The Impact of Water Resources Usage on Water Status and Agricultural Development in Syria

Carol Farid Alsayegh
Ph.D. Student
Faculty of Economics
Department of Economics and Planning
Tishreen University - Lattakia - Syria

Prof. Dr. Habib Abdulaziz Mahmoud
Faculty of Economics
Department of Economics and Planning
Tishreen University - Lattakia - Syria

Abstract

The research aims at highlighting the impact of water resources usage on water depletion state and agricultural development in Syria. Based on the analytical descriptive approach and the historical approach through adopting a time series extending from the year 2000 up to 2012, a description of the existing situation has been given and analyzed,. The research results have shown that Syria is confronting an important challenge, which is the achievement of efficiency in using water resources in agriculture, particularly under the limited water resources in Syria, which led to groundwater depletion on one hand, and this usage has not contributed in achieving agricultural development in Syria, on the other hand. The agricultural development indicators showed depreciation in the contribution of the Syrian agriculture to the Syrian gross domestic product, and a drop in the rate of the workers in agriculture, with an increase in the indicator of the agricultural dependency.

Keywords: WaterResources, Water Deficiency, Agricultural Consumption of Water, Agricultural Development, Gross Domestic Product, Food Dependency.

Introduction

The issue of water resources usage constitutes an exceptional and great importance to the local and international observers and concerned parties due to the correlation of water resources to life and its usage for development. Water, is considered the second basic need for all creatures after air on one hand, and on the other hand, it is a triple use substance for the human (domestic, agricultural and industrial) for the sake of meeting his needs and achieving the development requirements in general and achieving the agricultural development in particular. The importance of this issue appears clearly in the Arab Region and in Syria in particular, because Syria is located in arid and semiarid zones, where 75 % of its area is characterized by aridity, and this has an obvious negative impact on water reserves, and consequently on its supplies. The situation has aggravated during the recent decade due to lack of rain, the thing that has had a consequence in the weak various water resources (surface and ground) and the expansion of desertification phenomenon. Furthermore, Syria has witnessed an increasing population growth and an accelerating social and economic development, accompanied by huge increases in the demand rates of water, all of which have reflected in the depletion of water resources. Water is vital for life and is characterized same as other economic resources by relative scarcity in terms of place and time, and due to its important role in agriculture, we believe that it is necessary to deliberate its usage status in agriculture and to analyze the impact of this usage on water status and agricultural development in Syria. Based on the foregoing, we have chosen the research subject about the impact of water resources usage on water status and agricultural development in Syria.

Main Focus and Objectives of the Research:

The problem of the research arises from the fact that agriculture is the biggest consumer of water resources in Syria.

However, this water usage is inefficient since it has not contributed in achieving agricultural development, but it led to the depletion of water resources and aggravated water deficiency in Syria. We can express the problem of the research as follows:

- What is the impact of water usage in agriculture on water status and on the agricultural development in Syria? This main question radiates to the following sub-questions:
- What is the water status in Syria? What is the nature of water resources usage in agriculture (agricultural demand of water)?
- What is the impact of water resources usage in agriculture on the water status in Syria?
- Is the usage of water resources for agriculture in Syria, characterized by efficiency?
- What is the impact of this usage on the agricultural development in Syria?

The Objectives of this research are:

- To address the water status in Syria.
- To figure the status of water resources usage in the Agricultural Sector in Syria.
- To determine the impact of water resources usage in agriculture on water status in Syria.
- To determine the impact of water resources usage in agriculture on achieving the agricultural development in Syria.

Therefore, this research contributes in clarifying the impact of water resources usage in the Agricultural Sector on the agricultural development and on water status in Syria.

Hypothesis of Research:

H_0: Water usage for agricultural purposes has no negative impact on water status and it is efficient in achieving the agricultural development in Syria.

H_1: Water usage for agricultural purposes has a negative impact on water status and it is inefficient in achieving the agricultural development in Syria.

Research Methodology

The research has adopted the analytical descriptive approach, which depends on collecting the data and information that help in describing the problem accurately and in analyzing it in order to reach accurate results. It has also depended on the historical approach through adopting a time series extending from the year 2000 up to 2012, studying it and finding out its direction and growth. As for the study tools, the research has depended on a collection of books, governmental reports, laws, periodicals, references and statistics.

1. The Situation of the Availability of Water Resources in Syria:

Syria was classified in 2013 as one of the arid and semiarid countries. Syria needs /23/ billion m^3 to make the per capita quota therein equal to water poverty line that amounts to/1000/ m^3 per capita per year for the total purposes, considering that the International Standard has determined the condition whereby the annual the per capita quota of waterfalls below /1000/ m^3 as water deficiency limit *(FALKENMARK, 1990)*.

