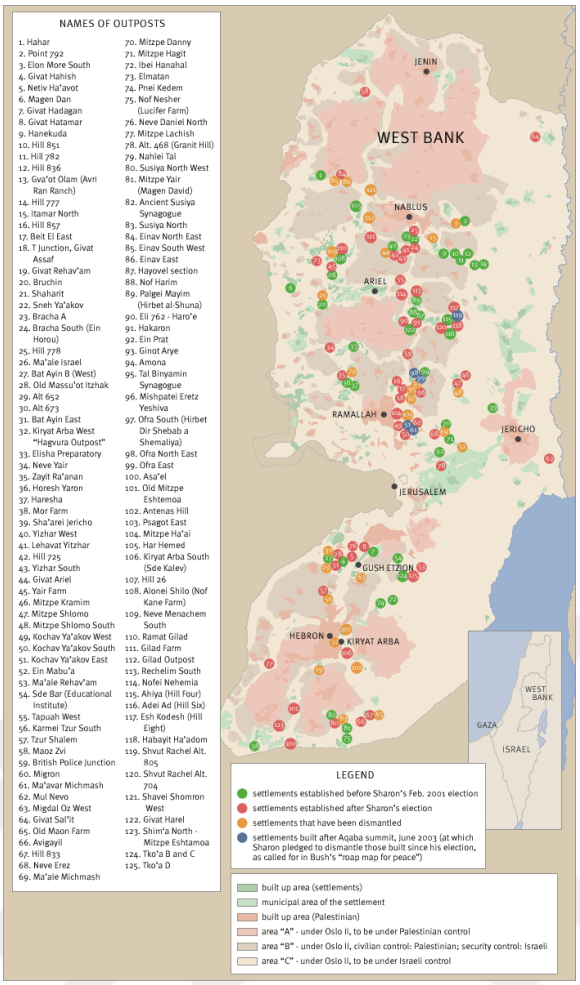

Figure 12: Overview of the Jewish settlements in the West Bank (A.R.I.J.2005).

2.8.5 Quality of Water in Gaza

The groundwater is the only water source in Gaza and used for agriculture, industry and domestic use. The thickness of the aquifer ranges between 10 meters in the eastern border to 150 meters beside the coastline while the border of freshwater extending from 10 meters beyond level of mean sea in the southeastern region to less than 2 meters beyond sea level beside the coastline. As we stated before, the accessible return of the groundwater is around 91 MCM/year whereas the entire perception is larger than 150 MCM/year.

2.8.6 Chemical Threats to the Gaza Aquifer

The large concentrations of nitrate and chloride represent the most dangerous elements that threat the groundwater in Gaza. According to US Environmental

Protection Agency that the acceptable levels of nitrate in the drinking waters must range between 10 mg/L and 250 mg/L. Table 16 illustrates drinking wells testing and refers that the nitrate levels in the drinking waters are greater ten times than the greater acceptable EPA levels. The chloride quantities that existed in the drinking wells is 1.5 greater than the acceptable level of chloride.

Table 16: Chloride and Nitrate Concentrations (mg/L) in Drinking Wells among Gaza Governorates (1999-2002) (Atwan, et al., 2004)

		Chloride		Nitrate	
Governorate	**# Samples**	**Mean**	**Maximum**	**Mean**	**Maximum**
North	198	126.9	489.5	114.4	360
Gaza	242	402.4	2180.5	121.3	291
Middle	40	488.9	782	65	104
Khan Younis	109	777.8	1580	190	383
Rafah	60	514.7	1236	110.1	240
TOTAL	649	397.1	2180.5	126.2	383

The seawater intrusion to the aquifer because of the continuous pumping over years led to its pollution. Also, the pollution phenomenon is caused by another reasons including the human reasons, agricultural reasons and wrong waste management. In 2001 the summation of the pumping location in Palestine is amounted of 137 pumping station 4 of them locate in Gaza and 133 locate in the West Bank. About one-third of residential complexes in Palestine do not contain on waste collecting services. Except for Jalabia camps, the refugee camps in Palestine do not contain on sewage services. Gaza contains only three extant water treatment and no one of them work effectively. Therefore, domestic wastewater are discharged by septic drilling or precipitation to the Mediterranean Sea.

2.8.7 Disease Related to Waters in Gaza

Center of Disease Control and Prevention revealed that there are 17 thousand case for disease related to waters in Gaza are discovered during 2002-2003. Nevertheless, because of numerous indications are frequently tangled with snother illnesses, many investigators atmosphere as numerous as 25 spates drive unreported for every one stated because many people are uncovered to hypothetically damaging germs and pesticides by taking showers or drink tap water (Atwan, N., et al., 2004).

2.8.8 Quality of Water in the Mountain Aquifer

The mountain aquifer that shared between the Palestinian and Israeli is considered one of the main source of waters in the West Bank. The great percentage of the waters in the higher levels of the three basins inside the West Bank and Jerusalem area where the recharge of rain is intense are rated as of potable quality with only insignificant salt rate range between 50-150 mg chlorides per liter. The western basin includes similar levels of chloride except in three areas which are Ayalon, Hartiv and Amatzia where the rate of chloride at these areas reach 300-400 mg/L. the rate of the brackish waters in Beersheba area range reach 200-300 mg/L.

2.8.9 Imbalances in the Mountain Aquifer

The continuous abstraction of the groundwater from the mountains is accompanied by many risks including the decrease of the groundwater at these areas and increasing the salt waters of the Sea in the western basin. The only source to recharge these waters are the rainwater which differ from one year to another. Extensive driving of the Mountain groundwater started in the 1950's together with several other emerging states as the centrifugal drive came into importance. Till that time, the annual water averages which been pumped from the northern and southern springs that include Taninim and Yarkon areas is amounted of 300 MCM. During the Britain mandate in Palestine between 1917-1947, the Britain exploited these springs in order to pump the waters to Jerusalem. When the Israeli authorities realized that the salt waters class are close to freshwater bodies, they implemented a policy that aim to prevent a significant drop in levels of freshwater in the district of the Taninim (northern) springs that during the 1960's were generating around 40 MCM/year. The decision was taken that levels of waters would not drop than +9.00 m. At the pump age regions, the waters levels are raised to 3.5 m/year. The Western basin compassion towards saltwater interruption is such that process of the Yarkon-Taninim Aquifer for the National Water System currently is managed conjunctively with the working system of Kinneret Lake if it is necessary from the economic way (Bashir et al 2005).

2.8.10 Pollution Threats to the Mountain Aquifer

The aquifer waters that existed at the mountain regions are polluted by different resources as follow:

- Penetration from septic tanks, drains, pit latrines and other sanitation accommodations;
- Spills that resulting from the sewage systems;
- Water leaking from sewage basins and treated or untreated irrigation waters.
- Leakage by the treatments plants;
- leachates from hard absorptions and dumping locations;
- leachates from composts and insecticides;
- leakages or spills by the installations of fuel and oil, stations of gasoline, fuel tankers, storage tanks for toxic supplies, animal sheds, etc. (Bashir et al 2005).

It is enough for one cubic meter from the heavy fuel or oil to render 200 x106 MCM of drinking water unhealthy for drinking (Bashir et al 2005). The compassion of the Aquifer region to the contamination deceits in its mineral, karstic, cracked unsaturated region. The soil absence shelter along with its biological atmosphere, make the groundwater of the mountains vulnerable to high penetration ratios in short detention times. In the mountain region there are 550 wells but only 550 of them are potable water. There are only 170 well are endangered alongside the pollutions but the residual wells are also categorized as contain straight contact between the soil and the aquifer or circuitously hydraulically connected and expose to pollution. The main layers of the mountain aquifer with its three dimensional schematic sketch is shown in Figure 13. The Eastern and Western (Yarkon-Taninim) basins can be distinct as the main driving wells in the curbed region of the Western basin.

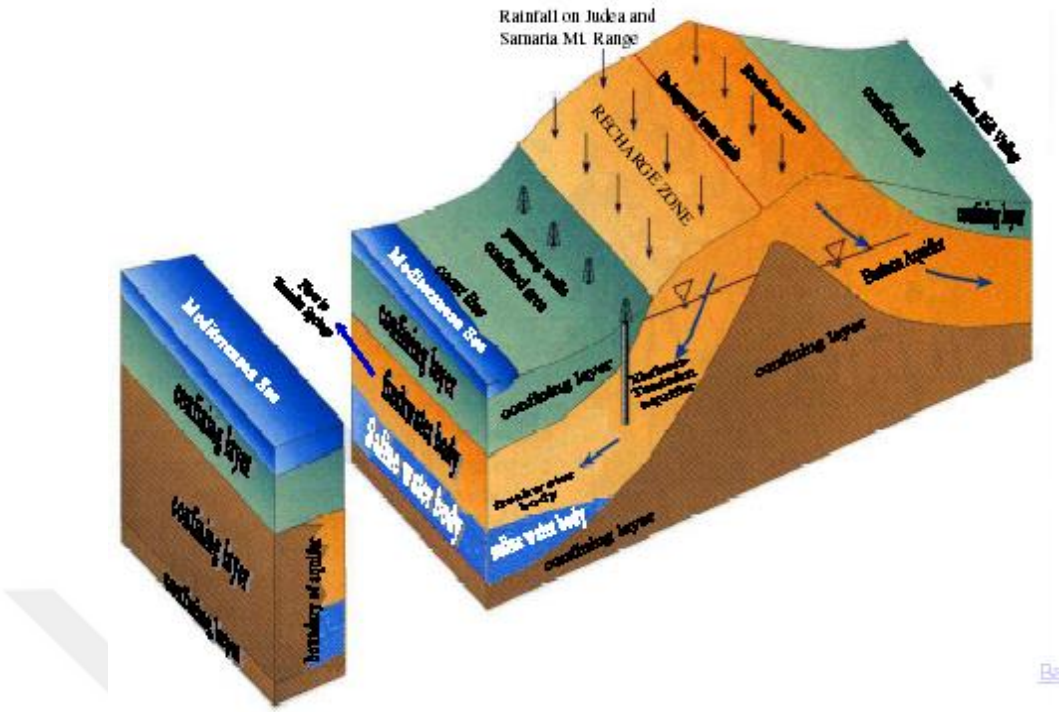

Figure 13: The border between the freshwater body and saline water body (Bashir et al 2005).

2.8.11 Salinization of the Mountain Aquifer

Figure 14 explains the risk of over-pumping. The risk of salt water leakage is increased whenever the interface between the body of freshwater and saltwater is raised. The border is seemingly increasing at a ratio of 1-10 meters/year. It rose through the years 1988-2002 by at smallest 50 meters associated to an assessed arrival of at minimum 300 MCM of saltwater (Benvenisti, Eyal et al 2000).

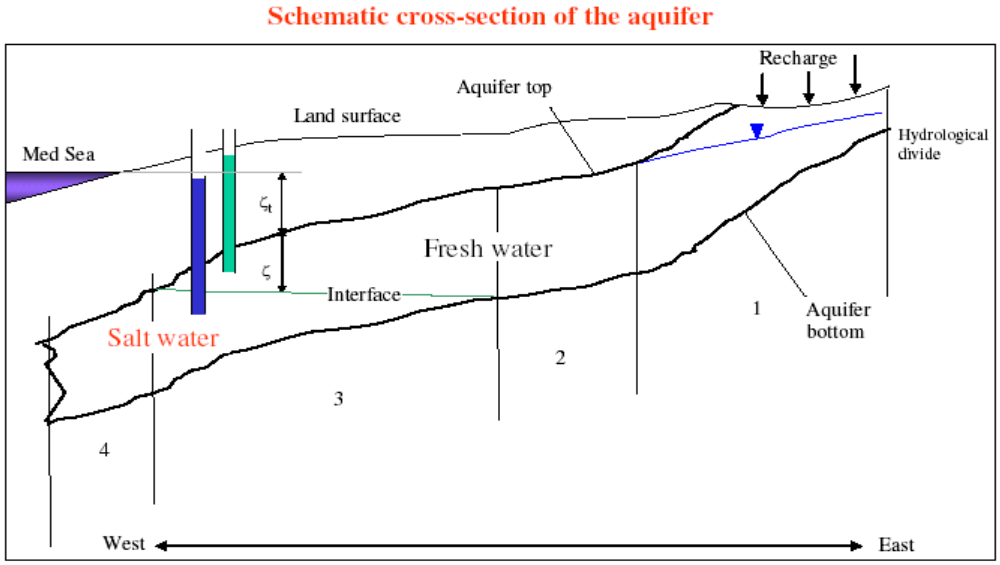

Figure 14: The Risk of over-pumping (Benvenisti, Eyal et al 2000).

The increase in salinity ratio and the general degradation in the type of waters at the groundwater class is coincided with the development of oxygen lack and H2S appearance (Benvenisti, Eyal et al 2000). Anoxic circumstances denote to the reduction of dissolved oxygen.

There are many studies which have been implemented in order to measure the Salinization of the Upper sub-aquifer in the Kefar Urriya driving meadows which locate at the western hills of the Judea Mountains that forces water from the Mountain Aquifer. The wtusies which interest at this topic include (Guttman et al., 1980), (Guttman et al., 1982), (Kroituro, 1987), (Ecker, 1995), (Guttman et al., 1997), (Rosenthal, et al, 1999), (Avisar et al, 2000), (Katz, 2001) and Frumkin et al., 2003. The instruments suggested for salinization in the whole previously mentioned comprised influx of water resulting from an evaporitic body, remaining seawaters from a maritime interruption and reddening of salts and biological matter from the covering local mount collection. The studies have not mentioned the salinization coincidence and the development of decreasing circumstances. Also, there is a modern study implemented by (Burg, 2004) and showed that the degradation of water quality occurs because of saline seepage, organic-rich water from the bituminous rocks to the essential mountain groundwater.

It is shown that this animal material is the petrol which eats the melted oxygen, vagaries the municipal of the red sox of the water and works as substrate for bacterial sulfate decrease in order to create H2S. The hypothesis supposed that the degradation occurs in all classes and the aquifer and the similar degradation may happen in other place. In the study area of Kefar-Uriyya pumping fields revealed a affected salinity incline above a coldness of just a few kilometers from <180-ppm CL in the east to >400 ppm CL in the west (Burg, 2004).

2.8.12 Untreated Sewage in the Mountain Aquifer

The dirt waters for more than two million people leak to the most important recharge area without any filtration which cause great problem. The quantity of sewage waters that leak to mountain aquifer region from Palestinian resources is approximated about 46 million cubic meters per year (Blomquist et al 2003).

The unlined cesspits are used in the rural Palestinian West Bank settlements in order to absorb about 60% of sewage waters while 70% of the urban places are associated with sewage systems and in most cases they are discharge the waters without any treatments in opening streams (Blomquist et al 2003).

Until the time of writing this research, there is only one plant in the west bank in order to treat the sewage waters. There are many obstacles that face the establishment of developed sewage systems in the West Bank and even in the urban areas including:

- The hard Israeli policy during the whole period of the occupation.
- The absence of the technical and financial human resources.
- The lack of good administration to manage the sewage facilities.
- Poor environmental and assurance responsiveness. (Brooks, David B 1993)

There is no information about the work process of the sewage systems in the Jewish settlements that existed in the West Bank. The reports of Israeli Water Commission state that 70% of the sewage waters are treated in satisfactory way. However, the conflicting reports refer that 48% of the sewage waters that created by the Jewish settlements in the West Bank are insufficiently treated or under the Israeli standards (Blatter, J. and H.Ingram 2001).

