مجلة الاقتصاد والتنمية البشرية، رقم المجلد،11العدد 3والصفحة 420– 433

# An Attempt to Diagnose the Water Crisis in the Arab World and Finding the Solutions

# محاولة تشخيص أزمة المياه في الوطن العربي وسبل معالجتها

Hadjer Magraoui*
PRYoucef Bibi

Faculty of Economic, Commercial and Management Sciences,
University of Algiers3.

**Received:** 15/02/2020, **Accepted:03/12/2020 publication 31/12/2020**

**Summary:** The water crisis in the Arab world is getting worsteveryday.This situation is due totheshortage in thewater resources and theincreaseof demand. This articlewill deal with the water resourcesin the Arab world, the conventional and non-conventional onesand will address the underlying causes leading to the water scarcity associated with the continuous increase inthe water demand.

**Key words :**water crisis, water resources,water demand.

**Résume:** La crise de l'Eau dans le monde arabe empire chaque jour. Cette situation est due à la pénurie de ressources en eau et à l'augmentation de la demande. Cet article traitera des ressources en eau du monde arabe, conventionnelles et non conventionnelles et abordera les causes sous-jacentes conduisant à la pénurie d'eau associée à l'augmentation continue de la demande en eau.

**Mots-clés :** crise de l'eau, ressources en eau, pénurie d'eau, demande en eau.

**ملخص**:تتفاقم أزمة المياه في الوطن العربي يوما بعد يوم بسبب ثروته المائية المحدودة وزيادة الطلب عليها، فمن خلال هذا المنطلق سوف نحاول في هذا المقال تبيان مصادر المياه بنوعيها التقليدية وغير التقليدية في الوطن العربي والتطرق الى الأسباب الكامنة المؤدية الى الفجوة المائية والمرفقة بالزيادة المستمرة في الطلب المائي.

**الكلمات المفتاح**:أزمة مياه، مصادر مياه، فجوة مياه، طلب مائي.

## 1. Introduction

As we know the water is extremely important. It is the most important natural resource on earth and because it is involved in all developmental processes, economic or social, so the issue of providing water in the required quantity and quality has become a goal for all the countries all over the world,

*Magraoui Hadjer: magraoui.hadjer@univ-alger3.dz

especially in countries that suffer from the scarcity of water resources such asthose of the Arab world.

The Arab world is located in the arid and semi-arid region of the world, which is characterized by low rainfall and limited water resources like almostall the countries of the Arab world. It falls below the water poverty line determined by the World Bank, estimated at 1000 $m^3$ per-capita per year. All these data made the Arab world face a big water crisis;the causes diverged and varied from natural conditions towhat was related to the human factors.

In this context, the water crisis made the Arab world face a serious water situation and great challenges which require concerted efforts from all the Arab countries to cope and address them.Therefore we will try through this study to identify the mechanisms and ways that enable the Arab countries to face the water crisis that they are going throughby answering the following question.

What are the measures that the countries of the Arab world should take and the strategies theyneedto implement in orderto protect its current water resources meet the increasing water demand and decrease the severity of this issue thatis expected to last in the future?

## 2. The reality of the water resourcesin the Arab world

### 2.1 Conventional water resources

#### 2.1.1 Rainfall

Rainfall amount in the Arab world is different from one region to another and from one period to another.About 67 % of the total area of the Arab countries receives rain that is less than 100 mm per year and is classified as desert and semi-desert regions and not suitable for rainfedagriculture.The rainfall rate ranges in about 15 % of the area of the Arab countries is between 100 - 300 mm per year and a large part of thisareais invested as natural pastures.About 18 % of the size of the Arab countries receivesrain more than 300 mm per year which is a major source of surface and groundwater. It covers the coasts and high areas of Syria, Lebanon and the Maghreb in addition to Sudan(Arab Monetary Fund, 2015).The following table represents the distribution of the amount of rainfall in the various regions of the Arab world.