The average annual traditional and untraditional water resources, organized and available for use during the period (2002-2012) has amounted to about /16.2/ billion m^3, and the average water uses has amounted to /17.7/ billion m^3, that is at a rate of 109 % of the available resources. Accordingly, the average deficiency has amounted to /1.5/ billion m^3 (water of Tigris River has not been counted in the water resources since it has not been organized yet and since the organized resources are those available resources for use). In 2007, the usage amounted to 123 % of the available resources, and the deficiency amounted to /3.5/ billion m^3 *(Syrian Ministry of Water Resources, 2013)*. The per capita quota out of the renewable water resources varies according to the rainfall supplies. The average quota during the years (2007-2012) estimated by about /843.1/ m^3 / year per capita. The per capita quota out of the total renewable water resources in Syria during the period (2002-2012) is shown in the following Table:

Table 1: Per capita quota out of the total renewable water resources in Syria for the period (2002-2012) (m^3per capita / year)

Designation / Year	2002	2007	2008	2009	2012
Per capita quota out of the total renewable water resources	990.4	869.5	855.5	838.4	809

Source: Prepared by the Researcher based on the data of the Statistics and Database Center (SERTCIC). Retrieved on 21/3/2015 from the website: **www.sesrtcic.org/databases-indeix-ar.php.**

Table 1 shows that the per capita quota out of the renewable water resources continued in deterioration during the period (2002-2012) and it reached below the international water poverty line, which amounts to /1000/ m^3 per capita / year. Water resources from rainfalls inside the country, that is the total internal renewable water resources, are estimated by /7.13/ billion m^3 as shown in Table 2, and the internal renewable surface water resources are estimated by /4.3/ billion m^3 per year. The renewal of groundwater is estimated by /4.8/ billion m^3 per year, out of which /2/ billion m^3 per year flows into the rivers, such as the springs water (the thing, which forms interpenetration between surface water and groundwater). The following Table shows the annually renewable fresh water resources as follows:

Table 2: The Annually Renewable Fresh Water Resources in Syria

Average Rainfall (Long Term)	252	mm / year
	46.67	billion m^3 / year
Internal Renewable Water Resources (Surface and Ground)	7.132	billion m^3 / year
Total Actual Renewable Water Resources (Internal and External)	16.797	billion m^3 / year
Credit Percentage	72.29	%

Source: Arab Organization for Agricultural Development, FAO, Water Data of the Syrian Arab Republic up to 2012 on the website**:**http://www.fao.org/ar/water/aquastat/data/query/results.htm.

The total actual renewable water resources are estimated by /16.797/ billion m^3 per year. The surface natural flow is estimated by /28.515/ billion m^3 per year. Whereas, the actual external surface renewable water resources are estimated by /17.335/ billion m^3 per year, including /15.750/ billion m^3 per year of the water that comes with Euphrates River, as proposed by Turkey unilaterally, and /0.335/ billion m^3 per year of the water that comes with Orontes River, as agreed upon with Lebanon. An amount of /1.250/ km^3 per year of the water comes from Tigris River *(FAO, 2010)*. The total amount of groundwater entering the Syrian Arab Republic is estimated by /1.33/ billion m^3 per year. Out of which /1.20/ billion m^3 per year from Turkey and /0.13/ billion m^3 per year from Lebanon (Al Dan Sources), while the total groundwater flowing out of the Syrian Arab Republic to Israel is estimated by /0.25/ billion m^3 per year and to Jordan by 0.09 billion m^3 per year *(FAO, 2010).* Looking at the Water Balance of the hydrological year 2008-2009, the total traditional and untraditional available water resources have amounted to about /16.6/ billion m^3 including the portion of Syria from Euphrates River in accordance with the Temporary Protocols signed with Iraq and Turkey which amounts to no less than /6.627/ billion m^3 per year in accordance with the Protocol of 1987 stating the passing of 500 m^3/sec as for Syria. In accordance with the Syria Convention of 1989 stating that, Iraq will take a quantity of 58% of the water passing through the Syrian-Turkish Borders while Syria will take 42% without counting the supplies of Tigris River since there is no agreement up until now to the allocation of its water.

In addition, its uses in Syria are limited because it flows in mountainous lands. In the hydrological year 2011-2012, the total traditional and untraditional water available resources after evaporation have amounted to about /19.1/ billion m^3*(Syrian Ministry of Water Resources, 2013)*. The total traditional water resources available in the seven hydrological basins in Syria is studied through the hydrological year 2011-2012, and the data of the following Table have been analyzed:

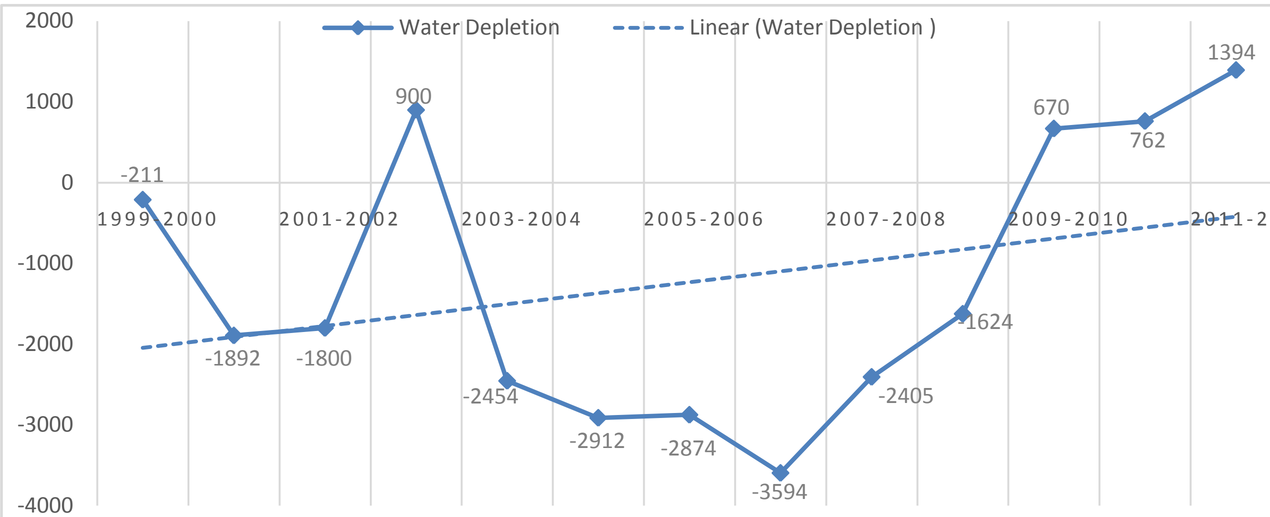
Table 3:Distribution of the Traditional Water Resources to the Hydrological basins for the Hydrological Year 2011-2012