The Israeli settlements at the West Bank are contributed in the organic and inorganic pollution loads with quantity approximated about 400,000 population equivalents (Blomquist et al 2003).

2.9 Water Demand in Israel

The number of population in Israel is about 6.2 million while its territory is about 1,017 sq. km. The community who live inside Israel is divide into 76% are Jewish; 15% are Muslim and 8% Christian. In 1948 Israel has achieved its independence and declared statehood. The percentage of the unemployment in Israel is amounted of 11% and there is about 18% of the people are below the poverty line. The average of the per capita income is $20,000/year while the Israeli GDP is $128 billion. A political overview of Israel today is shown in Figure 15.

Figure 15: A political overview of Israel today (Brooks, David, 1993).

2.9.1 Quality of Water in Israel

Objective as the fires in the Cuyahoga River in Ohio in June of 1969 assisted branch an fall of contamination regulator actions that resulted in the Clean Water Act, Great Lakes Water Quality Arrangement and the generation of the central and state Agencies of Environmental Protection. As well as, the tragic collapse in Israel on Yarkon River in Tel Aviv through the Maccabi Athletic Games in 1997 and at

least four Australian are killed where the waters they fell in were polluted by the sewage waters (Brooks, David B 1993).

2.9.2 Environmental Indicators

At later section of this study, we will talk about the Israeli history and the development of its organizational structures of waters in detailed way. The process of placing indicators for the sustainable development in Israel is started recently. These indicators refer to many issues including increasing the general awareness of the environment in Israel in one hand and transfer the information to the decision makers which associated to the ecological and maintainable growth styles on the other hand. These ecological signs in many fields are collected by the ministry of environment. These indicators are varied and include Hazardous Substances, Pollution of Soil and Fuel, Quality of Air, Environmental Planning, Marine Waters, Noise, Population Growth, Landscape and Biodiversity, Solid Waste, Water and Rivers and Wastewater Treatment.

2.9.3 Sewage Treatment in Israel

At the current time there are more than 500 facilities which used to treat the waters in Israel including 26 plants to treat the wastewaters. In 2001, there were about 440 million cubic meters of sewage created in Israel 95% of these sewages are composed in central manure systems 80% has been preserved and 65% (285 MCM) was regained to be reused. In 2001 70% of the wastes created by the state's action plants fulfilled with the principles set in guidelines; 20 mg/L BOD and 30 mg/L postponed solids (Brooks, David, 1993).

2.9.4 Chemical Monitoring of Effluent Water in Israel

The increase of using the sewage for the irrigation purposes, this leads to increase the chloride, sodium and boron levels and their concentrations became high and require the monitoring process. The levels of chloride and sodium in Haifa is illustrated in Figure 16 and Figure 17 explains the chloride levels in the Dan region that consists Tel Aviv city. Nearly half of the effluents that created by Israel is created by Haifa and Tel Aviv.

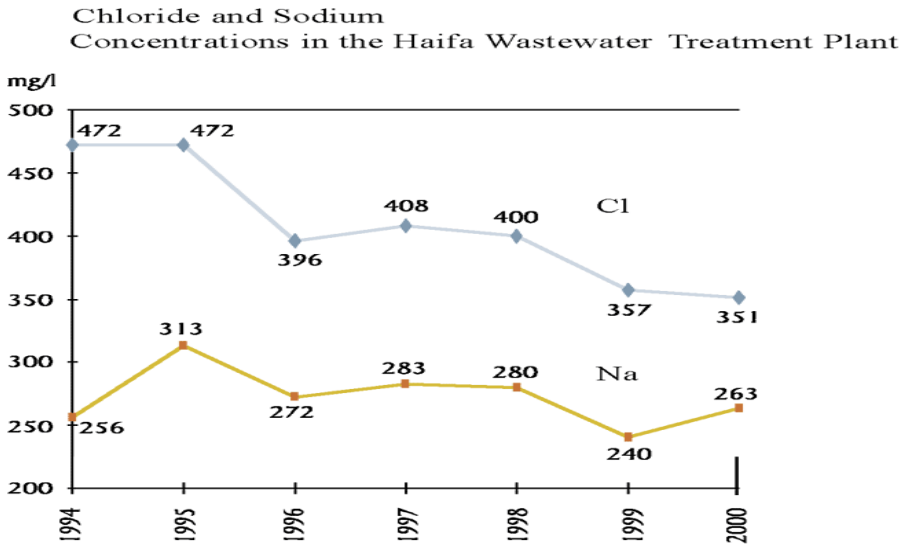

Figure 16: The levels of chloride and sodium in Haifa (Blomquist et al 2003).

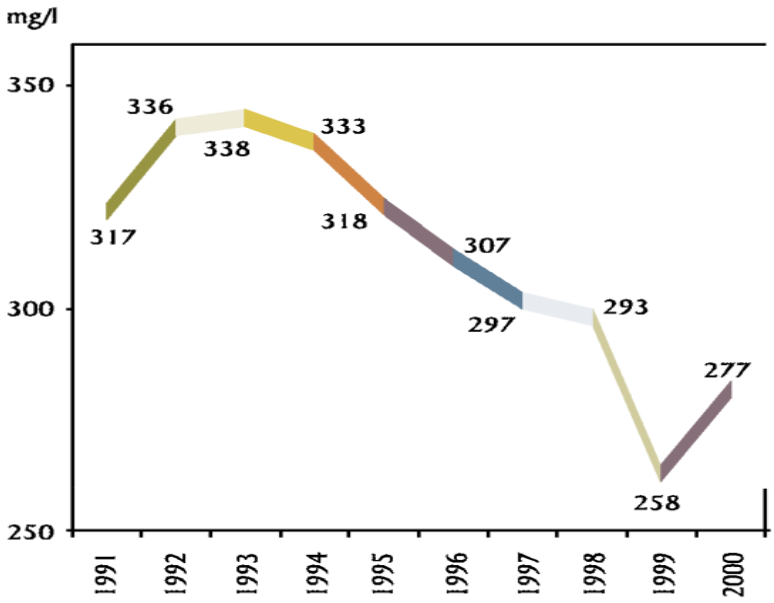

Figure 17: The chloride levels in the Dan region (Blomquist et al 2003).

According to the reports created by the hydrological services, the concentrations of the Coastal Aquifer are raised at a ratio of 2.4 mg/L each year strating from 1970 and became equal to 198 mg/L in 2000. The absorptions of the nitrate are improved from 30 mg/L in 1950 to 59 mg/L in 2000 a yearly amount of raised of about 0.6 mg/L. The concentration levels of the nitrate and chloride in the Northern Coastal sub-Aquifer have high increased as illustrated in Figure 18.

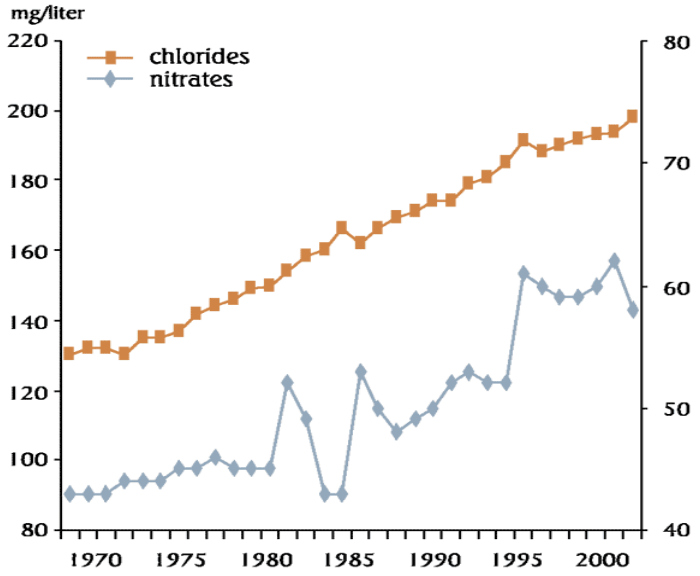

Figure 18: The concentrations of chloride and nitrate in the coastal aquifer(Blomquist et al 2003).

2.9.5 Cultural Challenges

Commonly the transboundary waters are accompanied by great problems. International transboundary groundwater difficulties signify a separate and significant type but not entirely transboundary aquifer are global (Brooks, David 2005). The conflicts which occur between the countries because of the transboundary water are difficult to be solved and can be solved only through the language, government and common traditions in the familiarity, law and the acceptance of using the waters. Nevertheless, there are famous problems where all of these factors have not been solved such problems such as the water problems in the adjacent states in the United States.

The differences between the Palestine and Israeli are huge and varied and represented by the military, economic and political differences and a large section of this study is discussing those institutional differences. (Brooks, David 2005). The holes in these regions have certainly compounded the resolve of the Middle East engagement and have prohibited an unpaid establishing of combined administration of district water assets. The confidence between water resource scholars who living and working in the Middle East depending on the supposition that the afford-mentioned elements can be solved. The base of the progress that can be happened is represented by the end of the Israeli occupation, restore trust and faith in institutional action, and enhance the quality of life and the political stability.

2.9.6 Islam and Judaism

In spite of the cultural, ethnic and religious differences between the Palestinians and Israeli, they are not considered complex factors in order to solve the conflict between the two states. Despite that this study does not discuss the religious issues, the two religions which are Islam and Jewish have common origins and historical concepts about the equitable distribution of waters between the two states. The Islam has many commands and references that work on organizing the interaction of the human being with his surrounding environment. Islam draws its followers specifically to the necessity of dealing with the waters in well manner and avoid damaging and provide the needs of waters to animals and plants and avoid the water which cannot be treated (Brooks, David 2005).

It is said that a generally viable system to manage the water resources in Islamic countries is additional probable to be comprehended if the administration mechanisms comprise a variety of extra inputs from the sacred, mystical and the resource-based compasses. Demand administration approaches on waters require continuous exertion in order to teach the people about the optimistic relationship between the Islam and waters (Brooks, David 2004).

Islam adopts the concept of jihad which enables the Muslims to deal with the current challenges that they face in their daily life. These instructions are interpreted by the fatwa which issued by the religion scientists in Kingdom of Saudi Arabia that enable the Muslims to reuse the treated effluent for the irrigation purposes. This fatwa enabled the Muslims to reuse millions of treated effluent (Brooks, David 2004).

The application of the Islamic method to manage the groundwater starts with faith in Allah and His limitless abilities comprising power, knowledge, wisdom, administration, mercy and justice. Therefore, the people must seek to the approval of Allah at their behaviors and obey the decrees of Allah in everything including acquiring and distributing satisfactory drinking water for entirely creatures; forbidding the monopoly of water which means to not use the waters as a product to be sold and bought but in order to ensure the distribution of waters between all of people to achieve its basic needs (Brooks, David 2005).

Since the Bible has been written in a part of the world where water is rare, it is not amazing that the characteristics of water expressively in the people life. Water scarcity became a serious issue and the aquifer is associated with wrath of god. The

Jewish prophets Elijah, Jeremiah and Haggai all expected lacks of waters as penalty from God. In contrast, the rainfall represents a good sign for God's favor and goodness.

In the old ages, the pollution and undrinkable waters were represented one the risky issues. One of the ten waves revolved the Nile waters to blood and clarifications have repeatedly discovered that this is a symbol for contamination. The pure waters is said in the Arabic and Hebrew as "Tahor" and needed when there was a need for cleaning in the temple in addition to its frequently use for God blessings(Brooks, David 2005).

"When the poor and indigent pursue water, and there is none and their language flop eth for thirst, I the Lord will hear them, I the God of Israel will not forsake them. I will open rivers in high spaces and fountains in the midst of the valleys: I will make the wilderness a pool of water and the dry land springs of water". (Brooks, David 2005).

The conflict that happiness between the Muslims and Jewish is always based on wrong conventions. Islam and Judaism are considered approach of life and stems from the same ancestor and have common concepts. The principle of apiece confidence does not prevent the propagation of the other. Lastly, it must be evoked that when Ishmael and Isaac went their distinct traditions to institutionalize and promulgate Islam and Judaism, correspondingly, both of them are resumed to Hebron when their father, Abraham, untrained on his passing bed and both of them, honoring their common father and heritage.

2.10 Water pollution in the coastal area

One of the problems which suffer by the clean waters in Israel is its continuing pollution from different resources for example the growth of pollution in the coast area lead to water pollution in the coastal area by different resources such as the remains of irrigation waters at these areas, the waste of factories and the land in the coast area swallow a large quantities of sewage waters. As well as ,the extra withdrawal of waters at this complex lead to leak of the waters to these waters which close to the clean waters where it will be a need to reach new clean waters for instance from the country project in order to increase the quantity of the waters at this complex.

This dangerous became reality in many cases where the diseases are spread where their source was the polluted waters which leaked to the drink waters where in 1988 there were many infections appeared such as the polio and this situation enforced the government to vaccinate all the population in the country.

2.11 Waters in Israel

Until now there is no one wrote about the discrimination of Arab farmers in Israel from the Jewish farmers in terms of the quantities of waters and especially that the Arab agriculture in Israel is almost marginal. However, it must take idea about this case where there are 1700 million glass of waters which specialized to irrigate the agricultural lands annually and only 27 million glass of waters is gone to the Arab farmers which is less than 2% of the waters. At the past there are many discussions are implemented about the confiscation of the Arab lands in Israel and about the process of removing them from the agriculture. The Israel ideology behind these policies were security ideology where as it was said the Arab farmer who work with Jewish farmer contributes in the security while the Arab farmer work in his land will harm the security. Also, even the few quantities of waters where given to them it was not given in the same price which paid by the Jewish. Moreover, the Arab in Israel are negatively characterized in terms of drink waters where they were allocated to the Arab cities the half of the waters which were allocated to the Jewish cities because they were said that the dirty Arab is good Arab. There are another dimension for the relationship of the Arab in Israel with waters which is based on drying most of the natural springs and wells which were used in the past in their purposes of the irrigation. Thus, the Arab population were depended on Mekorot Company completely both in drink and irrigation waters.

2.12 The water authorities in Israel

The water management in Israel is distributed into many committees which are the Knesset Water Committee, Ministry of Agriculture, the Commission (Netsepot) Water in Israel and the last one works with special wing which belong to the ministry of agriculture. The commission is responsible on the neglect in the deficit problem of waters and non-conduct steps and procedures in order to overcome the danger. As well as, in the last years and in the highlights of water and dry crisis, many public bodies have criticized the work of this commission and asked the

government to exempt the ministry of agriculture from its control on water wealth and suggested the establishment of independent public commission to be responsible in the waters instead of the water authority where it is controlled by the daily policy. The same invitation is directed by the government in its last report about the waters. In terms of water policy failure in Israel, the observer of the state placed many reports with strongly worded and the most important of them is the report of 1987 where its last line stated that there is overdraft in water withdrawal which harm the natural complexes waters in the country. In a workshop for the government control stated that "we hurt a great complex of waters and there is another complex in its way to damage and it is difficult to withdrawal the water from Tiberias Lake and there are some elements which say that the situation is not very danger and there are two warnings about the situation of the waters have launched from thirty years".

