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Case Study

THE IMPACT OF THE CRISIS ON THE AREA, PRODUCTION, AND PRODUCTIVITY OF MAJOR CROPS IN SYRIAN AGRICULTURE : A CASE STUDY OF WHEAT, BARLEY, AND COTTON

Keywords
Area;
Production;
Productivity;
Syrian Crisis Impact

JEL Classification
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Abstract

In this paper, an attempt has been made to investigate the area, production, and productivity of the main crops in Syrian agriculture before and after the crisis. To this end, the necessary data required for the study has been collected from the Central Bureau of Statistics in Syria, the Ministry of Agriculture in Syria, and the FAO database. The results of the study show that for wheat, barley and cotton, there has been a decrease in the cultivated area during the crisis compared to the period before it (503.706, 123.589, and 131.750 hectares, respectively). Besides, in terms of production, we note that there has been a negative impact of the crisis on wheat, barley, and cotton of 1,327.968, 84.139, 558.677 tons, respectively. Furthermore, as regards productivity, we observe that there has been a negative impact of the crisis on wheat, barley, and cotton of 0.374, 0.134, 1.034 tons/ha, respectively.

INTRODUCTION

Agricultural production in Syria, as in most Mediterranean countries, represents an important economic sector, as it contributes about 25% of the country's GDP (Qamh, 2016; World Food Program & Food and Agriculture Organization of United Nations, 2018). In fact, and especially before the Syrian crisis, the investment allocated to the agricultural sector was efficient in comparison to the rest of country's total investments (Alobid, Szucs, Zeed, & Alobied, 2019).

As evidenced by the fact that the agricultural sector provides food for citizens and raw materials for industry, it also contributes to improving the trade balance and provides the foreign exchange needed to secure financing for the imports required by other sectors (Sarris, Fiorillo, & Vercueil, 2003). It also contributes to the employment of about 31% of the labor market in the country and provides other sectors with the necessary labor (Huitfeldt & Kabbani, 2007; Nasser, Mehchy, & Abu Ismail, 2013). In 2005, the total area of arable land was 91.5 million hectares, or 32 percent of the total area of the country which is 185,180 km^2, whereas the total area of cultivated land was 74.5 million hectares (CBU, 2007).

From an agricultural point of view, Syria is a distinctive country. It has a vast expanse of level land, rich soils, wild climatic variations suitable for various types of crops, ample sunshine and a long growing season. The climate of the Syrian Arab Republic is Mediterranean with a continental impact: winter is cold and rainy, summer is warm and dry, spring and autumn are relatively short. Large parts of the Syrian Arab Republic are exposed to high volatility in daily temperatures (Meslmani, 2010). The maximum daily temperature difference can range from 32° C in the interior to about 13° C in the coastal area. The annual precipitation rates vary between 100 mm and 150 mm in the northwest, 150 mm and 200 mm in the area extending from the south of the country towards the Central and Central-Eastern regions, between 300 mm and 600 mm in the plains and foothills in the west, and between 800 mm and 1000 mm along the coastal area, rising to 400.1 mm in the mountains. As for the average rainfall in the country as a whole, the figure is 252 mm (FAO, 2008).

Syria is famous for the quality of its agricultural products, including fruits, vegetables and grains. Agriculture is considered the most important productive activity, especially around the Euphrates and Tigris basins and on the riverbanks of the Barada, Orontes and Qwaik (Varela-Ortega and Sagardoy, 2003; in Syria). Syria is the home of productive trees such as olives and pistachios (Tous & Ferguson, 1996).