Designation / Basin	Basin Area (Hectares)	Population (Thousand Persons)	Total Available Traditional Water Resources(Million m^3)
Tigris & Khabur	21129	1512	2207
Euphrates & Aleppo	51238	5714	7933
Orontes	21624	4170	2246
Coastal	5086	1802	4160
Barada & Awaj	8596	6100	881
Al-Yarmouk	6721	1537	332
Semi Desert (Badia)	70786	379	179
Total	**185180**	**21214**	**17938**

Source: Prepared by the Researcher based on the data of the Syrian Ministry of Water Resources for 2011-2012.

Table 3 shows that a percentage of about (56.52%) of the Syrian water comes from the Basins of Euphrates and Tigris and from Khabur.This is where the two rivers spring up from non-Syrian territories, and the area of the two basins together amounts to 39.08 %[*]ofSyria's Area .The population percentage in the two basins together is 34.06%[**] of the total Syrian population, i.e. there is an obvious disorder in the ratio of water distribution as for the area and for the population on the Syrian territories.

Figure (1): Water Depletion through the period (2000-2012)



Source: Prepared by the Researcher based on the data of the Water Balances for the mentioned years, by the Syrian Ministry of Water Resources, Damascus.

2. Water Status in Syria:

The Syrian water status reveals a water crisis represented in the deficiency in the Syrian Water Balance through the period (2000-2012):

Table 4: Water Status in Syria through the period (2000-2012) –The Unit: Million m^3.

Hydrological Year	Water Balance	Annual Change Rate %
1999-2000	-2211	-
2000-2001	-1832	-17.12
2001-2002	-1801	-1.69
2002-2003	899	-105
2003-2004	-2454	-373
2004-2005	-2912	18.66
2005-2006	-2874	-1.30
2006-2007	-3594	25.05
2007-2008	-2405	-33.08
2008-2009	-1624	-32.47
2009-2010	670	-141.26
2010-2011	762	13.73
2011-2012	1394	82.94

[*,**]Remark: The Percentages have been calculated by the Researcher based on Table (3)

The Syrian Water Balance has suffered in most of the years from water deficiency varying from one year to another, and it amounted by average through the period (2000-2012) to about/1383.2/ million m^3. Figure 1 shows its development:

Figure (2): Water Depletion in the Hydrological Basins through the period (2009-2012)

Source: Prepared by the Researcher based on the data of Table 5.

According to both Table 5 and Figure 2, we find that Syria suffers from water deficiency in five of its hydrological basins, which are the basins of Barada, Awaj, Al-Yarmouk, Khabur, and Orontes. This deficiency will accumulate in case of the succession of arid or too arid years. The surplus, which is realized in the Syrian Water Balance through the period (2009-2012), is attributed to the surplus realized in the Coastal Basin and Euphrates Basin and to the rainfalls that happened in the mentioned years.

Table (5): Water Balance for the Hydrological Basins for the period (2009-2012) -Unit: Million m^3

Hydrological Basins Balance / Year	Semi-Desert	Aleppo& Euphrates	Tigris & Khabur	Coastal	Orontes	Al-Yarmouk	Barada	**Total**
2009-2010	-3	322	-2114	2718	-110	-27	-116	**670**
2010-2011	-4	350	-2240	2936	-120	-35	-125	**762**
2011-2012	-1	348	-2256	3603	-130	-39	-131	**1394**

Source: Prepared by the Researcher based on the data of Ministry of Water Resources, for the Syrian Hydrological Basins for the period 1992-2009.

The realized surplus in the Water Balance for the years (2009-2012) does not reflect a good water status in Syria. Furthermore, the big deficiency in Khabur Basin indicates that it will be difficult to correct its condition without taking special actions.

3. Water Resources Uses in Agriculture (Agricultural Demand):

Water resources play an essential role in achieving the agricultural development and its stability, and in overcoming the contrast in rainfalls in terms of their quantity and quality *(Alyousef, 2010)*. Irrigated agriculture is considered the pillar of agricultural production and the achievement of food security *(Bartolini, 2007)*. The Agricultural Sector consumes the biggest part of the water resources in Syria, where this consumption has actually amounted to 88.12 % of the total uses between the two years (2000-2012) by average *(Syrian Ministry of Water Resources, 2012)*.Due to adopting the policy of self-reliance to achieve food security through the past four decades, the thing that necessitated permanent expansion in the reclamation of the agricultural lands and extension of the irrigated areas for food production, and consequently the consumption of huge quantities of water in irrigation. The extension in the irrigated areas takes place dueto the high returns from the irrigated areas in comparison with the agriculture dependent on rainfall. The Water Policies have focused through the period (2000-2012) on providing water for the Agricultural Sector and expansion in the irrigated areas, where Water Sector has played an essential role in the achievement of agricultural development and its stability and overcoming the rainfalls in terms of the distribution and quantity. The irrigated areas in Syria have developed at a rapid pace through the period (2000-2012), where the irrigated areas increased from /1185.7/ hectares in 2000 to /1399.4/ hectares in 2012, which indicates an increase in demand of water for agricultural purposes *(Alyousef, 2010)*, as shown in the following Table:

Table 6: Development of the Irrigated Areas through the period (2000-2012) –Unit: Area: Thousand Hectares - Water Usage: Million m^3

Year	Irrigated Area	Water Usage for Agriculture	Total Uses of Water Resources	Rate of Water Uses for Agriculture out of Total Uses
2000	1185.7	13188	14989	88 %
2001	1210.7	13683	15557	88 %
2002	1266.9	14410	16359	88 %
2003	1332.8	14669	16690	87.9 %
2004	1361.2	15608	17669	88.3 %
2005	1439.1	16640	18887	88.1 %
2006	1425.8	16914	18844	89.7 %
2007	1402.1	17273	19264	89.6 %
2008	1396.3	15395	17490	88 %
2009	1356.4	16180	18252	88.6 %
2010	1238.4	14299	16432	87 %
2011	1340.9	15330	17544	87.4 %
2012	1399.4	15436	17757	87 %

Source: Prepared by the Researcher based on data from Ministry of Agriculture and Agrarian Reform, the Annual Agricultural Statistical Abstract, Table 4 for the mentioned years, data from the Syrian Ministry of Water Resources, and data of the Water Balances for the mentioned years.

Table 6 shows that the area of the irrigated lands has increased through the period (2000-2012) by about /17.81/ thousand hectares by average per year, i.e. at an average rate of growth of (1.50 %), and in return thereto the land need of water have increased through the studied period by /187.33/ million m^3 by average per year, i.e. at an average rate of growth of (1.420 %). In order to study the development of the irrigated areas with the pass of time, the tight correlation between the irrigated areas and the time has been calculated in order to find out the Regression Model and to test its Significance:

Table 7: Correlation and Determination Coefficients of the Relationship between the Irrigated Areas and the Time Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.665	.442	.391	65.450

Table 8: Test of Regression Model Significance for the Relationship between the Irrigated Areas and the Time

ANOVA

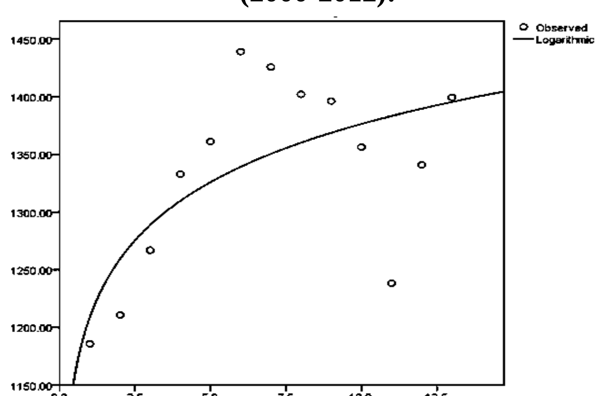
	Sum of Squares	Df	Mean Square	F	Sig.
Regression	37262.278	1	37262.278	8.699	.013
Residual	47120.794	11	4283.709		
Total	84383.072	12			

Table 9: Results of the Test of Regression Coefficients Significance for the Relationship between the Irrigated Areas and Time Coefficients

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
In (Case Sequence)	72.800	24.684	.665	2.949	.013
(Constant)	1208.761	46.509		25.990	.000

Table 7 shows that the relationship between the Irrigated Areas and the Time is an acceptable direct relationship, where the value of the Determination Coefficient shows that 44.2 % of the occurred changes in the irrigated areas are interpreted by Time, and the remainder is attributed to the impact of other factors not included in the Model. Also Table 8 shows the Test of Regression Model Significance, where the calculated value $F = 8.699$ is higher than the table value /4.84/ at the two Freedom degrees (1, 11) and the Significance Level /0.05/, also the Significance $P = 0.013 < 0.05$, and consequently the Regression Model is Significant. Table (9) shows that the estimations of the Regression Model Coefficients are Significant because the Sig. Value is less than /0.05/. Also the value of $B_0 = 1208.761$, $B_1 = 72.8$. Accordingly, the Equation can be written as follows: $\hat{Y} = 1208.761 + 72.8 \log t$ …………… (1)

Figure 3 shows the General Trend Line for the Development of the Irrigated Areas through the period (2000-2012):



Based on the foregoing, we notice that the development of the irrigated areas represents a direct reflection of the economic policies and the applicable corrective measures.

4. *Impact of Water Resources Usage on Water Status in Syria*

The irrational use of water resources in agriculture in Syria has left negative impacts on water resources represented in water deficiency in most of the basins. Remedying the deficiency was on the account of the groundwater where the agricultural areas irrigated with the groundwater have developed. The following Table illustrates the aforementioned:

Table 10: Development of the Irrigated Areas and their Needs of Surface Water and Groundwater for the period (2000-2012) - Unit: Thousand Hectares

Year	Irrigated Areas	Areas Irrigated from Surface Water	Areas Irrigated from Groundwater	Percentage of Areas Irrigated from Surface Water	Percentage of Areas Irrigated from Groundwater
2000	1210.7	512.5	698.2	42.3%	57.7%
2001	1266.9	512.6	754.3	40.5%	59.5%
2002	1332.8	515.5	817.3	38.7%	61.3%
2003	1361.2	506.5	854.7	37.2%	62.8%
2004	1439.1	574.4	864.7	40%	60%
2005	1425.8	560.4	865.4	39.3%	60.7%
2006	1402.1	551	851.1	39.3%	60.7%
2007	1396.3	583.4	812.9	41.8%	58.2%
2008	1356.4	595.4	761	43.9%	56.1%
2009	1238.3	582.1	656.2	47%	53%
2010	1340.9	614	726.9	45.8%	54.2%
2011	1399.4	647.1	752.3	46.2%	53.8%
2012	1428.1	642.4	785.7	45%	55%

Source: Ministry of Agriculture and Agrarian Reform, the Syrian Agricultural Statistical Abstract, and Table 4 Distribution of Irrigation according to the irrigation resources, with their development for the mentioned years.