2.13 Suggested solutions to the water crisis in Israel

One of the suggested solutions to solve the water crisis is to reduce the quantity of consumed waters in 15% annually. This can be done by inserting work program and distribute less share of waters. Also, another method to reduce the water consumption is to increase the price of waters that used in the irrigation which lead to rise the use of waters at this field and especially there are thoughts that the farmers consume high quantities of waters. Moreover, a third solution is to increase the quantity of waters which been purified from the leakage waters, the fourth solution is desalinate the seawater and the fifth solution is to import the water or stole it from a rich country of water such as Turkey, Syria, Lebanon or Jordan.

The cost of desalinate one glass of water from the leakage is 75 agora while the desalination of seawater is about 100 agora. If the government is desalinated what need of waters from the leakage waters, it needs to 150 million dollar annually. In spite of decreasing the consumption of waters by 15%, this money will be provided to the state safe. However, this reduction is difficult to be applied practically and will lead to high damages in different branches of the agriculture and into great deficits to the associated parties. These difficult will face the officials when they want to increase the price of irrigation waters and the inventible results of this problem will lead to terminate the cultivation of cotton and citrus which consume high quantities of waters. As well as, increasing the price of water will open

another gap between the government and farmers which enforce the government to pay financial aid for them in order compensate the damage because of increasing the prices. Among all of these suggestions, it is clear that terminating the cultivations which consume high quantities of water look like the more suitable solution and meet great acceptance at most of the parties.

3. CHAPTER THREE: WATER DEMAND IN JORDAN AND LEBANON

3.1 Water shortage in Jordan and Lebanon

The lack of waters in the future is the common subject to be discussed in the Middle East and it is already happened in Jordan where there is decrease in the levels of waters in most parts of the country and the water stream are drying. The quota system has been applied where the citizen get his right of the waters for one or two days in a week. The gap between the demands on waters and the available quantity is threatened to be increased according to increase the number of population.

If the current recessions are continued, per capita of water supply will be reduced from the current 145 m3/yr to only 91 m3/yr by the year of 2025. Therefore, these estimates put Jordan in the absolute water shortage category. According to the quota of the individual for water, Jordan has the minimum water levels in the world. The water experts are considered the countries where their per capita of the water is less than 1000 m3/yr are considered water poor countries (Aliagyoshi and Shatan 1995).

Since the early 1960s Jordan suffers from the lack of waters and it is classified as water scarce country. Jordan occupies number ten in the world in terms of waters shortage (P.R.P 1998). There are many human and natural factors which through Jordan will face long-term water crisis where the current water resources are limited because of the arid and semi-arid climate. Moreover, the economic development and population growth not only effect on the availability of waters but they are also effect on the quality of waters. This field of study focuses on the main reasons for lack of waters in Jordan and the current situation for waters at this country and also, some of the basic elements about the sensible, supportive and maintainable water solutions.

3.1.1 Water shortage in Jordan

The Jordanian Government privileges that in contrast to some of Jordan's neighbors, while a Jordanian in 1993 had an annual water share of 200 m3, an Egyptian averaged 1200 m3, a Syrian 1800 m3, and an Israeli 480 m3 as illustrated in Figure 18 (Waj 2005).

The waters need in capital has increased to 300,000 m3/day. This quantity of demand is increased by 90,000 m^3 from the maximum amount of the daily water levels that result in deficit of 35 million cubic meters (Mm3) a year.

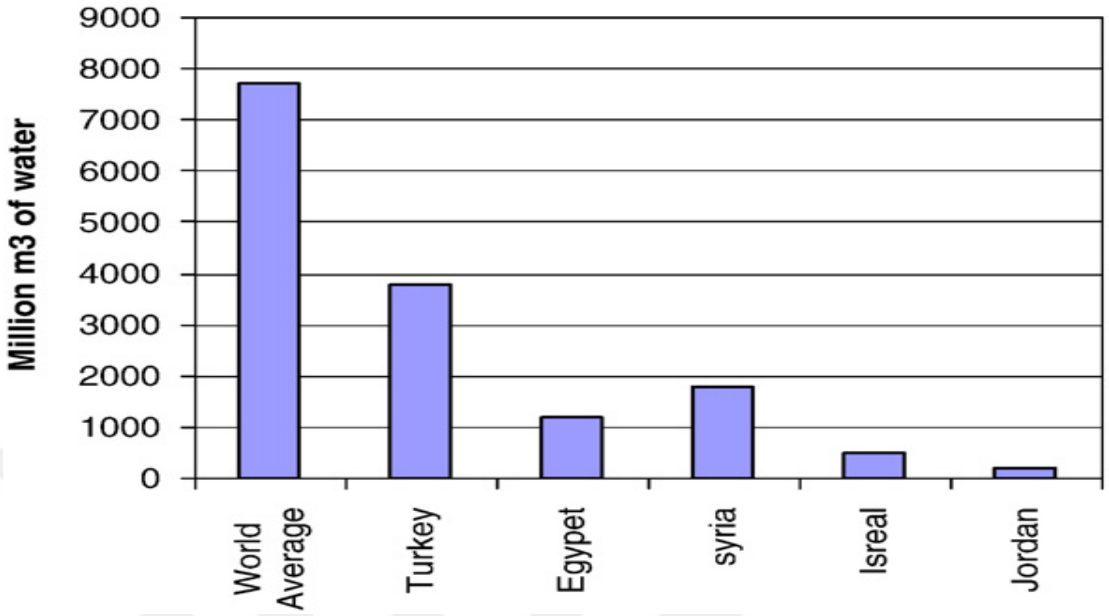

Figure 19: Comparison of annual water share between Jordan and some of Jordan's neighbors (Waj 2005).

As illustrated in Figure 19, the irrigation waters configure about 61% of the total demand on water while the industrial demand configures 6% and municipal demand 31%. Jordan is placed in an arid–semi-arid climatic region where near 80% of the country obtains average precipitation of less than 100 mm/yr and is commonly categorized as arid. 12.5% between 100 and 200 mm/yr, 3.8% between 200 and 300 mm/yr, 1.8% between 300 and 500 mm/yr, and only 1.3% receives more than 500 mm/yr.

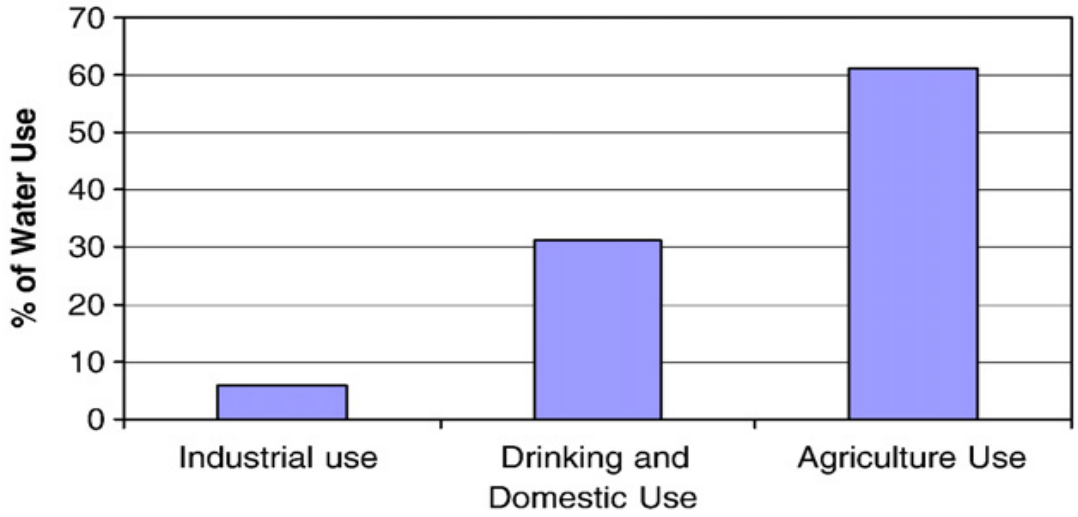

Figure 20: Comparison between industrial use, domestic consumption, and agricultural Activities(Waj 2005).

The quantity of waters that received annually by the eastern desert is approximated as 50 mm/yr. Figure 20 illustrates the quantity of precipitation in all parts of the country.

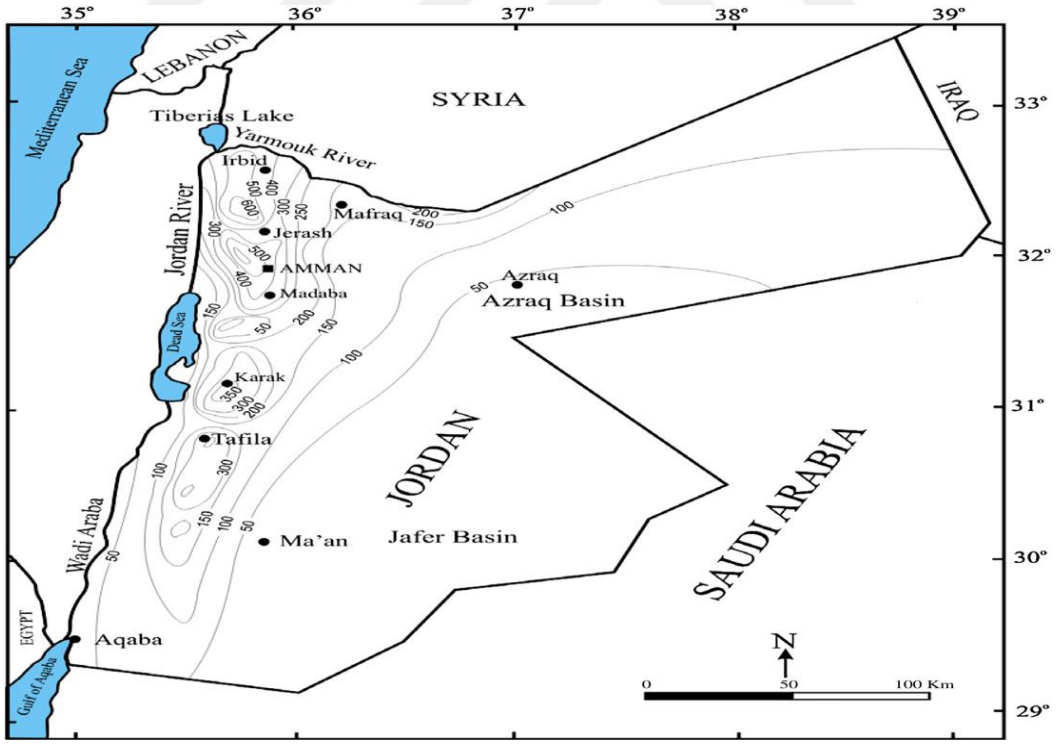

Figure 21: Average distribution of long-term (1938–2005) rainfall in Jordan (After WAJ and Meteorological Department) (Waj 2005).

The total amount of rainfall in Jordan during 2004/2005 is amounted about 9304 Mm^3 of which about 93.9% evaporates. The percentage of waters which infiltrates to recharge the aquifer is only 3.9%. The quantities of waters which are gotten by the Jordan River from the other rivers and stream are little because the rivers and streams are drying out. Thus, Jordan is mainly depends on rainfall to get the waters. Jordan has a large deserts areas within its southern eastern and eastern borders with Saudi Arabia and Iraq respectively. According to the future predications, the availability of waters are not good. The population number of Jordan in 2010 is about 3.7 million and thus, the gap between the demand on waters and the available waters have highly increased. Currently, the quantity of waters consumed by Jordan is 941 million cubic meters (Mm^3) of water annually which disseminated as 603.5 Mm^3 for irrigation, 38.4 Mm^3 for industry, 291.3 for household, and 7.8 Mm^3 for livestock. In the near future, the demand on waters will be increased because of the economic development and population growth.

According to many evidences, the water problems at this country is caused because of the following reasons:

1. The lack of rainfall at this country has negative effects on the surface environment of this country.
2. Excessive exploitation of water resources and the pollution of water supply because of the population growth that companied with the increase in industrialization and urbanization.
3. Inability to treat the waters industrially and municipally and create the industrial plants near the water streams which lead to its pollution and misuse of pesticides and fertilizers which lead to the pollution of surface and ground waters.
4. The excessive use of waters in the irrigation led to high shortage of waters in large parts of the country. This extensive use for waters caused the pollution and dryness of water resources in Jordan.

3.1.2 Surface Water

The main three rivers in Jordan are the Jordan, the Zarqa and the Yarmouk. Relatively, Jordan River is not suitable for drinking and irrigation because its waters are salty. Zarqa River is not suitable for domestic and irrigation use in the dry season

because it receives a large amount of substantial municipal, industrial and agricultural effluent and its quality is enhanced during the floods only. In spite of that the Yarmouk River is considered less stressed but it is also a drop for municipal wastewater (Abu-Taleb, and F. Maher 1993).

Jordan River is famous in the history by its two main parts (Southern and Northern) and it is more than just a creek. By the time where the long-suffering stream reached to the end, most of the water has dried into a wide diversity of pipes, pumps, and fields to tolerate the large growing demands of the human population in its vicinity. The problem of shrinking the Jordan River is considered one of the difficult problem in the region in addition to the salinization of groundwater problems in the country (Regure 1950).

One of the main problems that suffered by the Jordan Valley is the dissolved salt which flow towards it (Glasser 2002). The salt bodies is main reason of the salinization that existed in the Jordan River (Talon 2007). The water resources that mainly affected by the pollution are valleys, dams creeks and rivers which lie downstream from the treatments of wastewater plants and solid waste disposal locations. The King Talal Dam reservoir is considered one of the largest reservoir in Jordan and it is also threaten to the increase of salinity and chemical materials because of the factories which dispose of their wastes at this reservoir (Giddon 1990). Moreover, the quality of waters and the waters resources are effected by the trans-boundary movement of pollutants (Talon 2007). More than one third of the trans-boundary waters resources in the country are shared the regional conflict on the water resources. This type of problems is seen as feed of problems between the countries. The main resource of the waters in Jordan are the rivers of Jordan and Yarmouk and both of these rivers have been depleted by upstream diversion and over pumping in Syria and Israel. Jordan has other water resources which are the groundwater class such as Azraq Oasis that provide the waters to Amman (Hoff 1995). Mobilize the water resources and their use require comprehensive political management in order to guaranty the sustainability of waters and this approach must be adopted on the regional level to transform the precarious situations into solutions with mutual advantage.

3.1.3 Water Supply and Demand

The qualitative deterioration of waters in Jordan and its current situation as compare with its demand present serious problems about its balance. Table 16 and Table 17 explain the water balance in Jordan (demands and supplies). The picture looks very bad where any researcher can notice that the country may pass a real deficit if the water resource are exposed into pollution or faced annually deficit on water or the excessive use of waters.

Table 1: Jordan water demands per annum (Mm3) (NWDF 1996),(JICA 1995)

	1990	2000	2010	2020	2040	Data source
Municipal	240	340	477	670	1263	WAJ
Industrial	43	78	110	130	170	WAJ
Jordan Valley	300	350	443	443	443	WAJ
Southern Ghors	40	40	75	75	75	WAJ
Wadi Araba	4	4	13	19	19	WAJ
Highlands	289	255	255	255	255	WAJ
Disi	59	10	10	10	10	WAJ
Total demand (including losses)	975	1077	1383	1602	2236	

As shown in Table 17, the water projections of water resources based on the average water year prove that there is water deficit problems in Jordan.

