

The Impact of Using Natural Fertilizers on the Productivity and Sustainability of Potato Crops in the Region of Oued Souf in Algeria

Econometric study for the period 2002-2018

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أثر استخدام الأسمدة الطبيعية على إنتاجية واستدامة محصول البطاطس بمنطقة وادي سوف بالجزائر

دراسة قياسية للفترة 2002-2018

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Abstract:

The El-Oued region is a leader in the production of potato, which has reached a significant increase in recent years due to two major factors: abundant irrigation water, ease of exploitation of surface waters, and government support for the acquisition of production factors such as fertilizer. These latter have had a clear impact on the efficiency and quality of production.

Thus, the objective of this study is to measure the degree of use of all types of natural fertilizers except organic ones, without affecting the productivity of the potato crop on the one hand, and the sustainability of agricultural land use and irrigation water, as well as the health aspects of the crop itself.

Keywords: Natural fertilizers; Potato crop; Productivity; Sustainability; Oued Souf region.

(JEL) Classification: Q150; Q; D240; Q010; Y9.

ملخص:

تحتل منطقة الوادي الريادة على المستوى الوطني في مجال إنتاج محصول البطاطس، الذي حقق خلال السنوات الأخيرة وفرة كبيرة ترجع إلى عاملين أساسيين هما، وفرة مياه السقي وسهولة استغلال مياه الطبقة السطحية من جهة وتوفر الدعم الحكومي لاقتناء عوامل الإنتاج كالأسمدة بمختلف أنواعها، هذه الأخيرة كان لها الأثر الواضح على مردودية ونوعية الإنتاج.

وتهدف دراستنا هاته لقياس درجة استخدام الأسمدة الطبيعية بجميع أنواعها دون العضوية في التأثير على مردودية إنتاج محصول البطاطس من جهة وكذلك على استدامته من جهة الحفاظ على استخدام التربة الزراعية والمياه المستغلة للسقي، فضلا على الجوانب الطبيعية والصحية للمحصول في حد ذاته.

الكلمات المفتاحية: الأسمدة الطبيعية، محصول البطاطس، إنتاجية، الاستدامة، منطقة وادي سوف.

الترميز الاقتصادي (JEL): Q150; Q; D240; Q010; Y9.

I-Introduction :

The agricultural sector is considered one of the promising sectors in Algeria, which represents the main motive for the economic activity. Thus, it contributes in the rise of the economic development for the country and the achievement of self-sufficiency in this sector that decreases the dependency on the external imports. It became a way to lose dependency to the oil sector, especially with the oil prices fluctuation at the international market this last three years.

Therefore, the government outlined a developing strategy to support this pivotal sector, in order to elevate its profitability and achieve self-sufficiency on one hand, and creating a resource for the necessary capitals to realize the economic development on the other hand.

Oued Souf province represents one of the regions that had the government's big attention, after its worthiness was proved by planting numerous crops, mainly the potato product which gained a huge success the last years, and challenged multiple obstacles and hardships related to the desert nature of the region and the hot climate. Nevertheless, the availability of the planting spaces and the groundwater resources along with the use of the natural fertilizers were among the main factors that immensely contributed in the development of the sector. As a result, the province is listed at the top nationally in planting this crop, potato, in terms of quantity and quality, in addition to the competitive feature that opens the export door for the crop.

From this point, we tried through this study to answer the following question (problem):

To what extent does the use of natural fertilizers affect the productivity and the sustainability of the potato crop in the region of Oued Souf?

To answer the question (problem) and for the sake of acquainting the topic we will go through the following themes:

First: Analyzing the production fact of the potato crop in Oued Souf

Second: The econometric analysis of the relation between the use of natural fertilizers and its impact on the potato crop productivity in Oued Souf

Third: Analyzing the sustainability of the potato crop in Oued Souf.

II- Methods and Materials:

Analyzing the production reality of the potato crop in Oued Souf

2-1- Introducing Oued Souf province: El Oued province is located in the southeast of the country, with about 44.585 km² area and approximately 800 thousand inhabitants, and population density equivalent to 17.94 per km² ¹. (ARCHIVES, 2015) .

- Bounded on the north by Tébessa, Khenchela, and Biskra provinces.
- Bounded on the south by Ouargla province.
- Bounded on the west by Djelfa, Biskra, and Ouargla provinces.
- Bounded on the east by the Tunisian republic.

El Oued province is shared by 12 administrative districts, and divided into two different valleys:

- Souf valley region which is located in the middle of the eastern erg and it has 22 municipalities.