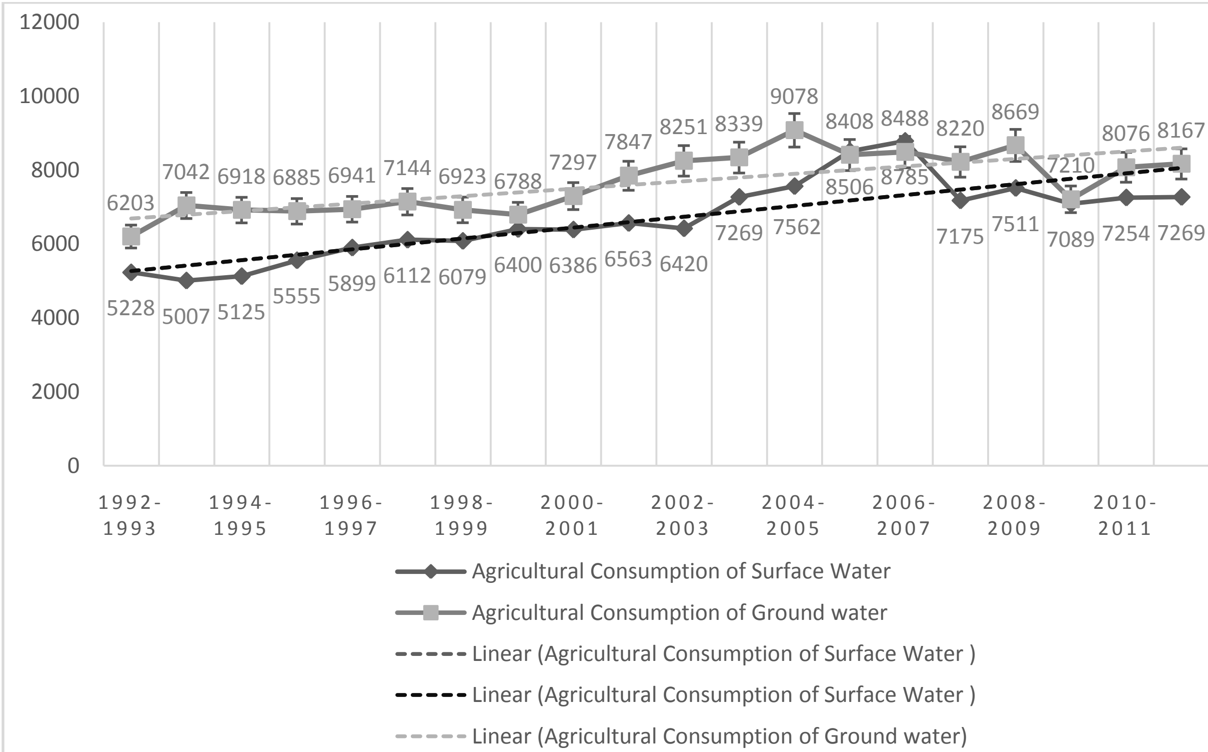
Table 10 shows the increase of the areas irrigated from groundwater, and the reasons of increase are attributable to the loans granted by the Agricultural Bank for financing the drilling of wells with low interest rates, and the detection of groundwater in various regions, and the price policy adopted by the State so as to ensure acceptable profit margin to the farmer to encourage him to proceed in agriculture, the thing that has made the process of drilling the artesian wells and shifting from the rain fed lands to the irrigated lands an economic process for the purpose of increasing the production of the strategic crops, the most important of which is wheat, for the sake of fulfilling the demand thereon at the national level *(Aldroubi, 2000)*. Moreover, the slow execution of the governmental irrigation projects and land reclamation has contributed thereby. The following Table clearly shows the agricultural consumption of the surface water and groundwater for the period (2000-2012):

Table 11:Agricultural Consumption of the Surface Water and Groundwater for the period (2000-2012) - Unit: Million m^3

Designation \ Year	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006	2006-2007	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012
Surface Water	6386	6563	6420	7269	7562	8506	8785	7175	7511	7089	7254	7269
Ground Water	7297	7847	8251	8339	9078	8408	8488	3220	8669	7210	8076	8167
Total	**13683**	**14410**	**14671**	**15608**	**16640**	**16914**	**17273**	**15395**	**16180**	**14299**	**15330**	**15436**

Source: Ministry of Water Resources, Water Balance and Data of Water Balance for 2011.

Figure 4: Development of Agricultural Consumption of the Surface Water and Groundwater through the period (2000-2012)



Source: Prepared by the Researcher based on the data of Table 11.