The most important crops produced in Syria are wheat, barley, cotton, maize, potatoes, lentils, tobacco, apples, citrus fruits, chickpeas, sugar cane, onions, peanuts, olives, grapes, and tomatoes (World Food Program & Food and Agriculture Organization of United Nations, 2018). Crops considered strategic by the state, especially wheat (49%), cotton (6%), barley (18%) and lentils (3%) occupy the largest proportion of the land involved in this agricultural system. Due to the large size of this system, a large part of the land is cultivated with major crops, and even secondary crops are grown in these areas. The most important crops that can be found in the country are rainfed and irrigated wheat (79% and 78%, respectively), other important crops include cotton (80%) and rainfed lentils (68%) (CBU, 2007). This is due to the impact of the size of the agricultural system, where one-third of the total cultivated area of sugar beet is located within this system, although it covers only 4% of the land involved in the system (Cafiero, Atiya, Grad, Al-Ashkar, & Sadiddin, 2009; Fatima et al., 2011; Mourad & Berndtsson, 2012; Wattenbach, 2006)

During the war in Syria, food security acquired great importance as a result of the decline in agricultural production, the impact of economic sanctions imposed on Syria and the deterioration of natural land and water resources. Accompanied by the change in supply and demand for food and as a consequence of the reduced implementation of public health and social security programs, crop production in Syria has been severely affected by the ongoing war (Bowles, Butler, & Morisetti, 2015; Gleick, 2014; Jaafar & Woertz, 2016; Taleb et al., 2015)

In order to identify the activity of the agricultural sector and the factors that have contributed to the increase in its production of the main crops, or which have limited its production capacity and productivity during the recent period, it is necessary to focus on the conditions experienced by this sector and on the statistics and accurate figures that indicate the volume of agricultural production and productivity for some main crops in Syria during the recent period. In this research we applied the dummy variables method to analyse the data which are utilized as a representative of some qualitative variables that affect economic phenomena such as gender, colour, religion, occupation, educational level, etc. These variables take two values: zero and one, and are used in regression models as explanatory variables or as dependent variables, but the greater emphasis on them as explanatory variables for many uses (Blaikie, 2003; Salkever, 1976).

MATERIAL AND METHOD

Description of the data collection

In this paper, an attempt has been made to examine the area, the production and the productivity of major crops (wheat, barley, and cotton) in Syrian agriculture during the period 2000-2017. This study is based exclusively on secondary data. The time series secondary data required for the study have been collected from the Central Bureau of Statistics in Syria, the Ministry of Agriculture of the Government of Syria, and also from the Aquastat FAO database. Concerning the wheat crop, the data required explained in figure 1 for the Area and the production and also the productivity see figure 2. Regarding the Barley crop, the data collected for 17 years for the area and the production see figure 3 and for the productivity in figure 4. With regards to the Area and the production and also the productivity for the cotton, crop sees figures 5 and 6 respectively.

Model Description

The study aims to explore the impact of the crisis on the most important crops grown in Syria (wheat, barley and cotton), by identifying the impact of the crisis on the areas planted with these crops, productivity and production. The study was divided into two periods :

- First period: before the crisis (0)
- Second period: after the crisis (1)

Dummy variables analysis has been employed in this study, to determine the impact of the crisis in Syria on the area, the productivity and the production of some major crops, the simple linear regression model was adopted by using the ordinary least squares method (OLS). The relationship between area, productivity and, production of the crops studied was described as a dependent variable, and the impact of the crisis was used as an independent variable, the model used can be formulated as follows:

$$Y_t=B_1 + B_2D_t+u_t$$

Y_t : indicates the estimated values of the studied variable;

D_t: represents the dummy variable and has the following values: Dt=0 before the crisis, and Dt=1 after the crisis;

B_1,B_2: parameters;

U_t : limit of error.

The data analysis was done with EViews 10TH Edition.

Research Hypothesis

I. Null Hypothesis: There is no significant impact of the crisis on the area, the productivity and the production of the crops studied.

II. Alternative Hypothesis: The crisis has a significant impact on the area, the productivity and the production of the crops studied.

RESULTS AND DISCUSSIONS

The wheat crop

Wheat is the main staple food in Syria, and is often consumed in the form of bread, hence the importance of wheat as the main crop to achieve food security. As a result, the government's strategy seeks to achieve self-sufficiency in this crop, and for these reasons encourages the growth of wheat in rainfed and irrigated areas (Sadiddin & Atiya, 2009).