**Table No (01):** The distribution of rainfallamounts among the various regions in the Arab world

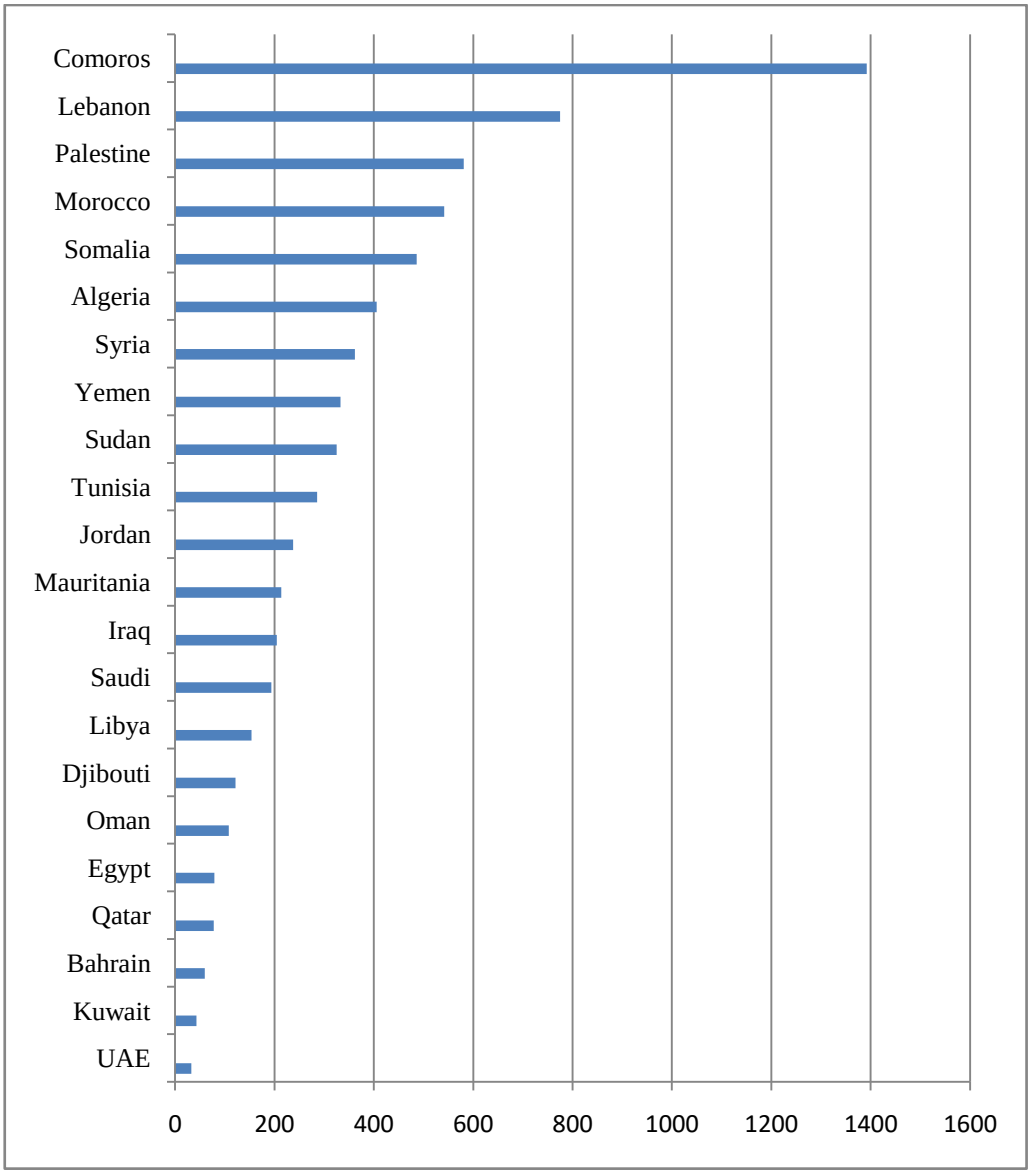
| **Regions** | **Amount of rainfall (billion$m^3$)** | **Rate %** |
|---|---|---|
| **The Arabian Peninsula region** | 211 | 9.2 |
| **Mashreqregion** | 178 | 7.8 |
| **Maghreb region** | 588 | 25.8 |
| **The Middle region** | 1305 | 57.2 |
| **Total** | 2282 | 100 |