Table 2: Jordan water resources per annum (Mm^3)),(JICA 1995)

		1990	2000	2010	2020	2040	Data sources
Treaty allocations	Adasiya	110	140	195	195	195	JVA
	Diversion		20	20	20	20	Treaty
	Above Deganya Tiberias Springs		10	10	10	10	Treaty
	Additional water		50	50	50	50	Treaty
	Jordan dam (min. average)			20	20	20	Treaty
	Subtotal	110	220	295	295	295	
JRV wadis	Jordan side wadis	120	120	120	120	120	JVA
	Wadi Al Hasa		8	8	8	8	JVA
	Wadi Wala			5	5	5	JVA
	Wadi Mujib		25	42	42	42	JVA
	Subtotal	120	153	175	175	175	
Groundwater	Northern Aquifers	460	410	258	258	258	WAJ
	Wadi Araba	4	4	13	19	19	WAJ
	Subtotal	464	414	271	277	277	
	Safe yield	277	277	277	277	277	WAJ
	Over-abstraction	187	137	0	0	0	
	Brackish desalination	0	5	40	40	40	JICA
	Disi Aquifer	12	15	130	130	130	WAJ
Wastewater reuse	% Municipal demand	20%	25%	30%	35%	50%	
	Total reuse	48	85	143	235	632	
Total resources		754	892	1054	1152	1549	
Jordan water deficit		221	185	329	451	687	

The main water resources in Jordan for 2000 are divided into two main resources which are the surface water resources basins and their capacity is about 373 Mm3/yr and the groundwater resources and their capacity is about 414 Mm3/yr (Hinker 1999).

The total potential supply for both of the resources are about 787 Mm3/yr. Nevertheless, the demand on waters for 2000 is about 1077 Mm3 while the total demand on waters for 2010 is amounted about 1383 Mm3. Due to the scarcity of waters in Jordan make its management from a technical, political, environmental and socio-economic perspective is very complicated problem.

The budget of waters in Jordan is amounted about I billion cubic meters that make it very low if it is compared with environmental, economic and social needs. The local, industrial and agricultural stockholders sectors must be considered in any water strategy.

Table 3: Future water demand, supply and deficit in Jordan (Mm3/yr), (JICA 1995)

	2010	2020	2040
Total water demand	1383	1602	2236
Domestic	477	670	1263
Industrial	110	130	170
Irrigation	796	802	803
Total water supply	1054	1152	1549
Surface water	470	470	470
Ground water	271	277	277
Water deficit total	−329	−451	−687

As shown in Table 19 that Jordan is highly depends on the aquifer and basins resources which feed and recharge by the annual rainfall.

Table 4: Aquifer and basin water status in Jordan (Mm3/yr) ,(JICA 1995)

Basin	Used	Available
Yarmouk	59	40
Jordan River tributaries	6.3	15
Jordan River plains	21.7	21
Amman and Zarqa	153.8	57
Dead Sea	68.6	57
Disi	56	100
North Wadi Araba	1.75	3.5
South Wadi Araba	4	5.5
Jaffar	23	27
Azraq	32	28
Sarhan	0.8	5
Hamad	1.8	8

The largest basin in the country is Yarmouk Basin. The main problem in the waters in Jordan is that about 93.9% of the waters is lost in the evaporation annually which left only small percentage in order to recharge the water supplies and the aquifer. The different water resources in Jordan including ground, surface, and nontraditional sources which measured in Mm3 are illustrated in Figure 21. As shown in Figure 22, the agricultural sector consumes the large percentage of the water with percentage about 77.5% of all consumed waters while the rest percentage is consumed by the other sectors including the domestic and industrial use. The water demand in Jordan is increased annually about 25 Mm3/yr.

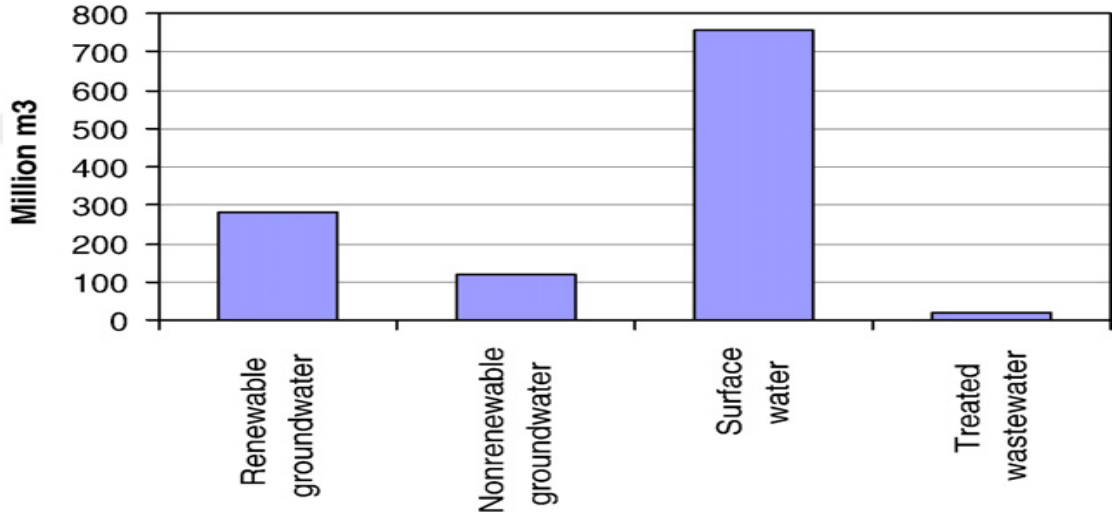

Figure 22: Water resources: ground, surface, and nontraditional 1985–2005 (Mm3) (Hinker 1999).

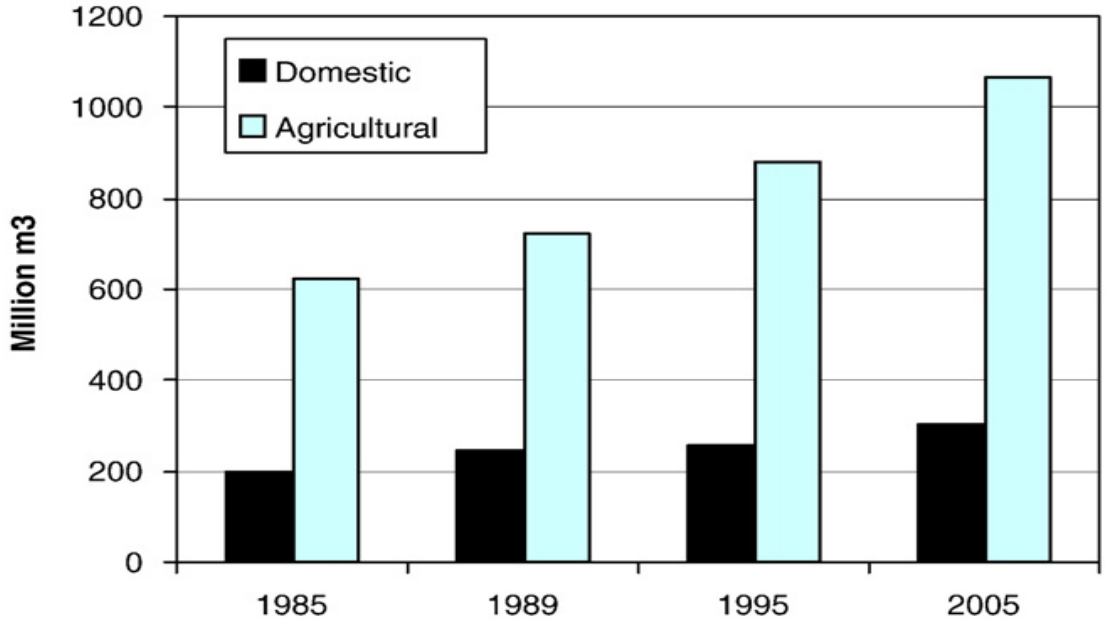

Figure 23: Water usage in Jordan, 1985–2005 (Mm3) (Hinker 1999).

The growth of water demand in the country is associated with the population growth in addition to the economic and urban development witnessed by the country.

Table 17: Population versus per capita water availability, (JICA 1995)

Year	Total annual renewable fresh water available (Mm^3)	Population (millions)	Per capita water availability (m^3)
1955	1331	1.447	920
1990	906	4.009	226
2020	1236	10.229	120

A large part of the water budget in Jordan is existed in the desert. The waters existed in the desert of Jordan represent a large addition to the waters in the country if it is collected in correct way (Hinker 1999). There are many studies and researches that related to this subject where its results showed to the possibility to increase the waters levels significantly. For instance, the analysis of the geo-hydrology of the upper Wadi Madoneh area which is around 9 km south of Zarqa city and 15 km east of Amman, strong-minded the penetration volumes, Dams locations, quantity of water added, and the effect of the recharged water on the aquifer in terms of predicting the effects on aquifer levels in addition to the quality of water (Quasisi 2008). Instead, other studies dedicated on harvesting the water as indirect measure in order to recover the water resource by decreasing the demand, for instance, the rainfall harvesting analysis in rain-fed agricultural areas, where rainfall can be deposited directly in the soil for crop production using terraces, rippers, contour ridges, and other kinds of water collection techniques. Nevertheless, these techniques are considered as limited efficiency because of the climatic conditions and the characteristics of the soil (Abuzerig et al 2000).

3.1.4 Water available for desalination

The desalination of waters are used in limited way in some houses and factories in order to bottle the waters for drinking purposes. Many factories are using plants in order to fulfill their own industrial needs with an overall capacity of approximately 9000m3 per day. The locations of these plants at Hussein Thermal Power Station, Oil Refinery, Pepsi Cola Co., Potash Co. and other small plants and

all of them established since 1980. There are two main resources are used for water desalination in Jordan the first one is the seawater at the Gulf of Aqaba and the second one is the brackish waters which available in the country. The brackish waters in the South of Ghore between Dier Alla town and the Dead Sea with salinity of about 5000– 7500 ppm and a yield of about 60 Mm3/yr is one source in Jordan. The brackish waters that existed in Jordan is approximated about hundreds of millions of cubic meters and they are distributed through the country and include the saline springs which locate to the west of the Jordan Valley with a capability of about 10 Mm3. Conversely, these resources suffer from many problems and it is difficult to be exploited where they are scattered in the country and the distance between each one of them are high in addition to its containing to many chemical materials which must be removed including manganese, sulfates and iron, as well as gases for example hydrogen sulfide. Finally, the largest problem is how to dispose the brine that may cause many environmental problems. These scattered resources can be exploited and offer suitable amounts of desalted waters by using solar energy or wind power.

The saline waters that exist in Aqaba Gulf provide unlimited resources of waters where this resource can be exploited to provide the desalted waters for Aqaba region to be used for the domestic and industrial use in Aqaba district and other part of Jordan. However, this resource must be transported to 350km to Amman and may be more remote areas in Jordan. As well as, it must be pumped from zero to around 1000m of static head. It must be mentioned that the brackish waters that existed in Ghore is less expensive than the waters existed in Aqaba Gulf , but it needs to be conveyed 45km and pumped from −400 to 1000 (1400)m of static head (Hiniker 1999).

3.1.5 Basics of a Sustainable Solution

The United Nations in its report issued in 1996 has explained the basics of the sustainable solutions which can be summerized as below:

1. In spite of the government efforts to supply many civil engineers during the time in order to get water resources with least cost, all of these efforts have been exhausted at this country.

2. The practical experiments proved the desalination process of the brackish water and seawaters is considered energy extensive process but it is more effective in terms of cost and is used extensively in many countries including United Arab Emirates, Kuwait, Saudi Arabia, and USA. Under the optimal circumstances the process of deasil seawater has decreased from $1.50 to possibly $0.63 per m3 (UNIDO 1996). Since Amman is above sea level and far from the seacoast, the cost to its inhabitants would (in the lack of a co-operative water exchange program with its neighbors) must contain extra pumping and transport costs of approximately $0.25 to $0.35 per m^3.
3. During the years many mega projects have been proposed of water desalination including the process of transfer the fresh waters after the desalination from the red sea or the Mediterranean (Murakani 1998). For example, The Red–Dead sea mega project which is presently in the environmental control assessment stage. Also, there is another project which is transporting the water from Turkey through the sea or by large plastic bags. Nevertheless, the huge projects of water desalination does not offer sustainable solutions for a short-term where the capital investment which may reach into many billions of dollars, the implementation time, the political complexities and the and full cost per cubic meter seem to surpass that of modular desalination plants.
4. Currently, the wastewaters are recycled and used for the agricultural purposes and represent sustainable solution. Water recycling depends heavily on the quality of the product and on the farm proximity from the plant.

3.1.6 Reduction of demand on water

The water demands can be reduced by the use of multiple methods and these methods can be illusttraed as bellow:

1. The use of modern techniques in the irrigation such as the use sprinkler systems, drip irrigation, subsurface irrigation systems and plastic greenhouses work on offering huge amounts of waters especially in the hot seasons because the agriculture sector in Jordan is the most sectors for water consuming (Browin 1996).

2. The domestic demands on waters configure 30% of total demand. Greywater can be recycled in order to substitute partly freshwater used in flush toilets while the use of appropriate showerheads will decrease the demand on fresh water. Furthermore, storing the rainfall by the use of roofs and store will significantly decrease the demand on waters for many purposes including the gardening purposes.
3. An integrated program can be developed in order to educate the people in Jordan on fairly use the waters can increase the process of water offering and help on preserving the quality of waters (Ringland 1998).

3.1.7 Recommendations

There are numerous solutions have been proposed in order to increase the water supply which include the following:

1. Achieve the highest possible benefit of rainfall waters by creating the big and small dams. Evaluating the current water harvesting structures by hydrological studies, analytical tests and defining the sediments quantity in these structures. These studies and researches are proven that it is possible to use the surface waters in order to recharge the groundwater and solve the water problems in Jordan partially and assimilating the ecosystems that impaired by mining the groundwater. Thus, it is suggested to establish the dams along with the watercourses and to get benefit through the summer season and used in many purposes instead of the continuing stream of waters towards the abandoned lands. This procedure will highly benefit the farmers in creating self-sufficiency food.
2. Wastewater and seawater desalination.
3. Use of suitable treatment techniques in order to treat the industrial wastewater which contain heavy metals. As well as, the government must establish plants for the purpose of treating the used waters in order to be used again effectively.
4. The main source of plants irrigation must be the treated wastewaters. If no suitable procedures will be taken in this country, we will witness serious problems within the next few years and the agriculture will be highly damaged.
5. Applying wide maintenance processes in order to fix the water networks and decrease the loss of drinking waters through the leakage.
6. Import the waters from the adjacent countries by using several techniques.

7. It must be a rationing program in order to distribute the waters on the final user in suitable way.
8. Reduce the consumption and increase the water supply in order to fulfill the increased use of waters. Certainly, evolving new water resources provide less and more costly choices than the conservation. For instance, the desalination of water to produce the freshwater is considered costly process. Also, loss of waters in Jordan can be reduced by the participation of private sector in managing the water resources and help to develop the infrastructure of water at this country. Enhancements must be carried out for water and wastewater projects schemes, water meters, home appliances, leak discovery equipment, pipes, pumps and plants of wastewater treatment.
9. Maximize the potential of water resources and take into consideration the related social and environmental effects. The planning operations in the deep groundwater resources are take place currently in order to support the urbanization planning in the effective use of aquifer with different characteristics. Also, continuing evaluations must be conducted in its existed and future water resources. Nevertheless, all of these are subject to the geographical constraints and the benefit analysis. The water resources issues in Jordan must not be opened for longer time and must be discussed by nations, organizations and individuals.