To illustrate the impact of the crisis in Syria, the model used is the dummy variables analysis (as shown in Table 1), which are calculated from a statistical analysis of Tables 2a, 2b and 2c, from which it is clear that the crisis has had a statistically significant negative impact on both the area and production of the wheat crop. The amount of change in the area planted as a result of the crisis amounted to about 503.706 hectares, with about 1,327.968 tons of wheat produced. As for productivity, the results of the analysis showed that the crisis had a statistically significant negative impact on the productivity of the wheat crop in Syria, with the change in productivity as a result of the crisis being about 0.374 tons/ha.

Statistical analysis shows that the equation (1,2) in the Table 1 for both the area and the production is significant ($p < 0.05$). The effects of the independent variable (Dt) in the area and the production were 39% and 36%, respectively, while the rest was due to other factors.

Barley

Barley is one of the most important crops in Syria, and has been grown mainly in the rainfed areas. Its importance is related to the animal production sector, where it is the main source of forage grains, which is why it is a very important strategic crop.

This study highlighted the impact of the current crisis in Syria on the barley crop. The impact was found to be negative, with the cultivated area of barley having decreased significantly since 2011; this decrease has reached about 123.589 hectares. The decrease has, however, been accompanied by an increase of about 84.139 tons in production, and about 0.134 tons / ha in productivity, as shown in Table 3, the results being obtained from a statistical analysis of Tables 4a, 4b and 4c. The statistical analysis showed that the equation (4) in the Table 3 related to the area planted with barley crop was very significant ($p < 0.01$), the effect of the independent variable (Dt) in the area was about 40%, and the rest was due to other factors. The

production and productivity equations (5,6) in the Table 3 were not significant (p> 0.05).

Cotton

Cotton is an important cash crop in Syria, and is classified among the strategic crops that the government provides special treatment for. In addition, cotton is considered one of the most important export crops, with an average contribution of 2.8% of the total value of Syrian agricultural exports in 2008-2010, compared to 16.5% in 2001-2003 (Sadiddin & Atiya, 2009). Furthermore, the cotton crop has occupied the number spot one among industrial crops in terms of production value, the second amongst exports (after oil) and the third in contribution to total GDP, after oil and wheat (Almadani, 2014).

Cotton cultivation, like other crops, has been affected by the circumstances that have accompanied the Syrian crisis. The results in Table 5 show a significant negative impact of the crisis on the cotton crop in Syria, in terms of area – about 131.750 hectares, production – 558.677 tonnes, and productivity – about 1.034 tonnes / ha, which are calculated from a statistical analysis of Tables 6a, 6b and 6c.

Statistical analysis shows that the equations (7,8,9) in the Table 5 related to the area, production and productivity respectively, are very significant (p <0.01). The effects of the independent variable (Dt) on the area, production and productivity was about 65%, 62%, and 47%, respectively, while the rest was due to other factors which are not included in our model. This significant impact on the cotton crop can be attributed to the fact that it is a summer irrigated crop, whose production requires the availability of hydrocarbons to operate diesel water pumps; farmers suffered greatly from difficulty in providing fuel during the crisis, as well as high prices and the high maintenance and repair costs for these engines. All these conditions, and others, led to farmers being reluctant to grow this crop despite the profit they can make from planting it.

CONCLUSIONS

In this paper, we have tried to highlight three main factors in the agricultural sector in Syria – area, production, and productivity - over 17 years, i.e. before and after the crisis. Based on these results we can summarize generally that there was a negative effect which proved significant on the production and productivity of wheat and cotton during the crisis in Syria, except for the Barley production that increased due to some reasons(not included in our model). The area planted with these important crops has decreased significantly since 2011 - the “starting point of the crisis” -, as it is reflected by the significant decrease in production and productivity per unit area. Through the above, we can state that the agricultural sector in Syria began to decline gradually after the start of the crisis and we can accept the alternative hypotheses Ha (The crisis has a significant impact on the area, the productivity and the production of the crops studied). If the government and international organizations do not join forces in order to support the agricultural sector, which is the economic cornerstone of Syria, the sector will continue to suffer under the present catastrophic circumstances.