Pumping big quantities of groundwater in the past years, as set forth in Table 11, for the purpose of increasing the production of the crops, has caused a drop in the levels of the groundwater, an increase in the pumping costs, a decrease in the flow of some springs and the dryness of some of them; with the consideration that the springs provide (21 %) of the needs of drinking water *(Ministry of Water Resources, 2013)*. In Al-Yarmouk Basin, the total flow of the springs has dropped from 3.5 m^3/sec in 2001 to 2.5 m^3/sec in 2011, and it dropped in Orontes Basin from 14.5 m^3/sec in 2001 to 11.7 m^3/sec in 2011 *(Syrian Statistical Abstract, Nature Conditions, 2011)*. We present hereunder some examples about the levels of the springs:

- Mzeireeb Spring in Daraa: Dropped from 900 to 310 lt/sec.
- Alsamak Spring in Homs: Dropped from 471 to 242lt/sec.
- Abou Kbaiss Spring in Hama: Dropped from 301 to 219 lt/sec.
- Ain Alzarka pring in Idleb: Dropped from 5500 to 4900 lt/sec.

This was preceded by the stop of Khabur Springs and the start of compulsory pumping from them. The decrease of the levels of the groundwater has reflected on the supply with drinking water, where the wells form (38%) of its sources, which means an increase in the pumping, costs. It has also led in some regions to searching for new drinking water sources and the execution of expensive projects for conveying the water of the new sources. This has also seriously reflected on the costs of the irrigated agriculture (56% of the total irrigated areas according to the Plan of 2013 is irrigated from the wells), which led to a decrease in the returns of the irrigated agriculture even in the lands of the high returns from the crops *(Syrian Ministry of Water Resources, 2013)*. Furthermore, the number of the wells has seriously increased since 2011 because of the current crisis in Syria. Though no count has been conducted for the violated wells, which were drilled in some Governorates through the years of the crisis, it is expected to greatly affect the withdrawal of the groundwater *(Syrian Ministry of Water Resources, 2013)*. Considering the demand of the groundwater for agricultural purposes according to the Hydrological Basins of 2011, we find a depletion of the groundwater in four Hydrological Basins which are Al-YarmoukBasin, Orontes Basin, Tigris & Khabur Basin and Euphrates & Aleppo Basin, where the quantities of the withdrawn groundwater exceed the available groundwater resources, the thing which leads to occurrence of depletion and deficiency in the groundwater balance of those Basins.

The highest depletion of the groundwater was in Tigris & Khabur Basin, where the deficiency was estimated by /2294/ million m^3, then comes Euphrates & Aleppo Basin where the deficiency was estimated by /931/ million m^3, as shown in the following Table:

Table 12: Groundwater Balance, Arbitrary and Unsustainable Use –Unit: Million m^3.

Hydrological Basins	Wells No. 2011	Irrigated Areas 2011 (Hectares)	Groundwater Balance for Agriculture just during the last 12 Years		
			Withdrawn Water Quantities	Available Groundwater Resources	Groundwater Balance
Al-Yarmouk	5372	19275	209	190	19-
Barada & Awaj	61024	34804	579	656	77
Coastal	21891	14162	125	857	732
Orontes	51091	118501	1146	978	168-
Tigris & Khabur	36803	450105	4071	1777	2294-
Desert	7436	31983	197	234	37
Euphrates & Aleppo	45578	227331	1472	541	931-
Total	**229195**	**189616**	**7799**	**5233**	**2566-**

Source: Ministry of Water Resources, Role of Ministry of Irrigation in the Eastern Region, January 2011.

Since the water quantities withdrawn for the Agricultural Sector exceed the volume of the available groundwater in most of the Hydrological Basins, there is consequently an urgent need to decrease the volume of the water used in agricultural irrigation by adopting the modern irrigation methods which can save water or by adopting the agricultural cycles of lesser consumption of water, and preventing the plantation of water-loving crops.

5. Impact of Water ResourcesUsage for Agricultural Purposes on Agricultural Development

Due to the depletion of groundwater resources, the drop of the well levels discharge, the decrease of the drinking water quality, and the dryness of some springs that feed the governmental irrigation projects and drinking projects, the Syrian Government has tended towards the concept of water resources sustainability and protection by adopting policies that depend on the optimal and rational exploitation of the water resources in agriculture, and setting the necessary standards and controls for this exploitation, and by entering the modern irrigation methods under the limited water resources and in consistence with the climatic and Syrian technical circumstances of the Syrian farms and the volume of the holdings, in addition to the conditions of the machinery, the policies and the appropriate procedures. Based on the results of the technical and economical researches on the irrigation methods and techniques, in addition to the deteriorated water status, the Syrian Government represented by the Supreme Agricultural Council has approved in 2001 the National Plan for Water Resources Usage Rationalization, in order to reduce the depletion of the available resources and to confront their quantitative and qualitative deterioration, particularly the groundwater. The Plan has included the following *(Syrian Ministry of Agriculture and Agrarian Reform, 2002)*:

1- Increasing the efficiency of water usage for agricultural purposes at the national level to (75 %) up to 2015.
2- Approving planning for the irrigated areas for potential rainfall of (75 %).
3- Approving the National Program to shift to the modern irrigation within four years, and the Government took a set of decisions in the two years 2000 and 2001 aiming at facilitating the process of shifting, removing the obstacles and handling the difficulties that may obstruct this process.

After applying modern irrigation, the irrigated area by the modern irrigation methods has increased but at a slow pace, as shown in the followingTable:

Table 13: Development of the Irrigated Lands by the Modern Irrigation for the period (2001-2012) -Unit: Hectares.