3.2 Water problems in Lebanon

3.2.1 Geography

The total area of Lebanon is 10400 km2 and it is located east of the Mediterranean Sea and surrounded from the north and east with Syria and bordered with Israel from the south. Lebanon is considered a mountainous country, stretching about 225 km beside the Mediterranean coastline from north to south and around 60 km in width from west to east. The forest and Mediterranean brushwood cover about 8 percent of this country. Before 2003, Lebanon was divided into six governorates which are Beirut, North, Mount Lebanon, Bekaa, Nabatiyeh and South. Later, two new governorates have been created which as Baalbeck Hermel and Akkar. Topographically, there are four similar areas successively north-south which are from west to east, as shadows: ¾¾a flat, narrow coastal strip similar to the Mediterranean sea; ¾¾the Lebanon Mountains, a chain with mid-range mountains

up to 1 000 m above sea level and high mountains reaching 3 087 m above sea level at Qurnat as Sawda in northern Lebanon; ¾¾the fertile Bekaa Valley at around 900 m above sea level; ¾¾the Anti-Lebanon mountainous chain which rises to 2 800 m and expanses through the eastern border with Syria. The carbonate rocks cover around 70% of Lebanon which consisted in the Middle Jurassic to the Eocene era. In spite of the alluvial soils of central and western Bekaa Valley and the sandy soils twisted on the basal cretaceous strata of the Akkar Plain, the soil in Lebanon is typically Mediterranean. The lands in this country is complex where it consists of steep and slope. The main physical factor is the high slope gradient intensifying the erosion of water for the higher soil layer, lead to a fragile construction and decrease the volume of the water holding. The agricultural lands in Lebanon is approximated about 360 000 ha, or 35% of the total area of the country. The cultivated area in 20015 at Lebanon is 328 000 ha, of which 142 000 ha permanent crops and 186 000 ha annual crops which increased about 68% since 1993. Lebanon contains two main agricultural areas which are North Lebanon and accounts about 26% of the total cultivated area and Bekaa Valley which consists about 42%. In 1999 the harvested crop region consisted both rained and irrigated production included the fruit of trees (26 percent), cereals (22 percent), olives (22 percent), vegetables (19 percent) and industrial crops (11 percent) (MOA and FAO, 2000).

3.2.2 Climate

The climate of Lebanon is normally Mediterranean which includes heavy rains during the winter season (November to May) and dry and arid circumstances during the remaining seven months of the year. Nevertheless, the effect of the Mediterranean Sea, the topographic geographies, and the Syrian Desert in the north generates a diversity of microclimates inside the country with conflicting temperatures and rainfall distribution. On the coast, the normal annual temperature is 20 °C, ranging from 13 °C in winter to 27 °C in summer while the average annual temperature in the Bekaa valley is lower at 16 °C, ranging from 5 °C in winter to 26 °C in summer. However, at the greater elevations in the mountain zones, the average annual temperature is lower than 10 °C, ranging from 0 °C in winter to 18 °C in summer. The average of annual rainfall is probable at 823 mm while this differs from 700 to 1 000 mm beside the coastal areas and from 1 500 to 2 000 mm on the high

mountains declining to 400 mm in the eastern areas and to less than 200 mm in the northeast. Beyond 2 000 m, precipitation is basically knives and helps to sustain a base yield for about 2 000 springs through the dry period. The dry years include amount of rainfall which is less than 50 percent in the average. The rainfall starts in October until April and normally occurs during 80 to 90 days. The annual stream flow happens from January to May, 16 percent from June to July and only 9 percent in the remaining five months from August to December. Based on the rainfall, The National Meteorological Service in Lebanon determined eight Eco climatic zones as follow:

- The coastal that consists of the northern, central and southern coasts.
- The mountains of Lebanon that divided into the central and northern mountains.
- The Bekaa Valley that is divided into the northern (interior Asi-Orontes), central (interior Litani) and southern (interior Hasbani) zones.

The annual probable evaporation mean ranges from 1-100 mm on the coast to 1-200 mm in the Bekaa Valley and the greatest are registered during July. In general, less adverse influences are perceived on the coast than in the Bekaa Valley where effects because of the wind and high vapor pressure shortfall are principal (LNAP, 2002).

3.2.3 Population

The total population in Lebanon according to the statistics of 2005 (as shown in Table 16) is 3.58 million and around 12% of them live in the countryside. The density of the population is 344 inhabitants/km2. During 2000-2005, the annual demographic growth is amounted about 1%. In 2006, all of the people who live at this country has reached to the enhanced water resources. In 2000, 98% of the entire people has reached to the enhanced cleanliness (100 and 87 percent in borough and country areas correspondingly).

Table 18: Basic statistics and population (Mdalal, 2006)

Physical areas			
Area of the country	2005	1 040 000	ha
Cultivated area (arable land and area under permanent crops)	2005	328 000	ha
• as % of the total area of the country	2005	31.5	%
• arable land (annual crops + temp fallow + temp. meadows)	2005	186 000	ha
• area under permanent crops	2005	142 000	ha
Population			
Total population	2005	3 577 000	inhabitants
• of which rural	2005	12	%
Population density	2005	343.9	inhabitants/km²
Economically active population	2005	1 337 000	inhabitants
• as % of total population	2005	37.4	%
• female	2005	30.4	%
• male	2005	69.6	%
Population economically active in agriculture	2005	35 000	inhabitants
• as % of total economically active population	2005	2.6	%
• female	2005	40	%
• male	2005	60	%
Economy and development			
Gross Domestic Product (GDP) (current US$)	2007	24 000	million US$/yr
• value added in agriculture (% of GDP)	2007	6	%
• GDP per capita	2005	6 011	US$/yr
Human Development Index (highest = 1)	2005	0.772	
Access to improved drinking water sources			
Total population	2006	100	%
Urban population	2006	100	%
Rural population	2006	100	%

3.2.4 Economy, agriculture and food security

As shown in Table 21, the gross domestic product for Lebanon in 2007 was 24 billion dollar. The service sector configured about two-third of GDP while the agriculture factor configured 6 percent. In 2003, the idleness average configured about 18 percent while the total vigorous people in 2005 was 37 percent. The number of the population who economically active at the agriculture sector in 2005 is approximated about 35000 and 40 percent of them are female.

The Lebanese workforce who work in agriculture sector in 1967 is approximated about 25 percent and declined to be 9 percent in 1990 and reached to less than 3 percent in 2005. Nevertheless, despite the difficulty of approximating the number of people who work at the agriculture sector, it is still considered a good resource of income especially at the rural areas and some of them work at this sector in a part time. This sector contains various products including apples, citrus fruits, sheep tomatoes, grapes, tobacco, vegetables, potatoes, poultry, olives, and goats. The country is considered a main source of vegetables and fruits and it is independent in pullet and crops 45, 15 and 10 percent correspondingly of its beats, wheat and darling wants. However, Lebanon meanings about 78 percent of meat and dairy crops.

The agricultural exports in 2005 amounted of 17.3 percent of the spreads with total income value of US$196 million while the agricultural ingresses amounted of US$1 230 million. As stated by the latest census implemented by the Ministry of Agriculture in 1999 (almost 30 years after the preceding one) there were 194 829

farm assets (a growth of 39 percent associated with 1970), 87 percent of which had fewer than 2 ha of agricultural region.

3.2.5 Water Resources

In spite of Lebanon does not suffer from a large water crises and it is in a favorable situation which make it has a suitable water resources but it also suffers to access the waters to many places especially during the long summer season because of the shortcoming in the water supply networks. The main stream in Lebanon locates on the western cross of the crags that have steep grades and its length about 730 km. It is estimated the amount of the annual new and perfect resources of water are around 4.8 km. Yearly external excess is around 4.1 km³ and aquifer renew 3.2 km³, of that 2.5 km³ configure the rivers flow base. Around 1 km³ of this current originates from above 2 000 spirals with a regular component produce around 10–15 l/s, supporting a recurrent flow for 17 of the total of 40 main flows in the country. The amount of the surface water which can be exploited technically and economically in Lebanon is approximated about 2.080 km3 which divided into the groundwater resources with quantity of 0.500 km3 and the surface waters resources with quantity of 1.580 km3.

The country includes 40 main streams of waters and according to the hydrographic system, the country is divided into five regions including:

- The Asi-Orontes Basin in the north; the Asi-Orontes River flows to Syria in the northeast of Lebanon.
- The Hasbani Basin in the southeast; the Hasbani River, which streams towards Israel in the southeast of Lebanon and it is a tributary of the Jordan River.
- The Litani Basin in the east and south; the Litani River access the sea in the southwest of the country; ¾¾ all the continuing main coastal river basins; the northern El Kebir River Basin is mutual with Syria, the river itself configure part of the border between the two countries before smooth to the sea.

All the minor, distributed and insulated sub-catchments remaining in-between, with no obvious surface stream flow for example, the endorheic catchments and insulated coastal pockets. A percentage of 45% of the country is covered by the first three river basins. Litani River streams completely inside Lebanon while the Asi-Orontes and Hasbani rivers are Transboundary Rivers. The longest stream in

Lebanon is Litani River and its length is about 170 km. Its total area represents 20 percent of the total area of the country with an area about 2 180 km2. The quantity of the annual waters flow to this river is about 475 million m3. Also, Lebanon includes 12 additional rivers flows from the western slopes of the mountain and flowing from east to west to the sea. The Coastline Rivers have reasonably small catchments (200 km2 on average) and small courses (< 50 km). The snowmelt and springs represent the main replenishment of rivers at this country. Nevertheless, at the last three decades, the rivers flows registered high declines of waters. The total size of the aquifers is 1360 million m3 while there number is eight. The quantity of aquifer which can be exploited amounted from 400 to 1 000 million m3 (Samad, 2003).
Groundwater that existed deep in the earth are recharged by the melting snow and rains and encouraged by the fissures and fractures. Also, the waters may appear at the lower elevation as the springs which flow to the rivers. Due to the rock formation and geologic rock, the springs are existed at this country and considered a feature of its features. Lebanon contains more than 2000 main springs in addition to many smaller springs which produce flow approximated of 1-150 million m3/year.

Also, there are another springs which distributed along the submarine area and in the coast. These springs are called the non-traditional springs as it is impossible to get their waters before flowing towards the sea. Lebanon does not contain a flow of surface waters from its neighboring countries because it is at higher elevation. The movement of 76 million m³/year of the El Kebir River on the boundary between Lebanon and the Syria is supposed to be created by the 707 km² bordering Syrian catchment regions. As well as, these areas may include quantities of groundwater without any statistics of the quantity of these waters. The total quantity of the surface waters which flow to the sea is amounted of 160 million m3 from a total surface water of 735 million m3/year. The total quantity of waters flow to Syria through Asi-Orontes River is approximated at 415 million m3. The total quantity of waters flow to Israel through Wazani is approximated at 160 million m3/year. The trans-boundary Mount Hermon aquifer donates in the releases of the Banias springs in the Golan and the Dan springs in Israel. The groundwater quantity that flow each year is approximated about 10-20 million m3/year. These quantities of groundwater include 740 million m3 is assessed to current to the sea, 150 million m3 to Israel (Hulah Lake) and 130 million m3 to Syria (Dan Springs). The construction of storage dams are difficult at this region because of the geological conditions. Qaraoun Reservoir is

a name called on the main simulated lake in Lebanon which discovers in the southern part of the fertile Bekaa Valley on the Upper Litani River. This lake is constructed in 1960 with total capability of 220 million m3 and active storing of 160 million m³ (60 million as the inter-annual reserve). This lake has great importance in supplying the hydroelectric plants where it generates around 7 to 10 percent (about 190 MW) from the entire yearly power demands in this country. Furthermore, the Qaraoun Reservoir supplies annually an overall of 140 million m3 for the purpose of irrigation (110 for South Lebanon and 30 for Bekaa), and 20 million m3 for home resolves to the South. Instead, in 1963 the green plan has been implemented in order to develop the water reservoirs and established hundreds of water basins with a greatest water volume of 0.2 million m³.Through the period 1964– 1992, the Green Plan steered an entire of 3.5 million m³ of earth pounds and 0.35 million m³ of concrete pounds. In the early 1970s, the authorities of Litani River established three hillside stock ponds with storage capability of around 1.8 million m.

The Bisri dam has been in 2008 with total storage capacity of 128 million m³and this dam aims to provide Greater Beirut city by waters while Khardaleh Dam which locates in the middle reach of the Litani River has been put on hold due to the bad safety condition in the southern part of the country. It must be mentioned that this put on hold dam has a total storage capacity equals to the stage capacity of Bisri dam. In 2007, Shabrouh artificial reservoir has been inaugurated which has storage capacity of 8 million m³. The location of this reservoir is close from Faraya town and supplies waters for irrigation and domestic purposes. This reservoir will help to reduce the shortage in parts of Metn regions in addition to Qadaa Kesrouan. The amount of wastewater which produced in Lebanon is approximated about 310 million m3 where 249 million m3 of them is created by the local region and about 61 million m3 produced by the industrial sector. In 1991, the amount of generated wastewater is amounted about 165 million m3 and this means that there is increase by 88 percent. In 2006, the wastewater which has been treated was only 4 million m3 of that 2 million m3 was intended for cultivated purposes and the break liable of in the marine environment by straight alteration to the rivers, or it was penetrated by the subterranean seepage to the groundwater. The possibility to use the domestic wastewaters is amounted of 100 million m3/year. Some of the unprocessed wastewater is used in the irrigation purposes. Also, Lebanon use the desalinated

seawater continuously with an estimated quantity amounted of 47.3 million m3 (Mdalal, 2006).

3.2.6 Water use

It is hard to regulate the precise image for the withdrawal of water and to make a convincing failure between the dissimilar regions. Many wells are not under control because they are no authorized (Table 17). Moreover, the public leakage systems are caused the loss of high quantities of waters. The amount of seepage of the water supply networks that infiltrated to the groundwater is approximated about 35-40 percent and they are extracted again across the pipe wells particularly in the Greater Beirut municipal region.

Table 19: Water sources and use(Mdalal, 2006)

Renewable freshwater resources			
Precipitation (long-term average)		823	mm/yr
		8.559	10^9 m^3/yr
Internal renewable water resources (long-term average)		4.800	10^9 m^3/yr
Total actual renewable water resources		4.503	10^9 m^3/yr
Dependency ratio		0.79	%
Total actual renewable water resources per inhabitant	2005	1 259	m^3/yr
Total dam capacity	2005	225.65	10^6 m^3
Water withdrawal			
Total water withdrawal	2005	1 310	10^6 m^3/yr
- irrigation + livestock	2005	780	10^6 m^3/yr
- municipalities	2005	380	10^6 m^3/yr
- industry	2005	150	10^6 m^3/yr
• per inhabitant	2005	366	m^3/yr
Surface water and groundwater withdrawal	2005	1 096	10^6 m^3/yr
• as % of total actual renewable water resources	2005	24	%
Non-conventional sources of water			
Produced wastewater	2001	310	10^6 m^3/yr
Treated wastewater	2006	4	10^6 m^3/yr
Reused treated wastewater	2006	2	10^6 m^3/yr
Desalinated water produced	2006	47.3	10^6 m^3/yr
Reused agricultural drainage water	2001	165	10^6 m^3/yr

The amount of withdrawal waters in 2005 is approximated at 1 310 million m3 including 60 percent was for agriculture sector, 29 percent for municipal sector and 11 percent for industry sector as shown in Figure 23.