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List of figures

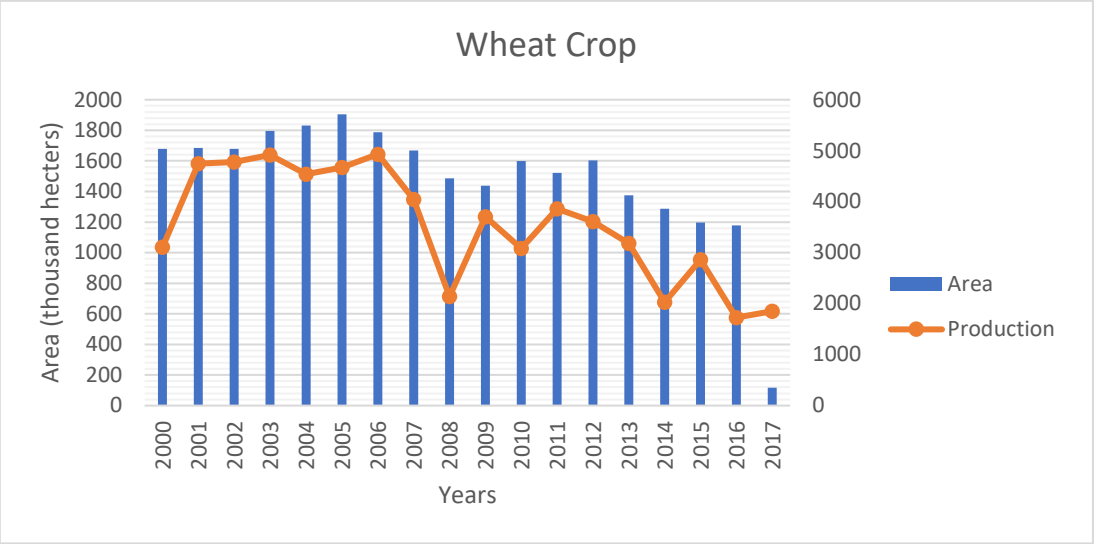

Figure No. 1
Area and Production of Wheat crop for period 2000-2017 in Syrian Agriculture
Note. Own editing by Excel

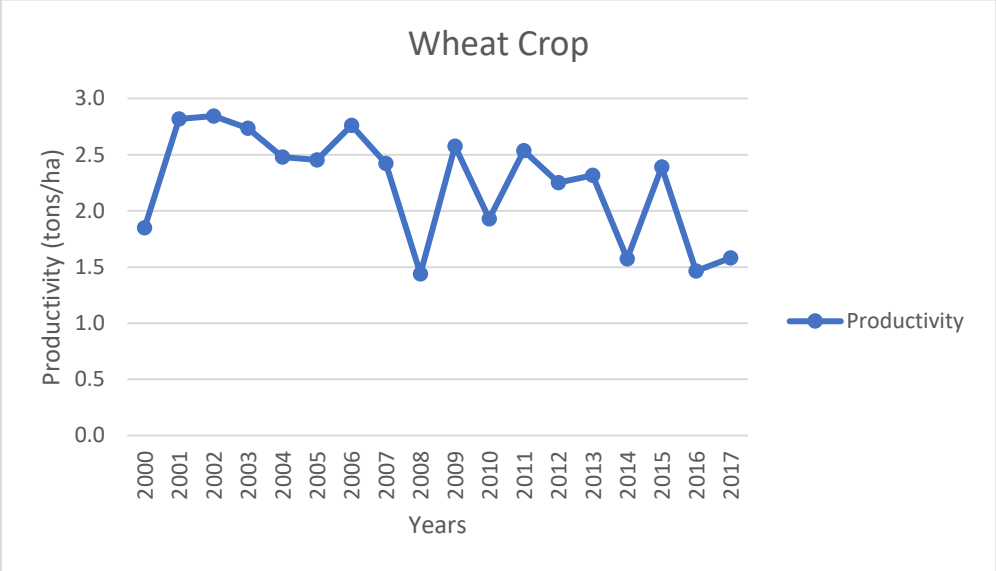

Figure No. 2
Productivity of Wheat crop for period 2000-2017 in Syrian Agriculture
Note. Own editing by Excel