**Source:** Mohsen Zoubida, Ti Ahmad, 2019, Water Economy and Methods of Public Service Administration, University Press Office, Algeria, p33.

Through the above table, we can see that the amounts of rainfall in the regions of the Arab world are different and vary fromone to another. The Middle region is known to have the highest rainfall rate, followed by the Maghreb and the Arabian Peninsula regions, whereas the Mashreqregion has the lowest rate, estimated at 7.8 % of the total rainfall in the entire Arab world .

The following figure also shows the rate of rainfall in the Arab countries for the year of 2016.

**Figure No (01) :**Rainfall ratesin the Arab countries for the year of 2016




**Source:** The Arab Organization for Agricultural Development, 2017, theArab Food Security Status.

Through the figure above, we notice that the rates of rainfall are different from one country to another. The Comoros scored the highest rate, estimated at 1392 mm, followed by Lebanon with 775 mm, Palestine 581 mm, then by Morocco with 542 mm, while the rainfall rateofSomalia, Algeria, Syria, Yemen and Sudan exceeded300 mm whereas Tunisia, Jordan, Mauritania and Iraq scored more than 200 mm. Saudi Arabia, Libya, Djibouti and Oman recorded more than

100 mm, while Egypt, Qatar, Bahrain, Kuwait, and the UAE scoredless than 100 mm, and the UAE ranked last by 33 mm.

### 2.1.2Surface water

Surface water includes rivers, freshwater lakes, and streams that result from springs and rain, and extend over large areas, which make them prone topollution,caused by the human development activities, and depends on them in agriculture and energy generation and in the development of various industries(Agoune, and al, 2017, p288).

The total surface water resources in the Arab countries are estimated at about 296 billion $m^3$a year and the Arab world extends from the Atlantic Ocean to the Arabian Gulf and from central Africa to the Mediterranean Sea. This vast area has many water courses, some of which stem from within Arab lands while most of them stemfrom the outside(Bin FarhatandAbbas, 2013, p4).About 44 major rivers generally flow across the Arab world(Yenounand Kahila, 2013, p5).The Arab countries also include 18 rivers pouring from outside the Arab lands which are the largest rivers in the region (Tanfout, 2019, Arab water security to face future challenges ofsustainable development, http://www.dspace.univ-biskra.dz:8080/jspui/bitstream/). The most important ones are:

#### 2.1.2.1 The Nile

The Nile is one of the longest rivers in the world, with a length of about 6825 km with a drainage area of 3 $km^2$.The Nile passes through ten countries. Egypt is the mouth of the riverpassing by Sudan. Itstems from the Blue Nile and its tributaries that come from the Ethiopian hill and form between 75%and 80% of the Nile water and the White Nile which stemsfrom the African great lakes, providing the Nile with 20% to 25% of the water(Bin FarhatandAbbas, 2013, p4).

#### 2.1.2.2 Tigris and Euphrates rivers

The Tigris Riverstems from southeast Anatolia in Turkey, specifically from the Taurus Mountains and then passes through Syria and around the Qamishli city at about 50 kmaway thenflows to the Fish Khabour town in the Iraqi territory.The Euphrates riveralso stems from southeast Anatolia in Turkey, specifically from the Taurus Mountains and it also consists of two rivers, the Eastern River, Murad Sow and the Western River, Qurat Sow(Al-Ahmad, 2019, Information about the Tigris and Euphrates,https://www.rjeem.com/).