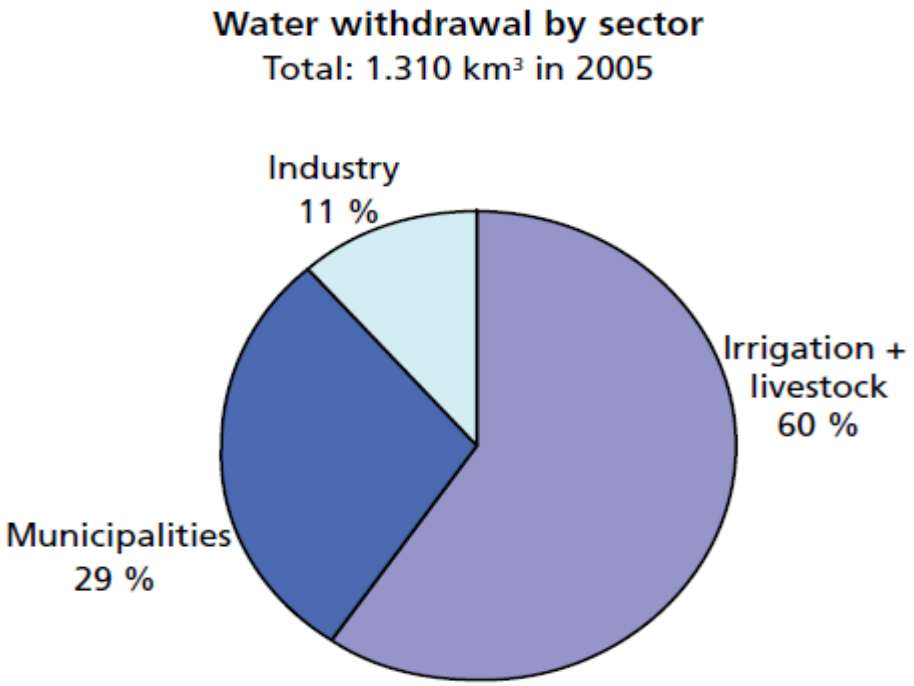

Figure 24: The amount of withdrawal waters in 2005 Hemson, D. et al. (2008).

Wells water and surface water explanation for 53.4 percent and 30.2 percent correspondingly of entire withdrawal water. Reused irrigation drainage explanations for 12.6 percent, the purified water for 3.6 percent and recycled preserved wastewater for 0.2 percent as shown in Figure 24.

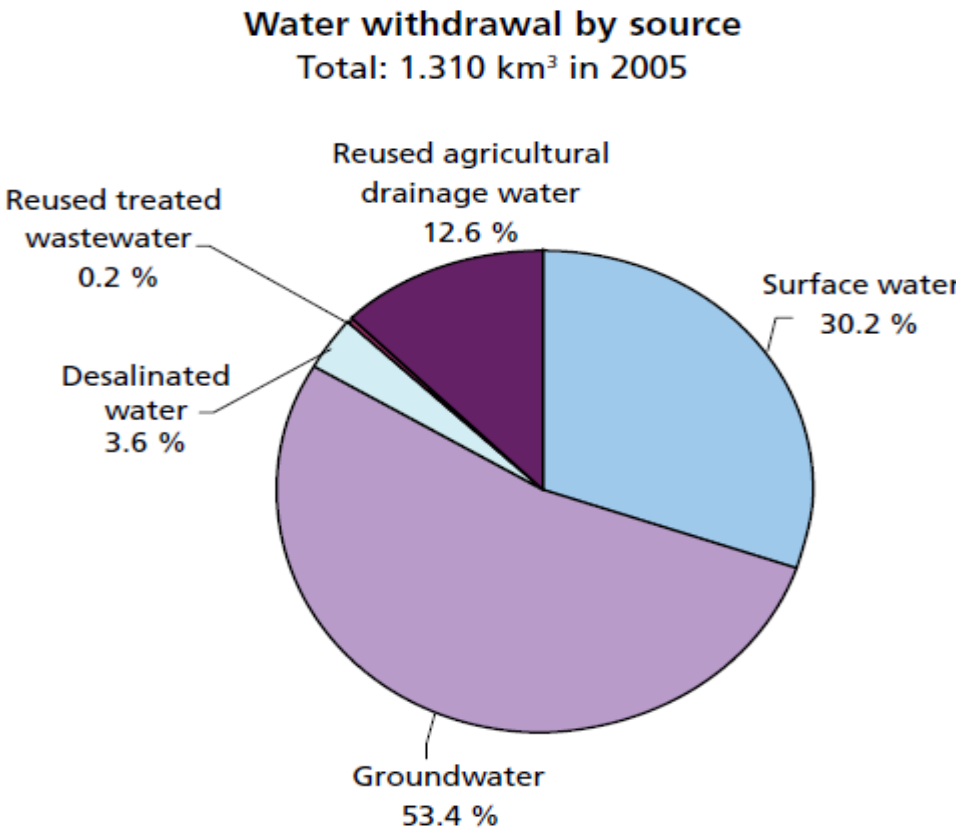

Figure 25: Water withdrawal by source Hemson, D. et al. (2008).

At the next few years, the amount of withdrawal waters which used for the agricultural use will be decreased and more of waters will be transferred for the industrial and municipal use. Also, the amounts of waters which will be used for the hydropower use is amounted about 700 million m3 of water per year. Cultivated water extraction valuation is depended on 8 575 m3/ha per year from groundwater and 11 200 m3/ha per year from surface water. The consumption of water by the individual is approximated about 200 liters for each persons through the wet period while it is amounted about 220–250 for each person through the dry season.

There is not adequate information about the amount of waters which needed in the industry sector until this time where the industry sector heavily depends on the aquifer with percentage of 60-70% and the rest of waters come from the surface waters. The wells are the main means which are used to abstract the aquifer. The number of wells that distributed around Beirut are approximated about 1000 wells and the depth of these wells between 50-300 m and the discharge for each individual is approximated of 35 l/s. The saltwater appears during the over pump of these wells.

3.2.7 International Water Issues

In 1978, Israel completely controlled on Wazzani spring/stream which recharge the Jordan River. In 1994, the Syrian and Lebanese governments extended to a water partaking arrangement about the Asi-Orontes River which through Lebanon obtains 80 million m3/year if the Asi-Orontes River's flow within Lebanon is 400 million m3 or more through which specified year. If this quantity has been decreased to less than 400 million m3, the share of Lebanon will be decreased accordingly. The wells that work at this area before the agreement will remain work but it is not acceptable to establish new wells. The Asi-Orontes River growths in a region north to Ba'albeck city of and streams through Syria before arriving Iskenderun (Alexandretta) and draining in the Mediterranean Sea. The Asi-Orontes River includes an important spring which is called Al-Azraq and the annual flows of this spring is greater than 400 million m3 (Amery, 1998).

In 2002, Lebanon announced that it will create a pumping station in the springs of Hasbani basin which resulted of high tension between Lebanon and Israel. The Hasbani River is raised in the south of Lebanon and recharged by the river springs. This river signs the Blue Line border to charge the Jordan and consequently the Sea of Galilee that is considered the main reservoir for Israel. In 200, the pumping station has been completed. The purpose of this station was to supply the domestic and irrigation water to more than sixty villages in the blue side of Lebanon. Also, at this year the armed conflict between Israel and Lebanon has been raised because of this issue. The Lebanese side stressed that this project is compatible with Johnston Plan of water resources while the Israeli side complained that the Lebanese did not consulted with them. At the end of 2002, the USA and EU sent enjoys in response to this tension in order to evaluate the situation (EU, 2004).

It is estimated that the potential of irrigation based on the available water sources is approximated about 177 500 ha. The amount of the watered regions in Lebanon in 1956 is approximated about 23 000 ha and increased to become 54 000 ha in 1966 while this area is decreased to become 48 000 ha in the early 1970s. In 1993, the total irrigated area was approximated about 87 500 ha including 20 000 ha for seasonal irrigation and 67 500 ha for perennial irrigation. The water of spring is mainly used for irrigation purposes while in 2000 the area which equipped for irrigation in amounted at 90 000 ha (Comair, 2005). Surface irrigation primarily of the basin and furrow type is practiced on 57 200 ha. It usually consists a simple intake structures or

diversion on flows or springs, open concrete main canals, and earth or concrete secondary canals. Sprinkler irrigation is mainly use on 25 100 ha particularly where potatoes and sugar beet are cultivated in the central Bekaa Plain. Confined irrigation is used on 7700 ha particularly in the north of Bekaa area and in the coastal area Litani-Awali complex and. Litani river are the main sources of irrigation. In 2000, 44% of the agricultural areas were irrigated by surface waters, 22% was irrigated by the groundwater including springs, recharge wells and deep wells and the rest part irrigated by the mix of groundwater and surface water. The dependence on the groundwater has been increased during the 1990s because of the delay of the government to implement the water projects. At this period, the individual farmers who face shortage in the waters depended on the groundwater and especially by the use of private wells. In the period between 1992-1995, more than 2000 wells have been further to a whole of more than 10000 wells particularly in the south coast hills and in the north and middle of Bekaa Central Plain. Since 1070 the public irrigation formula have not been changed which consist of 5 large-scale diagrams (> 1 and 62 medium-scale (100–1 000 ha) and small-scale (< 100 ha) diagrams. The pressurized irrigation is used by only two methods and the rest schemes are using the open waterways transportation of water and superficial irrigation techniques that are flowing to confined irrigation. Through the public irrigation, the average plot size is amounted about 1.8 ha. The age of most of these schemes are 20-25 years and maintained in poor way and also, in progressive deterioration state. If water has to be propelled from the durable wells by using the pumping means, the difficult will be increasing the irrigation cost and also the distribution networks are in bad status. Through the period 1994-2000, the government have developed the irrigation projects where it created 24 irrigation schemes, of which 5 medium-scale and 19 small-scale and improved the transportation and distribution efficiency of waters and transformed an entire irrigated region of 28 000 ha. In 2000, small diagrams (< 100 ha) concealed 27 percent of the entire prepared region for irrigation, medium size diagrams (100– 1 000 ha) 25 percent and great diagrams (>1 000 ha) 48 percent.

3.2.8 Role of irrigation in agricultural production, economy and society

The gathered irrigated region in 2003 is approximtaed about 105 293 ha and half of this area locates at the Bekaa Valley (MOA and FAO, 2000). The total yearly harvests which have been harvested of this irrigated area signify about 77 percent of

the annual crops. The highest watered yields are mueslis (24 percent, mostly wheat), potatoes (18 percent), citrus (16 percent) and potatoes (14 percent). The national census which have been implemenetd in 1999 explaimned that 60 percent of the refined region in farm assets outstanding 10 ha was watered whereas this part was about 42 percent in these from 4 to 10 ha and 30 percent in the farm assets cover less than 4 ha (Choueiri, 2002). The total cost of developing the irrigation process ranges from $US4000-7000/ha for large diagrams, $US3 750/ha for medium schemes and $US2 500/ha for small schemes. The costs for operations and maintenance are amounted about $US40/ha annually for small diagrams with importance external irrigation. While the costs of medium schemes ranges from $US100/ha per year for gravity surface irrigation to $US600/ha per year for private wells, whereas, in large schemes they range from $US400/ha per year for private pumping in rivers to $US600/ha per year for tube wells. The operations and maintenance are limited into very particular needs. It must be mentioned that the maintenance costs that placed by the Ministry of Energy and Water is very limited and does not include the real maintenance costs. In the general schemes, the operational prices are used to regulator the waters delivery systems.

Water distribution operation depends completely on the irrigated area and the season. Implement the irrigation schedule by a person who employed at the irrigation season. Generally, the maintenance is enhanced when the administration is handled by the regional water authorities and municipalities.

3.2.9 Status and evolution of drainage systems

Generally, the drainage is not deliberated a serious basic in Lebanon. The volume of cultivated areas which treat from the difficulties of drainage is properly restricted and is primarily in South Bekaa (about 5 000 ha) and in the Bequaia Plain in Akkar (about 4 000 ha). The amount of shattered region in 2001 is approximated about 10000 ha and 30 percent was in the region prepared for irrigation and 70 percent in rained regions (ICID, 2007). calibration of River is implemented in order to defend against overflow injury and water logging particularly the Litani River, upstream of Qaraoun Lake, where the drainage and standardization works recognized in the 1970s helped to improve the flood damage on about 1 500 ha. The project that implementing in collaboration between Jordan and Lebanon commences the recovery

of 11 facts in the Litani and its branches. The evaluation will be appeared after the implementation of five points and showing the improvement of 50 percent. The growth of the drainage in the future consists the completion and achieve the standardization of the Litani River and its seven branches in the South Bekaa Plain to regain around 1 500 ha of the sodden region and to simplify the works of drainage in additional dangerous region of 3500 ha that is also visible to regular floods from the rivers. The improvement of drainage will increase the yields in percentage amounting of 40-60 percent. Also, there are another issues that must be taken into consideration including the protection of boggy plains for travelling birds. The number of hectares which colonized by the irrigation is amounted about 1000 ha.

3.2.10 Water Management, Policies and Legislation Related to Water Use in Agriculture

3.2.10.1 Institutions

According to the law number 221/2000 which stated that the water issues must be controlled by many institutions (Hamamy, 2007). There two main important directorates under the Ministry of Energy and Water that are the General Directorate of Hydraulic and Electric Resources and the General Directorate of Operation. Ministry of Water and Energy implements the water policy and control the implementation of electric and hydraulic projects. Also, it works on applying the laws and legislations associated with waters and it has the administrational supervision on the sanitation facilities. Moreover, the Ministry of Water And Energy applies the mine laws and controls hydraulic and electric concessions.

The institutions have the financial and managerial independence in their regions. They are responsible on the irrigation projects, investments and hydraulic projects and the visibility study which related with the main plan that papered by the Ministry of Energy And Water. According to the law No. 221/2000, they accomplish, operate, maintain and recover costs pursuant. Their plans, projects and visibility study are yearly updated. The quality of waters are controlled and monitored by the Ministry of Public Health. Collect the date related to rainfall is implemented by the Meteorological Service of Civil Aviation of the Ministry of Public Works. The collection of wastewaters is implemented by the Municipalities and the Ministry of Interior and Municipalities. The green plan is responsible on

creating earth ponds and small water reservoirs and it workings below the support of the Ministry of Agriculture. The authority of Litani River is the unique authority which is responsible to preserve special responsibilities which spread outside its administrative area. Also, it is the authority which is responsible on managing and developing the water of irrigation and related works in South Lebanon and southern Bekaa. Moreover, it is responsible on assessing surface water beside the Lebanese land. Law No. 221/2000 offers a two-year intermediate era to recognize the present water panels in the local water establishments.