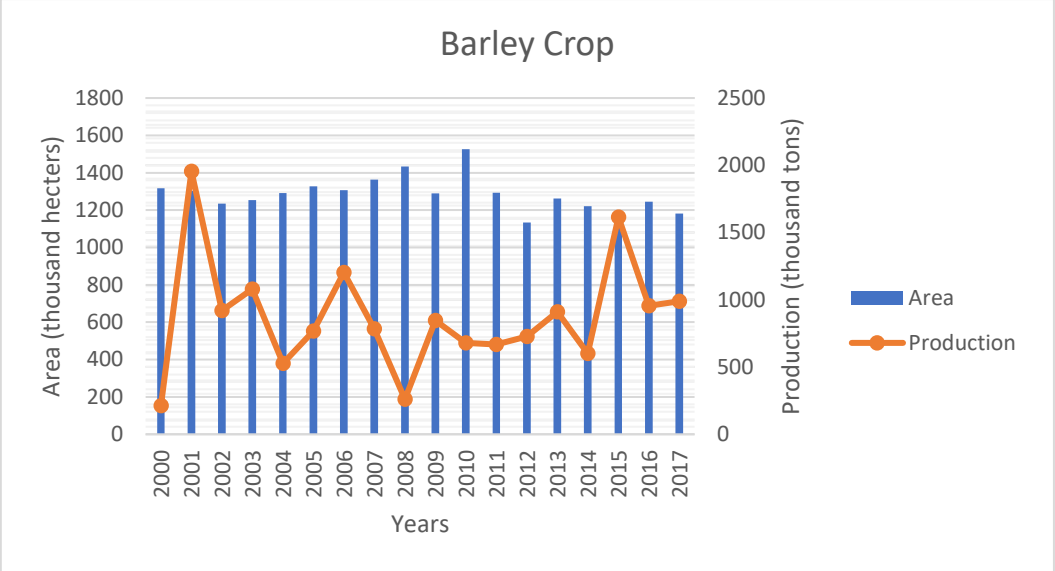

Figure No. 3
Area and Production of Barley crop for period 2000-2017 in Syrian Agriculture
Note. Own editing by Excel

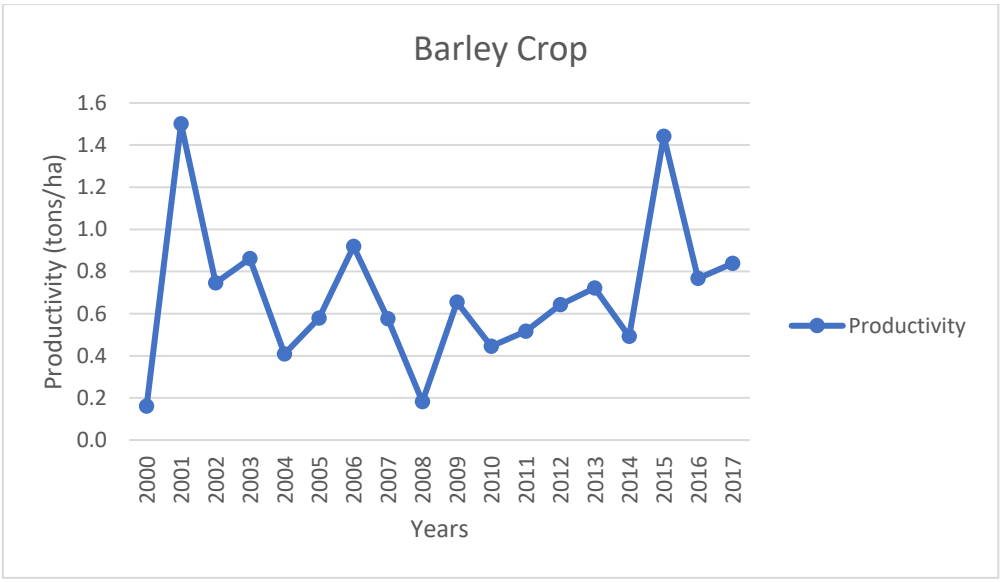

Figure No. 4
Productivity of Barley crop for period 2000-2017 in Syrian Agriculture
Note. Own editing by Excel