#### 2.1.2.3 TheJordan River or River Jordan

It is a river that passes in the Levant. It covers about 80 km. It consists of three tributaries which are Baniyas coming from Syria, the Dan coming from northern Palestine, Hasbani coming from Lebanonand Lake Tiberias that formed as a result of the occurrence of thevalley’s great riftand the river separates the

historic Palestine from Jordan until it pours into the DeadSea(Bin Farhat and Abbas, 2013, p4).

### 2.1.2.4 The Senegal River

It stems from the Fouta Djallon hills and forms the border between Senegal and Mauritaniathen empties into the Atlantic Ocean (Boureghda, 2014-2015, p75).

### 2.1.2.5 Litani River (Lebanon)

It is 170 km long, itstems from the spring of the Aleik in Baalbek,itendsat the north of the city of Tire in the locality of Al Qasimiya (Burj Rahhal) and pours into the Mediterranean Sea (Quasim,2019,The Litani river between the ambitions of the Israeli enemy and chronicneglect. Who is going to save it from pollution and takes advantage of hiswater? http://www.icparty.org/).

The surface water of international rivers in the Arab world can be summarized in the following table:

**Table No (02):** surface waters of international rivers in the Arab world

| Country | Internal origin | External origin | Total water resources |
|---|---|---|---|
| **Syria** | 2.8 | 16 | 18.8 |
| **Iraq** | 21.8 | 39 | 60.8 |
| **Jordan** | 0.1 | 0.2 | 0.3 |
| **Egypt** | 0.5 | 55.5 | 56 |
| **Sudan** | 6.5 | 18.5 | 25 |
| **Somalia** | 3.6 | 4.5 | 8.1 |
| **Mauritania** | 0.4 | 5.4 | 5.8 |
| **Total (billion $m^3$)** | 35.7 | 139.1 | 174.8 |

**Source :**MohsenZoubida,Ti Ahmad,2019, Water Economy and Methods of Public Service Administration, University Press Office, Algeria,p36.

Through the above table we notice that the percentage of surface water coming from outside the Arab countries is higher than the percentage of surface water of internal origin, especially Egypt, Iraq, Sudan and Syria which makes them in permanent conflict with countries ofthe estuary.

### 2.1.3 Groundwater

It includes all types of water found in the ground.Thewater stored beneath the earth's surface resulting from the leakage of rain water into these layers, theyare renewable water basins.There is also thenon-renewable groundwater that was stored in the underground reservoirs for a long timeand which is no

longersupplied bythe rainbecause of many climate and geological factors(Agoune, and al, 2017, p288).

The estimated water reserves of groundwater in the Arab world are about 7734 billion $m^3$, and42 billion are annually renewed.Where as 35billion $m^3$are available for use, the volume of non - renewable resources is up to 1500 billion $m^3$(Younsi, 2017, p167).

The following table shows the distribution of groundwater in the Arab world.

**Table No (03):** Distribution of groundwater in the regions of the Arab world

| **Territory** | **Reserve (Unit billion $m^3$)** | | **Annual Supply (Unit billion $m^3$ )** | | **Available for exploitation (Unit billion $m^3$)** | |
|---|---|---|---|---|---|---|
| | Quantity | Ratio | Quantity | Ratio | Quantity | Ratio |
| **The Mashreq** | 13.3 | 0.2 | 8.5 | 20.2 | 6.58 | 18.7 |
| **TheArabian Peninsula** | 361.6 | 4.7 | 4.8 | 11.5 | 4.71 | 13.5 |
| **Maghreb** | 920 | 11.9 | 17.4 | 41.5 | 15 | 42.8 |
| **The Middleregion** | 6439 | 83.2 | 11.2 | 26.8 | 8.75 | 25 |
| **Total** | 7733.9 | 100 | 41.9 | 100 | 35.04 | 100 |

**Source:** Mohsen Zoubida, Ti Ahmad,2019,Water Economy and Methods of Public Service Administration, University Press Office, Algeria,p37.