3.2.10.2 Water Management

Nominal features of irrigation administration comprise the analyses of implementing the cost-benefit for the medium and great irrigation schemes and cost-recovery of water provision above time. Across the time, the irrigation cost by using large pumps from the deep wells have increased in addition to the cost of distributing the waters to the farms. Also, the use of agricultural inputs led to the gradually worsening of the water excellence. The small size of the irrigation projects, weak services and the small size of the lands have left a large gap in the policy of managing the irrigation waters in this country. Local water administration Experience originates from exact gears of recovery of the public arrangements by the use of both conventional and pressurized irrigation systems.

The investment in the irrigation sector have increased heavily and its schemes have gained a large experience. At the recent times, the water issues have gained increased attention in order to enhance the efficiency of using waters by the use of suitable irrigation techniques and water collections technologies. The studies which accompanied at the Irrigation department and agro meteorology of the Lebanese Agricultural Research Institute (LARI) and at the American University of Beirut, Faculty of Agriculture and Food Science focused on enhancing the effectiveness of water use both in irrigated and rain fed agriculture (Karam *et al*, 2003, 2005, 2006). Supplemental irrigation ground research of legumes and cereals is considered an important study as it is leading to rise in harvest in rare water surroundings. Nevertheless, publishing the study results to the end users is still not enough. Engineering curriculum have been adopted in some general schemes in order to manage the waters with the focus on enhance the network management and water

distribution. Conversely, the non-existence of associations for water users led to bad management of waters on the scheme and one the farm level. Increasing the investment on water resources in the private irrigation schemes led to increase the investment at this sector and the emergence of experienced workers. In the early 1990s the government commenced administration policy in order to overcome the scarcity of waters based on the following:

- Reintegration the already presented irrigation systems.
- Water sector reform.
- Water storage in the soil basins and dams by launching the ten-year masterplan.
- Implement the new irrigation systems by the use of developed pressurized distribution systems.

3.2.10.3 Finances

The lack shared policy is one of the most important problems that face the Lebanese water sector. It is supposed that the standard for water provision must be profitable water use effectiveness i.e. the cash created for each unit opening of water and that this can only be proficient by the great water cost joined to a free water market. As well as, the other problem that prevent pricing mechanism of water is the possibility (water is regularly not measured), present legal and past water privileges and a social environment where the water is seeming because the shared inheritance. Thus, increasing the prices of water is a meaningful formula only in the regions which equipped well by waters and regions with high social class.

Currently, there is an overall agreement that the resources of water have been exhausted and this ratio is not defensible. Water scare resources are commonly used in order to get the fruits with high value where it is used in the protected homes that the infrastructure is relatively advanced. The employees who work in the irrigation sector have hurt from an absence of inducements. Water allocated by the revolution and/or with a stable stream ratio hampers the application of water-saving technologies conflicting to volume-related value arrangements. Moreover, the fees value on waters reach into small percentage as compared with the quantity of crops which will be produced. Thus, increasing the prices of water will have little effect on the behavior of farmers. For example, on a decent inducement was the one which

accessible to the farmers in the South Bekaa by the public sector the irrigation scheme with the equipment of irrigation in order to irrigate sufficiently 900 ha of reclaimed soils. This method used the localized irrigation and helped to decrease the waters for each hectare from 15000 m3/year into 6500 m3/ year. In the other regions, the irrigation by the use of drip type has been donated to decrease the consumption of water by 50 percent comparing with the groove irrigation.

Among 1 January 1992 and 31 December 2000, the Council for Development and Reconstruction (CDR) gave 129 agreements worth an overall of US$409.2 million in the water provision sector at this country (CDR, 2001). There are about 60 percent of these projects have been accomplished in 2001. 95 percent of these contracts included the capital costs, about 4 percent involved the practical support and just 1 percent localized to the operation maintenance. In 2000, the Lebanese Government agreed on placing a plan that aim to reorganize the water sector including the irrigation waters, sewage system and drink water in order to enhance, manage and maintain the effectivity of water sector. Law No. 241 (29/5/2000) modernized the current 22 water panels to four Regional Water Oraginzations: North Lebanon for the Governorate of North Lebanon, Beirut and Mount Lebanon for the Governorates of Beirut and Mount Lebanon, South Lebanon for the Governorates of South Lebanon and Nabatiyeh, and Bekaa for the Governorate of Bekaa. All of these organizations work under the supervision of the Ministry of Water and Energy and work on managing the irrigation water, sewage system and drink water. These organizations are given wide responsibilities including planning the water policies on the national level, measure the feeding of the groundwater, building of water storing capabilities (dams, tanks and pools of earth), controlling the drinking water excellence and treated wastewater, water legislation and water assessing. Moreover, these organizations are responsible on studying, managing and rehabilitating of the water projects. Law No. 221/2000 allows the local water organizations to set and gather water tariffs for home and cultivated purpose. The costs of the subscription for water stream differ by the dependence on the availability of waters and costs of distribution such as the pumping distribution are more expensive than the gravity distribution. The water tariffs in Beirut are expensive because they are pumped from deep wells or conveyed from a long distances. The water tariffs at the other parts of this country is cheap where the waters are brought by gravity or available in springs. The costs of tariffs in 2001 are extended from US$43 to US$153/year for 1 m3/day

scale payment that is equal to US$0.12 to US$0.42 per m3 water per day per household supposing that the ingestion of 1 m3 of water each day. Nevertheless, most of the families have incurred additional costs in order to get further quantities of waters.

Actually most of the families pay much more on per cubic meter according to the following two reasons.

i. Normal and periodic lack of waters;
ii. There is frequent need in order to purchase the water from the isolated carriers with cost which is normally range from US$5–US$10 per m3.

The water is supplied by the gravity in the general irrigation schemes and it is charged at a flat ratio for each cropped region. Since the water is delivered through pipes in the Litani irrigation schemes, volumetric metering is delivered. This irrigation scheme is applied in some region at the south of Bekaa irrigation scheme and Saida-Jezeen irrigation scheme. For instance, water controls differ between US$260/ha in the Qasmieh-Ras-El Ain Irrigation diagram in south Lebanon to US$30–150 /ha in the Danneyeh and Akkar irrigation schemes in northern Lebanon.

3.2.10.4 Prospects for agricultural water management

The water idea is distributed by the ministry of energy and water from 2000-2010. It determines the strategy in order to fulfill the future needs of waters in Lebanon where the amount of water that consumed in 2010 is amounted of 2.6 km3 (Hamamy, 2007). The amount of money which localized to increase the water amount by the manufacture of dams and tanks is approximated about US$1.327 billion. There are six parts where the strategy depends on:

- Increasing the water provision by the construction of 6 lakes and 26 dams that will rise the capability of storage to 800 million m3.
- Develop the water networks, rehabilitate and preserve.
- Increase the amount of irrigation waters.
- The construction of 20 plants in the coastal region in order to treat 80% of the wastewaters.
- Clean and preserve the courses of the water.
- Rehabilitate and extend the electric equipment to include the villages and far areas.

The distribution schemes which existed in Lebanon suffer from the lack of distribution canals which resulted in increasing the quantity of lost waters and decreasing the irrigation efficiency. Thus, the focus most be concentrated not only on increasing the quantity of distributed waters but also on increasing the efficiency of distributed waters in terms of removing illegal connections, water metering and presenting on-farm observes for the effective irrigation water use. At this regard, it is important to create association for water users because they create an important connection between the institutions supply the waters and the farmers. In 2015 the Lebanese Government succeeded in implementing large-scale projects and updated the conventional irrigation networks which increased the irrigated lands to reach 74000 ha. The probable increase at the irrigation comprises 23500 ha in southern Bekaa Valley and 5000 ha lying on together edges of the Litani River which need drainage systems. The irrigation plans include another regions such as 5 000 ha in the Ammiq area in southern Bekaa, 7000 ha in Hirmil in northern Bekaa, and 4000 ha in the Plain of Akkar in northern Lebanon. A complete of 35000 ha are appropriate for irrigation in southern Lebanon, comprising 1200 ha close to Saida. In the Kassmieh area, presently 4 000 ha are prepared for irrigation and 3600 ha are really irrigated. The water which should be saved must increase the irrigated area by 2000 ha. The coastal rivers and aquifers must irrigate about 58 000 ha in the coastal line. An significant first step in the whole process of a long-term water management policy in Lebanon is the forging of a good operating partnership between the main actors in the water sector, including the Ministry of Energy and Water (MEW), the four district water establishments, the Litani River Authority, the Ministry of Agriculture and the Ministry of Environment in addition to the numerous private actors.

CONCLUSION

The rapid loss of waters is a common problem in the Middle East which can lead to climate change on the all sides of water use. The share of the individual from water have been decreased in some countries to 170 cubic meters per year. This level is considered risky because it is lower than the water scarcity level which is internationally recognized that amounted of 1000 cubic meters.

If the Middle East countries have increased their population increase, they will head towards severe shortage at the water resources. The freshwater for numerous uses will continuously decrease. The water scarcity will be increased in the Middle East and many other countries and it will be worse if the donors' authorities and governments stayed weak in front of this regional problem. Therefore, if the situation is stayed like this, the domestic water services for hundreds of millions of people will be collapsed. Consequently, the production of the food for each individual will be decreased. The struggles between these countries will be raised on the freshwater resources which resulting on increasing the food costs.

The lack of freshwater will increase the demand of the states on the aquifer and speeds the recession of ecological systems and effect on the quality of waters. This issue is clearly distinguished in Palestine particularly in Gaza Strip. The researcher trusts that only assembled full corporation between its countries forces itself for generation to come. The collaboration between countries which suffer from the water scarcity will help on finding solutions to this problem. Here the role of the governments and civic society organizations come in transporting the water from one country to another or from one region to another and help on solving this problem. Moreover, these entities help on placing low cost projects such as solar energy and wind energy projects which may help in transporting the freshwater. The desalination of water may be taken into consideration by the governments in spite of its high cost.

This research is sought to discover the Israeli greed in the Arab waters by imposing their control on the water resources and it is clear to everybody that Israel seek to impose their power even strongly on the water regions which rich of waters to achieve their resettlement greed and get new water resources which represent as one of the most important living continuity in front of the large number of coming Jewish from different parts of the world. This research is focused on the water issue which registered lacks at the Arab countries and Israel which impose the necessity to

their collaboration to increase these resources instead of focus on the water rights. Israel sees that the water issue is an important case as it is considered economic resources issue which must be developed by the technical methods by get benefit from tis technical experiences in addition to the regional collaboration. While the Arab side sees to the water issue as a political issue and associate the collaboration with Israel by with draw from the occupied Arab regions especially from the Syrian and Lebanon side. The water issues is interfered in the heart of the settlement process for the Arab and Israeli conflict and it plays a significant role in the resettlement of conflict. So, the waters can be an important factor to continue the wars if it is not solved fairly solution and its solution must be the beginning to enter the region towards the permanent peace. It is necessary to solve the water crisis if we want to succeed the settlement process in the Middle East especially that the waters have political and economic dimensions. Therefore, the future of the settlement is highly associated by solving the water issue. We think that the real solution of the water require from the Israeli government to recognize the rights of the other in the waters and not to impose preconditions on the Arab parties because the main concept of settlement with the Arab means to get through the agreements on what Israel was obtained by power and its explanation on water become legally and to enter in mutual projects with Arab countries without any waiver or recognize to the rights of the Arab in their waters. In addition, the Israeli officials announce that lack of agreement on solving the water problem means the war danger and to show that the Arab are who stand against reaching to an agreement.

In spite of the existence of many water projects for mutual collaboration between Israel and Arab countries, it stays without any importance while Israel does not want to exchange the land with peace and it wants to keep its control on the water resources and the problem is stayed in the water peace projects but with the peace itself because it is difficult to solve the water crisis in the middle east without solving different conflict parties between the Arab and Israel and especially the Palestinian issue. So, it is not expected to implement water collaboration between Israel and the Arab without recognizing the rights of the other. While in terms of the water problem in Jordan, Jordan also suffers from the water crisis in spite of the attempts which tried to raise the water levels and decrease its consumptions by using multiple techniques where the level of the groundwater in some water basins has highly decreased and in some cases it led to dry the wells because of decreasing the

averages of the groundwater and increase the pumping numbers. Moreover, the nature of the inadequate water resources led and increase the number of population led to transform the water problems into crises in Jordan in the dry seasons and the average of the exploited waters is amounted about 862 billion cubic meter and the maximum which can be exploited from the local resources reach in 2020to about 1300 million cubic meter. Finally, Lebanon also treat from the water dry where the ministry of agriculture in Lebanon stated that the irrigated land does not exceed 450 square kilometer while the required area to be irrigated is about 600 square kilometer. It must be mentioned that only the South and Bakaa need into billion cubic meter of waters annually. In other hand, a wide areas of Lebanon expose into the water dry not only for irrigation but on the drink waters. Thus, it is clear that Lebanon is extremely needs into waters and it is logical to take it before the other can take what it wants.

REFERENCES

A. Flexer, J. Guttman, H. Shulman, Y. Anker, A. Yellen-Dror, L. Davidson, (2004), The potential use of new Geological findings for water exploration in lower Jordan Valley, Water for Life in the Middle East, Second Israeli–Palestinian–International Conference, Turkey.

A'ib, H., (2009), Water in the Middle East: Political Geography of Resources and Conflicts. Cairo: General Egyptian Book Association.

Abu-Taleb, F., (1994), Environmental management in Jordan: problems and recommendations, Environmental Conservation, pp. 35–40.

Abu-Zreig, et al., (2000), Rainfall harvesting using sand ditches in Jordan, Agricultural Water Management 46 (2), pp. 183–192.

Achiron F., Frumkin R., (2004) "Water Allocations Israeli- Palestinian International Conference on Water for Life Held in Antalya, Turkey, pp.10-14.

Administration Centrale de la Statistique (ACS), 2006, Compendium statistique nationalsur les statistiques de l'environnement au Liban 2006.

Al-Abbasi, R. T, (2010), Water Crises in Arabian Gulf and Proposed Alternatives. Retrieved from http://pulpit.awatanvoice.com/content-95154.html.

Laura A. , Oron G., Manor Y., Gillerman L. and Salgot M., 2004, Wastewater Reclamation and Reuse for Agricultural Irrigation in Arid Regions: The Experience of the City of Arad, Israel." In 2nd Israeli-Palestinian International Conference on Water for Life Held in Antalya, Turkey, pp.10-14

Al-Faisal, M., (1977). Water Supply and Weather Modifications Through the Use of Transported Icebergs from Antarctic. Desalination, 20(103), pp. 415-423.

Amani A., and Lubad S., (2004), Health Effect due to PoorWastewater Treatments in Gaza Strip, In 2nd Israeli-Palestinian International Conference on Water for Life, Held in Antalya Turkey, pp. 10-14.

Al-Jamal, K.. (2001), Prospects for Desalination in Gaza, Watermark, The Newsletter of the Middle East Desalination Research Center.

Allan, T., (1997), Virtual Water: A Long Term Solution for Water Short Middle Eastern Ecinomies? Paper presented at the British Association Festival of Science, Roger Stevens Lecture Theatre, University of Leeds, Water and Development Session.

Allon Y., (2012), The Case for defensible borders, foreign affairs, vol. 55, No. 10, p.40.

Al-Rubay'e, S., (2002), Water projects in the Middle East. Damascus: Dar Al-Hasad for publication, printing and Distribution.