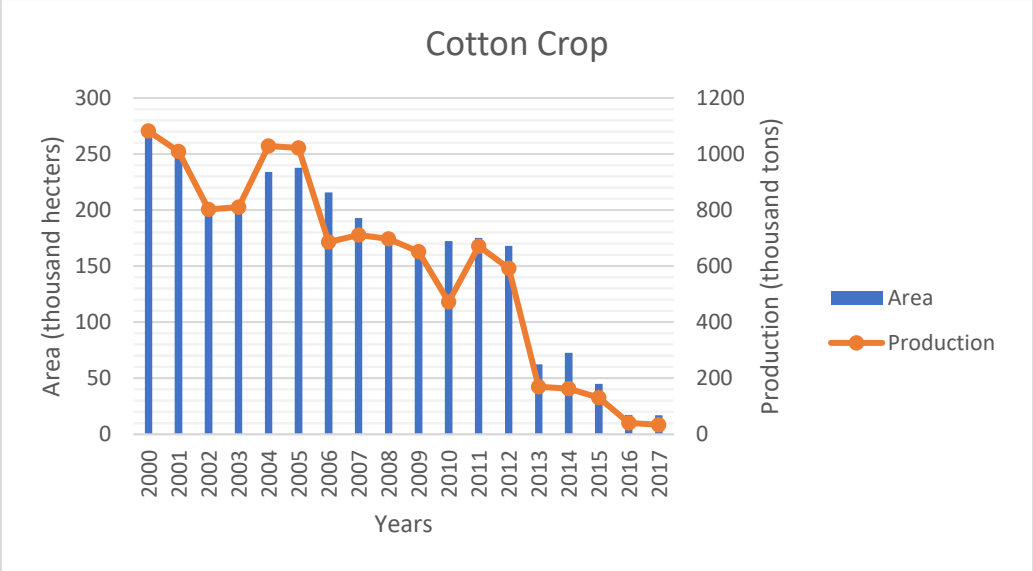

Figure No. 5
Area and Production of Cotton crop for period 2000-2017 in Syrian Agriculture
Note. Own editing by Excel

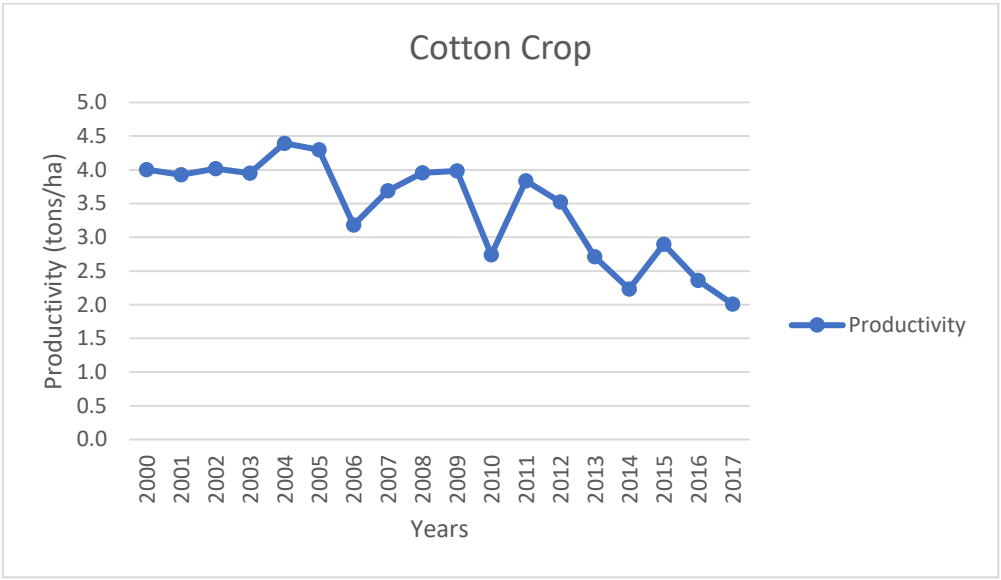

Figure No. 6
Productivity of Cotton crop for period 2000-2017 in Syrian Agriculture
Note. Own editing by Excel