Year	Irrigated Area by Sprinkle	Irrigated Area by Dripping	Total Irrigated Area by Modern Irrigation Methods	Total Irrigated Area	Modern Irrigation Percentage out of Total Irrigated Area
2001	66.2	44.2	110.4	1266.9	8.7%
2002	138.5	76.4	214.9	1332.8	16.1%
2003	133.3	52.1	185.4	1361.2	13.6%
2004	130.2	57.5	187.7	1439.1	13%
2005	159.9	84.4	244.3	1425.8	17%
2006	163.3	72.7	236	1402.1	16.8%
2007	164.1	79.7	243.8	1396.3	17.5%
2008	162.2	92.4	254.6	1356.5	18.7%
2009	178.9	103	281.9	1238.3	22.8%
2010	187.2	110.8	298	1340.8	22.2%
2011	190.7	123	313.7	1399.4	22.4%
2012	191.3	122.8	314.1	1428.1	22%

Source: Syrian Ministry of Agriculture and Agrarian Reform, Syrian Statistical Abstract, Table (4) for the mentioned years**.**

Table 13shows that, in spite of shifting to the modern irrigation methods, the area irrigated by the modern methods is little, where the rate of the areas irrigated by the modern irrigation methods has not exceeded (22%) out of the total irrigated area in Syria through the period (2000-2012), and the flood irrigation methods or what is called the traditional irrigation methods are still the prevailing methods, whose average irrigation efficiency does not exceed (40%) and by irrigation loss of more than (60%) *(Hasan, 2007)*.

Moreover, the water exploitation efficiency from the total annual renewable surface water and groundwater is in decrease. In the Agricultural Sector, that consumes (88-90 %) of the total exploited water, the efficiency does not exceed (40-45%) *(Hasan, 2007)*, especially with the slow shifting procedures to modern irrigation (dripping, sprinkle, surface), which means the continuity of the overconsumption of water per the irrigated area unit and blocking the water from new areas that can be irrigated. The irrigated area by advanced irrigation means has amounted to /311/ thousand Hectares, i.e. (20%) less than the /1567/ thousand Hectares planned to be irrigated in 2013 *(Syrian Ministry of Water Resources, 2013)*. The low efficiency of water usage in agriculture is attributed to the weak regulatory legislations, the absence of support to the farmers to develop to the modern irrigation methods, and the rehabilitation of some irrigation networks and shifting them from the surface irrigation to the modern irrigation. When we think about the waterwaste comprehensively, we find out the importance of improving the current level of agricultural irrigation efficiency. Increasing the efficiency of agricultural irrigation water exploitation by just one percent point at the level of the region would mean irrigation water saving by (1.42) million m^3. For example, improving the irrigation efficiency by (20) percent points would mean saving by (28.4) million m^3 of agricultural irrigation which is adequate to irrigate an additional area ranging between (2.85) and (5.7) million Hectares completely. Moreover, shifting to the modern irrigation methods, according to the research experiments, saves about (30-40%) of the used water *(Arab Organization for Agricultural Development, 2008)*.

Syria suffers in particular from weak development indicators concerning water and low agricultural development indicators. The following Table shows depreciation in the rate of the contribution of the Agricultural Sector to the gross domestic product, and it shows an increase in the indicator of food dependency.

Table 14: Some Indicators of Agricultural Development and Food Security in Syria through the period (2000-2012)

Designation / Year	2000	2004	2005	2006	2009	2010
Syrian Total Area (Thousand Hectares)	18518	18518	18518	18518	18518	18518
Area Fit for Agriculture (Thousand Hectares)	5905	5910	5933	5950	6012	6045
Rate of Area Fit for Agriculture out of Total Area	31.9%	31.9%	32%	32.1%	32.5%	32.6%
Irrigated Area (Thousand Hectares)	1210.5	1439.1	1425.8	1402.1	1238.3	1340.8
Rate of Irrigated Area out of Total Area	6.5%	7.8%	7.7%	7.6%	6.7%	7.2%
Agricultural Product (Billion Syrian Pounds)	223749	246270	265504	292457	265048	239527
Gross Domestic Product (Billion Syrian Pounds)	904622	1089027	1156714	1215082	1420833	1469703
Rate of Agricultural Product to the Gross Domestic Product	24.7%	22.6%	23%	24%	18.7%	16.3%
Cereal Production (Thousand Tons) (A)	3510	5278	5627	6297	4735	3898
Cereal Imports (Thousand Tons) (B)	1557	1624	2465	1916	4183	3173
Cereal Exports (Thousand Tons) (C)	-	894	755	112	1	31
Total Consumption (Thousand Tons) (D=A+B-C)	5067	6008	7337	8101	8917	7040
Food Dependency Indictor $\frac{B}{D}$x100	30.7%	27%	33.6%	23.7%	47%	45.1%

Source: Prepared by the Researcher based on the data of the Syrian Ministry of Agriculture and Agrarian Reform, the Syrian Statistical Abstracts for the mentioned years, Tables (4 & 14), Cereals: (Wheat, Barley, White Corn, and Yellow Corn).

Table 14shows the very big volume of the Syrian imports of cereal through the period (1995-2010), the thing that resulted into an increase in the intensity of the economic problems and the aggravation of the deficiency in the Syrian Trade Balance. This led to a massive wave of population displacement from the rural regions and a counter overpopulation in the cities, thus caused very serious economic and social problems, the most notable of which is the various kinds of the rampant unemployment, open and disguised, where the rate of people working in agriculture amounted to (14.32%) in 2010 *(Syrian Statistical Abstract, Manpower, 2011)*, in addition to the bad condition of the machinery, infrastructure and social services of water, electricity and sewerage networks and housing, etc., and in general the high population rate of living under the poverty line.