Al-Sa'ed R., 2005, Obstacles and Chances to Cut Pollution Load Discharges from Urban Palestine, Water International, Volume 30, no 4, pp.538- 544.

Amery H. A., 2001, Islamic Water Management, Water International, Volume 26, pp. 481- 489.

Amery, Hussein. (1998), Assessing Lebanon's water balance, Workshop on freshwater balances in the Eastern Mediterranean region, held at the International Development Research Centre (IDRC) and Carleton University, Ottawa, Canada.Applied Research Institute-Jerusalem.

Arlosoroff, S., 2005, Water Demand Management-A Strategy to Deal with Water Scarcity; Israel-A Case Study, In 2nd Israeli-Palestinian International Conference on Water for Life, Antalya, Turkey.

Arlosoroff, S.. (2002), Integrated Approach for Efficient Water Use; Case Study; Israel." In The World Food Prize International Symposium Held in Des Moines, Iowa.

Arlosoroff, Shaul. (2000), Water resource Management in Israel," In Management of Shared Groundwater Resources: The Israeli-Palestinian Case with an International Perspective, ed. Eran Feitelson and Marwan Haddad, pp.57-74.

Askenazi, Rotem and Maha Issa. (2005), The Israeli-Palestinian Joint Water Committee Assessment." Foundation GIPRI.

Assaf, Karen, Nader al Khatib, Elisha Kally and Hillel Shuval, (1993), A Proposal for the Development of a Regional Water Master Plan, Jerusalem: Israel/Palestine Center for Research and Information.

Assaf, Karen. (2000), The Need for Joint Management and Monitoring of the Water 'Usage' cycle." In Management of Shared Groundwater Resources: The Israeli-Palestinian Case with an International Perspective, ed. Eran Feitelson and Marwan Haddad, pp.75-82.

Atwan, Nawal, et al. (2004), Allocations of Water and possibilities in an Israeli-Palestinian Water Accord." Princeton University.

Al-Qaisi B.M., (2008) Geo-hydrological Study of Groundwater Artificial recharge in Madoneh Area, M.Sc thesis not published, Mu'tah University, Jordan.

Barghothi, Ihab, Khalil Saleh, Aiman Jarrar and John R. Pasch., (2004), Planning with Uncertainty: West Bank Water Management Strategy Analysis, In International Water Demand Management Conference Held at Dead Sea, Jordan.

Barghothi, Ihab. "House Committee on InternationalRelations", Committee on International Relations, U.S. House of Representatives, www.house.gov/international_relations/108/bar050504.pdf. accessed May 5 2004.

Bashir, Basema M. and Ziad A. Mimi. (2005), Synthetic Unit Hydrograph for Al Fara'a Catchment in the West Bank, Water International, Volume 30, no. 3, pp.372-377.

Benvenisti Eyal, (2000), The Legal Framework of Joint Management Institutions for Transboundary Water Resources, In Management of Shared Groundwater Resources: The Israeli-Palestinian Case with an International Perspective, ed. Eran Feitelson and Marwan Haddad, pp.407-427.

Blatter J. and Helen I., (2001), Reflections on Water:New Approaches to Transboundary Conflicts and Cooperation, Cambridge, MA: Massachusetts Institute of Technology.

Blomquist W. and Helen M. I. (2003), Boundaries Seen and Unseen: Resolving Transboundary Groundwater Problems, Water International, Volume 28, no 2, pp.162-169.

Brooks D. B., (1993), Adjusting the Flow: Two Comments on the Middle East Water Crisis, Water International, pp.35-39.

Brooks D. B., (2005), An Operational Definition of Water Demand Management, International Journal of Water Resources Development.

Brooks D. B., 2005, An Anecdotal History of Third Track Negotiations on Palestinian-Israeli Water Issues from 1992-2004, At the Water and Peace: Palestinian and Israeli Perspectives Conference Held at the Lyndon B.Johnson School of Public Affairs, University of Texas, 19 January.

Brooks D. B. and Sarah W., (2004), Water Demand Management as Governance: Lessons from the Middle East and South Africa, In 2nd Israeli-Palestinian International Conference on Water for Life Held in Antalya, Turkey.

Burg A. and Ittai G. and Joseph G., 2004, Changes in Water Quality Along the Water Flow From the Recharge Area to the Confined Area-The Western Mountain Aquifer, Kefar-Uriyya Case Study, In 2nd Israeli-Palestinian International Conference on Water for Life Held in Antalya, Turkey.

CDR/MHER/BTD-CADRES-Consulting Engineers, (1994), Rapid initial assessment of small and medium irrigation schemes in Lebanon, Beirut.

Choueiri, E., (2000), Stratégie et Politique Agricole, Annexe 2: Ressources hydrauliques et pratiques de l'irrigation.

Comair, F., (2005), The loss and exploitation of water in Lebanon (in Arabic). Daccache, pp. 319.
Conseil National de la Recherche Scientifique (2004), Atlas du Liban, pp.63.

Daibes F., (2003), Interview by author, 29 December 2005, Daibes, Fadia, ed. Water in Palestine: Problems, Politics, Prospects, Jerusalem.

Damashkeya G., (1994), the Water Crisis and the Conflict in the Arab Region, Damadcus, Syria, pp. 44-50.

David B., (2004), Water Demand Management as Governance: Lessons from the Middle East and South Africa, In 2nd Israeli-Palestinian International Conference on Water for Life Held in Antalya, Turkey.

EU, (2004), Improvement of Irrigation Water Management in Jordan and Lebanon (2003-2008). Available at www.irwaproject.com.

Hof F.F., (1995), The Yarmouk and Jordan rivers in the Israel–Jordan peace treaty, Middle East Policy, pp.47–56.

FAO. (1994), Irrigation rehabilitation and modernization project: Preparation report. FAO Investment Centre/World Bank Cooperative Programme Report No. 5/94 CP-LEB 8. Rome.

FAO. (1995), Agricultural infrastructure development project: Preparation report. FAO Investment Centre/World Bank Cooperative Programme Report No. 106/95 CP-LEB 9. Rome.

Geadah, A., (1993), Projet d'irrigation de la Bekaa-Sud: Étude de faisabilité, document de travail en vue de la reprise des activités. Litani River Authority, Beirut.

Gill R., (1998), Scenario Planning: Managing for the Future, John Wiley & Sons Ltd, Chichester, West Sussex, England, pp. 131.

Glaser, J., (2002), Hydrochemical investigations in the North-Eastern Dead Sea Area, Jordan. Master thesis, Karlsruhe, Germany.

Haddad, M. and Numan M., (2004), Non-Conventional Options for Water Supply Augmentation in the Middle East: A Case Study." Water International Volume 29, no 2, pp. 232-242.

Haddad, Marwan, Eran Feitelson and Shaul Arlosoroff. "The Management of Shared Aquifers." In Management of Shared Groundwater Resources: The Israeli-Palestinian Case with an International Perspective, ed. Eran Feitelson and Marwan Haddad, 3-23. Ottawa: IDRC, 2000.

Haddad M., Eran F., Shaul A. and Taher N., (2000), A Proposed Agenda for Joint Israeli- Palestinian Management of Shared Groundwater, In Management of Shared Groundwater Resources: The Israeli-Palestinian Case with an International Perspective, ed. Eran Feitelson and Marwan Haddad, Ottawa, pp.43-56.

Haddadin M., (2001), Water Scarcity Impacts and Potential Conflicts in the MENA Region, Water International,Volume 26, no 4, pp.460-470.

Hakimian H., (2003), Water Scarcity and Food Imports: An Empirical Investigation of the 'Virtual Water' Hypothesis in the MENA Region. 10th Annual Conference of the Economic Research Forum for the Arab Countries, Turkey and Iran, Morocco, pp. 16-18.

Hamad W., (2005), The Water War in Middle East, Collaboration House for Publishing and Prinitng, Damascus, syria.

Hamamy G. (2007), EGM on the production of statistics on natural resources and environment. Lebanese Presentation. Presidency of the Council of Ministers. Central Administration of Statistics.

Hambright, K. and David, F., (2006), Jamil Ragep and Joseph Ginat. eds. Water in the Middle East: Cooperation and Technological Solutions in the Jordan Valley, Norman, OK: University of Oklahoma Press.

Harpaz Y., Marwan H. and Shaul A., 2000, Overview of the Mountain Aquifer, In Management of Shared Groundwater Resources: The Israeli-Palestinian Case with an International Perspective, Ottawa, pp.43-56.

Haskins, J. et al., (2010), Scientists Unite to Combat Water Scarcity; Solutions Yield More crop per drop in Drylands. Retrieved from www.eurekalert.org/pub_releases/2010-020210.php.

Heineman, Robert A., William T. Bluhm, Steven A. Peterson and Edward N. K., (2002), The World of the Policy Analyst, New York: Chatham House,.

Hemson, D. et al. (2008). Poverty and Water: Explorations of the Reciprocal Relationship. Lindon & New York: Zed Books.

Husseini H., 2004, The Palestinian Water Authority: Developments and Challenges Involving the Legal Framework and Capacity of the PWA. In 2nd Israeli-Palestinian International Conference on Water for Life Held in Antalya, Turkey.

Ibrahim Mudher, (2004), The Jewish Resetelment, The Palestanian Rights and Peace, Analysis Center of Palestanian Studies, Washington, United Staes of America, pp. 13.

Ingram H. and Joachim B., (2001), Reflections on Water; New Approaches to Transboundary Conflicts and Cooperation. Cambridge.

Isaac J. and Maher O., (2000), The Potential of GIS in Water Management and Conflict Resolution." In Management of Shared Groundwater Resources: The Israeli-Palestinian Case with an International Perspective, ed. Eran Feitelson and Marwan Haddad, Ottawa, pp. 329-345.

Isaac J. (2002), Core Issues of the Palestinian-Israeli Water Dispute, Applied Research Institute.

Issar A. S. (2004), The Water Resources of Israel Past, Present, and Future: A Comprehensive Outline." A Review Prepared for The Palestinian Center for Regional Studies.

Jaber B., (1994), The water problem in Lebanon. Conference on the problems of water in the Middle East, Centre for strategic studies, research and documentation, Beirut.

Jaber B., (1995) The water resources in Lebanon. Conference on the environmental management for sustainable development in Lebanon, Beirut.

Jägerskog, A., (2004), Why the States/Entities in the Jordan River Basin are Co-operating over their Scarce Water Resource, In The Hague Conference on Environment, Security and Sustainable Development Held in The Hague, Netherlands, pp. 9-12.

Japan International Cooperation Agency JICA, (1995), Final Report on Brackish Groundwater Desalination in Jordan, Amman, Jordan,.

Kahane, Yona. "The Turonian-Cenomanian Aquifer," Management of Shared Groundwater Resources: The Israeli-Palestinian Case with an International Perspective. Ottawa: IDRC, 2000 83-106.

Kally, E., & Fishelson, G. (1993). Water and peace: Water Resources and the Arab-Israeli Peace process.

Karam, F., Breidy, J., Stephan, C. and Rouphael, Y. (2003), Evapotranspiration, yield and water use efficiency of drip irrigated corn in the Bekaa Valley of Lebanon. Agricultural Water Management, pp.512– 537.

Karam, F., Lahoud, R., Masaad, R., Daccache, A., Mounzer, O., and Rouphael, Y. (2006), Water use and lint yield response of drip irrigated cotton to the length of irrigation season. Agricultural Water Management, pp.287–295.

Karam, F., Lahoud, R., Masaad, R., Sfeir, T., Mounzer, O., and Rouphael, Y. (2005), Evapotranspiration and seed yield of field grown soybean under deficit irrigation conditions. Agricultural Water Management, pp.1017–1032.

Kay, Paul A. (2000), Measuring Sustainability in Israel's Water System." Water International, Volume 25, no 4, pp.617-623.

Khinsee, B., (2005), Present Water Condition in most Middle Eastern Countries.

Libiszewski S., (2011), Water Disputes in the Jordan Basin Region and Their Role in the Resolution of the Arab-Israeli Conflict, ENCOP Occasional Paper No.13. ETH.
CBS (Statistics of Bureau Central).
Litani River Authority (LRA), (2000), Hydro-Agricultural Development of South Lebanon, Irrigation and Water Supply Scheme. Litani River Authority, Beirut.

Litani River Authority, Directorate of Studies, (1993), The Master Plan and the 15-year plan for the equipment and the exploitation of the Litani River Basin. Litani River Authority, Beirut.

Masahiro M., (1998), Alternative strategies in the inter-state regional development of the Jordan Rift Valley, in: Glantz, Kobori (Eds.), Central Eurasian Water Crisis, United Nations University, Tokyo, Japan.

Mdalal, S.E. (2006), Water resources in the Arab World (in Arabic). Dar El Fikr Al Arabi (Eds.), pp.176.

Mike H., (1999), Sustainable Solutions to Water Conflicts in the Jordan Valley Green Cross International Switzerland, pp. 21.

Ministry of Agriculture (MOA), UNCCD, UNDP, GTZ. 2002. Lebanese Nation Action Program (LNAP), Beirut, pp.188.

Ministry of Energy and Water (MEW), (2004), Projet d'Irrigation El Qaa-Hermel et Barrage.

MOA and FAO. (2000), Résultats globaux du recensement agricole. Ministère de l'Agriculture, FAO, Projet 'Assistance au recensement agricole, pp. 122.

Molden, D., (2007), Water for Food Water for Life: A comprehensive Assessment of Water Management in Agriculture, UK & USA: Earthscan.

Muhamad A., (2011), Qatar intends toward investments in agriculture in Region. Retrieved fromhttp://www.raya.com/site/topics/printArticle.asp?cu_no=2&_item_no=609428&version=1&template_id=35 &parent_id=34, National Water Demand Forecast, Ministry of Water and Irrigation, Amman, Jordan, 1996.

Al-Jayyousi O.R. and Shatanawi M.R., (1995), An analysis of future water policies in Jordan using decision support, Systems Water Resources Development, pp.315.

PRB, (1998), World Population Data Sheet, Demographic Data and Estimates for the Countries and Regions of the World, PRB, Washington, DC, USA,.

Gideon R., (1990), The potential impact of industrial wastes on water resources in Amman-Zarqa basin, Proc. Sec. Environ. Poll. Symp.

Roudi-Fahimi, C., & De Souza. (2002). Finding the Balance: Population and Water Scarcity in the Middle East and North Africa. Population Reference Bureau, Washington D. C.

Reguer S., (1993), Controversial waters: exploitation of the Jordan River, Middle Eastern Studies, pp.53–90.

Samad Z., (2003), Millennium Development Goals, Lebanon Report.

Shadeed, O., (1999), Water and Palestinian Security. Amman, Jordan: Dar Majdalawi for Publication and Distribution.

Tal A., (2007), International Water Law and Implications for Cooperative Israeli–Palestinian Transboundary Water Management, Security and Transboundary Water Management, Springer,.

UNIDO, (1996), Guidelines for Infrastructure Development through Build-Operate-Transfer (BOT) Projects, UNIDO, Vienna.

Wolf, A. (1996). Middle East Water Conflicts and Directions for Conflict Resolution. Washington D.C. USA: International Food Policy Research Institute.

World Bank, (1994), Irrigation rehabilitation and modernization project: Staff appraisal report. Report No. 13012–LE. Washington DC.

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