List of tables

Table No. 1
Analysis of the impact of the crisis on the area, production, and productivity of the wheat crop in Syria during the period 2000-2017

Attribute	Model	R^2	F
Area	(1)Yt=1686.351 - 503.706 Dt (17.258)*** (3.219)**	0.39	(10.366)**
Production	(2)Yt=4058.323 – 1327.968 Dt (14.765)*** (3.013)**	0.36	(9.078)**
Productivity	(3)Yt=2.391 – 0.374 Dt (3.69)*** (0.54)**	0.15	(2.875)

Note. Own editing

** Significant at 1%
*** Significant at 0.1%
() The number between brackets, under the Regression Coefficient, indicates the (t) calculated values.

Table No. 2a
Dependent Variable: Area-Wheat crop

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1686.351	97.56108	17.28508	0
D_2011	-503.7068	156.4458	-3.219689	0.0054

R-squared	0.393167	Mean dependent var	1490.465
Adjusted R-squared	0.35524	S.D. dependent var	402.9711
S.E. of regression	323.5735	Akaike info criterion	14.50117
Sum squared resid	1675197	Schwarz criterion	14.6001
Log likelihood	-128.5105	Hannan-Quinn criter.	14.51481
F-statistic	10.3664	Durbin-Watson stat	0.890988
Prob(F-statistic)	0.005352		

Note. Performed by using EViews

Table No. 2b
Dependent Variable: Production-Wheat crop

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4058.323	274.8518	14.7655	0
D_2011	-1327.968	440.7434	-3.013019	0.0083
R-squared	0.361998	Mean dependent var		3541.891
Adjusted R-squared	0.322123	S.D. dependent var		1107.183
S.E. of regression	911.5802	Akaike info criterion		16.57268
Sum squared resid	13295657	Schwarz criterion		16.67161
Log likelihood	-147.1541	Hannan-Quinn criter.		16.58632
F-statistic	9.078285	Durbin-Watson stat		1.367497
Prob(F-statistic)	0.008252			

Note. Performed by using EViews

Table No. 2c
Dependent Variable: Productivity-Wheat crop

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.391182	0.137877	17.34289	0
D_2011	-0.374896	0.221095	-1.695636	0.1093
R-squared	0.152326	Mean dependent var		2.245389
Adjusted R-squared	0.099346	S.D. dependent var		0.481846
S.E. of regression	0.457286	Akaike info criterion		1.377422
Sum squared resid	3.345761	Schwarz criterion		1.476352
Log likelihood	-10.3968	Hannan-Quinn criter.		1.391063
F-statistic	2.875181	Durbin-Watson stat		2.105114
Prob(F-statistic)	0.109323			

Note. Performed by using EViews

Table No. 3
Analysis of the impact of the crisis on the area, production, and productivity of the barley crop in Syria during the period 2000-2017

Attribute	Model	R^2	F

Area	(4) Yt=1331.382 – 123.589 Dt (57.098)*** (3.305)**	0.40	(10.925)**
Production	(5) Yt=839.468+84.139 Dt (6.437)*** (0.402)**	0.01	(0.161)**
Productivity	(6) Yt=0.639+0.134 Dt (5.946)*** (0.781)**	0.03	(0.610)

Note. Own editing

** Significant at 1%
*** Significant at 0.1%
() The number between brackets, under the Regression Coefficient, indicates the (t) calculated values.