Conclusions and Recommendations:

Conclusions:

1- The Syrian water resources are limited, and Syria suffers from water crisis, acute water deficiency and a drop of the per capita quota out of the renewable water resources therein, where this quota is below the international water poverty line which amounts to /1000/ m^3 per capita / year. There is also an obvious disorder in the rate of water distribution as for the population and area in Syria.
2- Syria suffers from water deficiency in five of its hydrological basins which are the basins of Barada & Awaj, Al-Yarmouk, Khaburand Orontes; while the water surplus was found in two hydrological basins only which are the Coastal Basin and Euphrates Basin. This does not reflect a good water status.
3- The Agricultural Sector consumes the biggest part of the water resources in Syria due to adopting the policy of self-reliance to achieve food security, and depending on the irrigated agriculture and expanding it.
4- There is a drop in the efficiency ofusage of the water resources in agriculture in Syria. Under concentrating on the traditional irrigation methods (such as flood surface irrigation) whose efficiency does not exceed (40-45 %), with the slow procedures of shifting to modern irrigation, the thing that led to depletion of groundwater, dryness of several springs, and aggravation of water deficiency in Syria.
5- Syria suffers from the weak development indicators related towater. The agricultural development indicators reveal depreciation in the rate of the contribution of agriculture in Syria to the gross domestic product, and its

contribution rate is also low in manpower employment. Though agriculture in Syria receives the biggest portion of water resources, it has not succeeded in achieving agricultural development, as evident from the high agricultural dependency indicator in Syria.

Based on the foregoing, we refuse the Null Hypothesis (H0) and accept the Alternative Hypothesis (H1), which states that water usage for agricultural purposes, has negative impact on water status and is inefficient in achieving agricultural development in Syria.

Recommendations:

1- To rationalize water consumption in the Agricultural Sector which is considered the biggest consumer of water, through the permanent development of irrigation methods, the application of the most recent techniques, concentration on the vertical expansion of agriculture.

More attention to scientific research for adopting some species of plants and crops characterized with low consumption of water and able to bear aridity and salinity of water and soil , developing the peasant's production structure by focusing on the production of crops and plant and animal products of low water consumption, and applying the night irrigation process in order to reduce the evaporation in daylight hours.

2- To achieve the utmost benefit from rainfall, through the increase in the construction of dams and reservoirs.

3- To rationalize the use of the groundwater resources, to develop exploitation therein and to drill wells :This includes the optimal exploitation of those resources in agriculture without depletion, preserving them from contamination, supporting the strata that embed the groundwater, and rising water level in the wells.

4- To expand the treatment and purification of sewage water and the agricultural and industrial water being an important source for agricultural and industrial purposes and for cleaning and others.

5- To reduce water loss and to prevent water leakage during the distribution operations, through increasing the efficiency of water transfer and distribution networks, developing them, making maintenance for them, and renewing them permanently.

6- To improve the efficiency of irrigation water usage through awareness by spreading the culture of rationalizing its usage and protecting it from contamination.

7- To pay more attention to high technology, research and development which are required for the Agricultural Sector, which is highly affected by the climate variability.

References

Aldroubi, R. (2000).The Agricultural Issue in Syria between 1970-1995, its Status, Impacts and Development. *Damascus University Journal for Economic and Legal Sciences*, 16(1), 222.

Arab Organization for Agricultural Development. (2008). *Study of how to develop the methods of cost recovery of irrigation water availability in the light if the local and international developments*, Sudan, Khartoum: Arab Organization for Agricultural Development, 17.

Alyousef, D. (2010). *Study of Water Policies and their Role in achieving Food Security in Syria*, Unpublished master's thesis, Department of Economics, Faculty of Economics, Albaath University, Homs, Syria, 2, 8.

Bartolini, F. (2007).Water Resources Management for the Prefecture of Dodecanese.(2rd ed.). Greece: Skiathos, 91.

Central Bureau of Statistics. (2011a).*Syrian Statistical Abstract of Human Resources and Manpower, Table (6/3).*Damascus: Central Bureau of Statistics.

Central Bureau of Statistics. (2011b).*Syrian Statistical Abstract of Nature Conditions, Table (7/1)*. Damascus: Central Bureau of Statistics.

Falkenmark, M. (1990).Global Water Issues Conformity Humanity. *Journal of PeaceResearch*,72(2), 5.

Food and Agriculture Organization, (2010), Aquastat database: Syria.[Online] Available:http://www.fao.org/nr/water/aquastat/data/query/results.html(July 4, 2016)

Hasan, A. (2007).*Efficiency of Water Resources Usage in Agriculture in Syria*. Damascus: National Center for Agricultural Policies, 4-5.

Syrian Ministry of Agriculture and Agrarian Reform. (2002). *Facts No. 1 of the Second National Workshop on the Agricultural Policies*. Damascus: National Center for Agricultural Policies, 7.

Syrian Ministry of Water Resources. (2012). *Analysis of the Status of the Syrian Irrigation Sector*. Damascus: Syrian Ministry of Water Resources, 19.

Syrian Ministry of Water Resources. (2013a). *Sector of Irrigation: Water Resources and Deficiency*. Damascus: Ministry of Water Resources, Damascus, 4, 5.

Syrian Ministry of Water Resources. (2013b). *Water Status and Prospective Solutions*. Damascus: Ministry of Water Resources, 4.