According the above table the Middle region of the Arab world has the largest reserve of groundwater which is estimated at 6439 billion $m^3$, with approximately8.75 billion $m^3$available to exploitation, while the lowest reserve goes tothe Mashreq, estimated at 13.3 billion $m^3$ ,6.58billion $m^3$ available to exploitation.

### 2.2Non-conventional water resources

### 2.2.1Desalination

It is the process of removing salt from water so that it can be used for drinking orirrigation(Desalination definition meaning, 2019,http://www.collinsdictionary/ .../desalination-plant). The Arab region takes the lead in the desalination as it holds more than half of the world's desalination capabilities(Water resources in the Arab region: availability, status, and the threats_ facing it, 2019, http://www.undp.org/content/dam/rbas/doc/…/chapter1).

It also constitutes an important source of water, especially in some Arab countries such as the Gulf and Libya. It is characterized by a lack of ownership of

natural water resources and their occurrence along the Redand Mediterranean seas and the Atlantic and Indian oceans in addition to the Arabian Gulf, so they use this type of water even though it is expensive(Boufas, 2011, p4).

### 2.2.2The agricultural wastewater reuse

Surface irrigation represents about 85% of the irrigated area in the Arab world.As it is known, the efficiency of this method of irrigation is low and is estimated at about 49% in this regionandthe drainage of water is high because of the severe demand and due to the need to improve the efficiency of the use ofthe available water, it was necessary to work on the reuse of agricultural wastewater once again(Tanfout, 2019, Arab water security to face future challenges ofsustainable development, http://www.dspace.univ-biskra.dz:8080/jspui/bitstream/).

### 2.2.3 Wastewater reuse

The quantities of wastewater in the Arab region are increasing due to the population increase, the high standard of living and the accompanying development in the use of water for sanitary purposes. This situation caused more pressure on Arab water resources which are already small.It also has created a critical environmental situation due to the increase of polluted wastewater, therefore this situation has required a solution that helps support the water resources with the safe disposal of this polluted water, and then the reuse of this wastewater after its treatment has become the best solution that would increase the Arab water resources (Tanfout,2019, Arab water security to face future challenges ofsustainable de development, http://www.dspace.univ-biskra.dz:8080/jspui/bitstream/)

## 3. The Causes of the water crisis in the Arab world

There are many reasons that led to the gap between the water demand and Arab water supply which resulted in a water crisis and if it is not controlled, it will inevitably lead to negative repercussions on economic and social development. Among these reasons we mention:

### 3.1 Growing population

The Arab world's population steadily growing since several decades has led to the growing need for water and the demand is expected to increase in the future. The total estimated water demand in 2030 would be about 524 billion $m^3$which is far more than the total investment potential in the Arab world(Salman, 2005, p15).

### 3.2 The draining of the Groundwater reservoirs

Groundwater basins in most countries of the Arab world have been subjected to a large drain due to high pumping rates and unsafe withdrawals. Some undergroundreservoirsthat have high levels of water close to the surface of

the earth and high productivity weresubject to investment since the fifties and in the following decades the investment has really increased in ways that doesn't suit the storage capacities of thesereservoirs.Moreover the watersupplydecreased due to repeated aridity periods which reflected on the productivity of these basins(Boureghda, 2014-2015, p78).

### 3.3 The environmental pollution of water

Pollution is considered as one of the biggest threats on the water resources in the Arab world, due to the weakness of environmental protection techniques from the effects of industrial pollution, which leads to the loss of large quantities of ground and surface water resources, and pollution increases with the increase of wastes generated bythe industry, agriculture and people(Tanfout, 2019, Arab water security to face future challenges ofsustainable development,http://www.dspace.univ-biskra.dz:8080/jspui/bitstream/)

### 3.4 Excessive use of water

Water in the Arab countries issignificantly wastedduring the domestic, agricultural and industrial use.This is due to the lack of an adequate water price that would regulate the growing levels of demand, as well as old irrigation methods that lack lined networks that reduce the water loss (Boufas, 2011, p7).