Table No. 4a
Dependent Variable: Area-Barley crop

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1331.382	23.31716	57.09881	0
D_2011	-123.5891	37.39065	-3.305349	0.0045

R-squared	0.405764	Mean dependent var	1283.32
Adjusted R-squared	0.368624	S.D. dependent var	97.32584
S.E. of regression	77.33429	Akaike info criterion	11.63859
Sum squared resid	95689.47	Schwarz criterion	11.73752
Log likelihood	-102.7473	Hannan-Quinn criter.	11.65223
F-statistic	10.92533	Durbin-Watson stat	1.866178
Prob(F-statistic)	0.004469		

Note. Performed by using EViews

Table No. 4b
Dependent Variable: Production-Barley crop

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	839.4688	130.4065	6.437323	0
D_2011	84.13918	209.1156	0.402357	0.6927

R-squared	0.010017	Mean dependent var	872.1896
Adjusted R-squared	-0.051857	S.D. dependent var	421.7132
S.E. of regression	432.5094	Akaike info criterion	15.08152

Sum squared resid	2993031	Schwarz criterion	15.18045
Log likelihood	-133.7337	Hannan-Quinn criter.	15.09517
F-statistic	0.161891	Durbin-Watson stat	2.378478
Prob(F-statistic)	0.692745		

Note. Performed by using EViews

Table No. 4c
Dependent Variable: Productivity-Barley crop

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.639273	0.1075	5.946734	0
D_2011	0.134727	0.172383	0.781557	0.4459

R-squared	0.036773	Mean dependent var	0.691667
Adjusted R-squared	-0.023429	S.D. dependent var	0.352432
S.E. of regression	0.356536	Akaike info criterion	0.879679
Sum squared resid	2.033892	Schwarz criterion	0.978609
Log likelihood	-5.917109	Hannan-Quinn criter.	0.89332
F-statistic	0.610831	Durbin-Watson stat	2.316592
Prob(F-statistic)	0.445887		

Note. Performed by using EViews

Table No. 5
Analysis of the impact of the crisis on the area, production, and productivity of the cotton crop in Syria during the period 2000-2017

Attribute	Model	R^2	F
Area	(7) Yt=211.403 – 131.750 Dt (14.267)*** (5.544)**	0.65	(30.745)**
Production	(8) Yt=815.975 –558.677 Dt (12.126)*** (5.177)**	0.62	(26.807)**
Productivity	(9) Yt=3.830 – 1.034 Dt (22.617)*** (3.808)**	0.47	(14.505)

Note. Own editing

** Significant at 1%
*** Significant at 0.1%
() The number between brackets, under the Regression Coefficient, indicates the (t) calculated values.

Table No. 6a
Dependent Variable: AREA-Cotton crop

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	211.4036	14.81736	14.2673	0
D_2011	-131.7501	23.76063	-5.544889	0
R-squared	0.657723	Mean dependent var		160.1675
Adjusted R-squared	0.636331	S.D. dependent var		81.4918
S.E. of regression	49.14361	Akaike info criterion		10.73181
Sum squared resid	38641.52	Schwarz criterion		10.83074
Log likelihood	-94.58629	Hannan-Quinn criter.		10.74545
F-statistic	30.74579	Durbin-Watson stat		0.952974
Prob(F-statistic)	0.000044			

Note. Performed by using EViews

Table No. 6b
Dependent Variable: Production-Cotton crop

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	815.9756	67.28938	12.12637	0
D_2011	-558.6772	107.9031	-5.177584	0.0001
R-squared	0.626233	Mean dependent var		598.7123
Adjusted R-squared	0.602872	S.D. dependent var		354.1423
S.E. of regression	223.1736	Akaike info criterion		13.75822
Sum squared resid	796903.5	Schwarz criterion		13.85715
Log likelihood	-121.8239	Hannan-Quinn criter.		13.77186
F-statistic	26.80738	Durbin-Watson stat		1.271812
Prob(F-statistic)	0.000092			

Note. Performed by using EViews

Table 6c
Dependent Variable: Productivity-Cotton crop

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.830636	0.169362	22.61799	0
D_2011	-1.034351	0.271584	-3.808586	0.0015

R-squared	0.475501	Mean dependent var	3.428389
Adjusted R-squared	0.44272	S.D. dependent var	0.752448
S.E. of regression	0.561711	Akaike info criterion	1.788782
Sum squared resid	5.048314	Schwarz criterion	1.887712
Log likelihood	-14.09904	Hannan-Quinn criter.	1.802423
F-statistic	14.50532	Durbin-Watson stat	1.925906
Prob(F-statistic)	0.001545		

Note. Performed by using EViews