### 3.5 Neighboring countries and the problem of Arab water security

Year after year the water problem in the Arab world is getting worst because of the apparent and growing shortage of the water coming from the rivers outside the Arab world (the Nile, the Euphrates and the Tigris) due to the huge projects built by Turkey and Ethiopia, in addition to the Zionist water strategy relating on the Arab water resources and at the expense of Arabs' interests and rights(Ibrahim, 2015, p523).

### 3.6Climate changes

The phenomenon of global climate changes has become realistic. Most of its manifestations were in the past caused by random climate changes that affected various regions in the world,especially the regions of the Arab worldthat were affected from time to time by aridity that wasdifficult to link to a specific system. The Arab world will be greatly affected by climate changes.The future expectations support that the amounts of rain will decrease during the coming years which would negatively affect the reservoirsof water. At the same time the demand for water will increase as a result of population growth, the increase of temperatures will lead to high levels of evaporation and thus increase the demand in water for agriculture which will make the water crisisworst(The Arab Strategy for Water Security in the Arab Region to face the challenges and meet the future requirements of sustainable development 2010 – 2030, 2019, https://www.unescwa.org/).

## 4. Suggestions to overcome the water crisis in the Arab world

Based on what was discussed earlier and based on future expectations, it became clear to us that the water situation in the Arab world is alarming, as the per capita water is constantly decreasing and most Arab countries fall below the water poverty line, due to severalenvironmental, human or natural factors.So the Arab countries have to put in place measures and strategies to face the critical water situation and would limit its depletion and among these strategies we suggest: (The Arab strategy for water security in the Arab Region to face the challenge and the future requirements of sustainable development 2010-2030, 2019, https://www.unescwa.org/).

### 4.1 The follow up on the regional studies concerning the reality of water resources in the Arab world and the setup of anArabic complementaryinformation system.

Providing water information systems along with decision support systems in the management of water resources at the country level and linking them with an Arab water information system will allow to follow the development of water conditions in the regionand allrelated topics in terms of uses in various development sectors and those related to social conditions, in addition tofollowing up on the development of the situation of the major river basins shared with non-Arab countries.

### 4.2 The development of the scientific research and the transfer of modern technology

The development of scientific research in the Arab world and finding a mechanism for coordination between its centers interestedin the water resources, agriculture, drinking water, sanitation and energy, is the primary key to face the water crisis in the Arab world moreover the settlement of appropriate technology to solve the problems related to the water sector and improve water management in accordance with an integrated and sustainable concept.

### 4.3 Confronting the climate changes and their impacts on water resources in the Arab world and how to adapt to it

The climate changes became prominent in the list of the world’s priorities in the field of scientific research and this scientific researchmust be developed at the Arab level, especially by developing scenarios related to the expected possibilities of climate changes and to which extent the Arab world would be affected, given that it is considered as one of the most fragile region’sto these changes, especially those related to the recurrence of droughts or floods, as well as studying the implications of all of this on water resources, particularly regarding agricultural production, to develop appropriate policies and plans to adapt to their results in the region.

### 4.4 Establishing principles of integrated water resources management

Water resources regardless of their source, are all dealt with through these principles, as it is a water source that must bring the maximum economic benefit and protect it in matters of quantity and quality.In order to meet the various requirements of development and management of the water resources from a holistic and integrated perspective so that all the involved sectors and all segments of society are taking parts in its management, including the water users, civil society associations and the private sector, while taking into consideration the principle of sustainability and at the same time considering the environment as one of theusers. The insurance of this approach requires defining the responsibilities of each participating partyin ways that these responsibilities do not contradict but rather complete each other.

### 4.5 Increasing the water use efficiency

This can be achieved by increasing the efficiency of irrigation, introducing modern irrigation systems, increasing the efficiency of drinking water distribution networks in cities and urban areas and the rationalization of both thewater resources managementand water the demand. Recovering the cost of water insurance and using theincomes in the maintenance of water networks in urban,ruraland agricultural areas and sewage networks to reduce waste, in addition to studying alternativeways of savingwater.

### 4.6 Establishment of institutional and human competences in the water sector

This matter requires setting a clear educational and scientific strategy where the needs formanagers and educational curricula in universities and institutes are matched.Training programs that are prepared for managers in the water sector in Arab countries are still below the required level and if they are found, they are not integrated and ongoing.

### 4.7 Raise water and environmental awareness among all members of the Arab society

This can only be achieved through a general review of how to increase the level of awareness of the Arab citizen and change his behavior towards this vital resource,developing a comprehensive plan for that and emphasizing the need to return to religious values and teachings.

### 4.7 Expanding the use of non-conventional water

Regarding the increase of the demand for waterand the inability of traditional water resources to cover the deficit between demand and water supply in the Arab world, desalination of sea water and treated wastewater will remain a strategic option which is not an alternative in the future in securing waterand therefore the localization of the requirements of these two techniques in terms of

industrialization, employment, and scientific research is considered as a main pillar facing the water shortage expected in the future.

### 4.8 Institutional development, water legislation and laws

Institutional development, water legislation and lawswould help in achieving justice among the various categories of water users and it also helps protecting water resources from pollution and depletionbut we should find ways to implement them properly.

### 4.9 Promoting and encouraging popular and private sector participation

The success of any water development projectand ensuring its sustainability is achieved through the participation of the local populationinvolved in all the steps that precede and follow the project and the involvement of the private sector in water projects allows to improve performance and raise efficiency by setting clear legal conditions that regulate its work.

### 4.10 Preparing a common Arab plan

This can lead to theexploitation of the water and coordinate betweenneighboring countries during negotiations with countries with water resources (sources) in order to make a fair distribution of this wealth.

### 4.11 Arab-Arab cooperation

Regarding the exploitation of the common water and filling all the gaps that separate andweaken the unity of the Arab rank and dedicate this controversial approach that helps the downstream countriesin taking advantage of this situation.

## 5. Results

Thisresearchled tothe following results:

- The Arab world belongs to the arid and semi-arid region of the worldwhich is characterized by a lack of rainfall that supplies surface and groundwater;
- The ratio of surface and ground water in the Arab world varies from onecountry to another;
- Water demand in the Arab world is met byconventional and unconventional water sources;
- Some countries of the Arab world rely on surface water of external origins which results in conflicts with the downstream countries;

- The severity of the water crisis in the Arab world varies from one country to another;

- The disruption in the water balance of the Arab world results from the increase in water demand compared to the water supply which is due to several combined reasons. The most important one is the small ratio of water compared to the global volume besides the population increase.

## 6. Conclusion

According to what was discussed through this study, it became clear to us that water is an important resource for all the countries of the world, especially in the Arab world, in which water resources are limited and diminishing over time. The water resources in the Arab world face great challenges due to pressures because of internal and external factors.The internal factor includesthe population growth, depletion of the waterground, water pollution ,excessive use of water and the phenomenon of climate changes that already affected the water resources and will probably have negative impacts in the future according to the expectations on the amount of water in the Arab world, while the external ones are represented mainly in the Zionist greed for the Arab world's water and the problem of the common water shared between the Arab and non - Arab countries. In order to stand up and address the Arab water resources crisis, a unified Arab strategy must be set and enforce the Arab cooperation regarding the water resources sector and search for solutions that would reduce water waste and rationalize its use to allow it to be provided to all consuming groupsincluding the domestic, agricultural and the industrial sectors.

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