- Right valley region which is located in the flat lands and it has 8 municipalities.
- **Natural resources:** El Oued province is considered a region with strategic importance concerning the resources, because ²: (SOUAD, 2002)
- Nationally, it has the biggest palm tree resource, and the biggest crop production.
- It has the national largest groundwater reserve.
- Its soil can be used for planting, building, bricks and gypsum industries.
- It has the African largest mine of both industrial and table salt (Chott Melghir and Chott Merouan).
- It has a considerable area of a pastoral forest, which encompasses the largest number of camels at the national level
- It produces 25% of the national product of the tobacco (the first rank).
- The national top producer of the groundnut, and it contributes with a considerable production of potato.
- Its lands bear the planting of 10 million palm trees, and has the largest soil and water.
- It has an important location because of the 300 km external borders (with Tunisia and Libya)

2-2- Presenting the potato crop production and the amount of natural fertilizers used in Oued Souf province:

El Oued province, or Oued Souf (the southeast of Algeria), had transformed into an excellent agricultural pole in the production map at the level of Algeria, considering the great leap achieved by the agricultural sector after 50 years of the independence. It moved in a short time "relatively", from the simplest forms of agricultural production to the finest, especially in planting potato which, in a little while, allowed the province to proceed for an advanced rank of the producing regions of this crop. El Oued could achieve, in the last agricultural seasons, what seemed to be a miracle after it ranked at the top in producing both seasonal and non-seasonal potato. It produced more than 11 million quintals of non-seasonal potato on more than 35 thousand hectares planted area. Which represents 40% of the national production of this most consumed crop in the Algerian society.³ (Report, 2018)

The following table ,(see table 01) presents the potato production volume and the amount of natural fertilizers used in the cultivation process in Oued Souf province.

It's noticeable, through the table data, that the planted areas have immensely increased, which positively reflected on the huge rise of the potato production volume. On the other hand, the use of natural fertilizers in potato cultivation also increased. Hence, the potato production volume moved from 360580 quintals in 2002 to reach 11360000 quintals at the end of 2018 with a growth rate exceeded 100%. Whereas the use of natural fertilizers also increased from 138000 quintals in 2002 to about 6500000 at the end of 2018. It's clearly noticeable that using more natural fertilizers annually led to the rise of potato production volume, in terms of both quality and quantity. This result is due to the use of good quality fertilizers in the potato cultivation process, in addition to many other factors like:

- The availability of arable lands, in vast areas and easy to exploit.
- The availability of groundwater, suitable for irrigation, near the surface which facilitates its extraction.
- The availability of a qualified, active and experienced workforce, in addition to the helpful agricultural equipment.
- The agricultural support provided by the government (material and moral support), in order to expand the agricultural activity area in the region and thus increase the productivity of the potato crop.

III- Results and discussion :

The econometric analysis of the relation between the use of natural fertilizers and its impact on the potato crop productivity and sustainability in Oued Souf, Algeria between 2002 -2018.

Econometrics is considered one branch of economics, as it is concerned with measurement and field interpretation of the relationships between phenomena and economic variables, and it is also considered a compromising tool between economic theory and economic reality, by using mathematical and statistical tools⁴ (Bourbonnais, 2000). Therefore, after we presented and analyzed the volume of potato production in the first part of the study as well as the number of natural fertilizers used in its cultivation, we will try in this applied part to study the effect of using natural fertilizers on the productivity and sustainability of the potato crop in Oued Souf, Algeria during the period. (2002-2018).

3-1- The analysis approach used:

To study the relationship between potato production and used natural fertilizers, we relied on annual data on economic variables for the period (2002-2018), which were drawn from publications and reports of the Ministry of Agriculture in Oued Souf, Algeria. In line with recent guidelines in time series analysis, which had a prominent role in making economic relations measurable and quantitative analyzable, we also used common integration analysis methods, which include the Engel-Granger method, to analyze the relationship between potato production and the fertilizers used within the national economy.

The analysis of joint integration allows to clarify the true relationship between two variables, by looking for a common integration vector. The method of joint integration analysis that we will use is based on cases where the basic time series variables are integrated from the same degree, which is the first degree, and for the purposes of this study we used a regression model A line to determine the nature of the relationship between potato production and the natural fertilizers used as follows:

$$PRO_t = B_0 + B_1 ENG_t + U_t \dots \dots \dots (*)$$

PRO_t : potato production. ENG_t : natural fertilizers used.

The following figure (see figure 01) shows the graphs of both potato production and natural fertilizers used during the studied period:

3-2- The results of the analysis:

The study of the data revealed several results, which can be divided into several elements as the following:

3-2-1- The results of the stability tests of the two series:

The stability test aims to examine the properties of the time series for both the production of potatoes and natural fertilizers used during the period (2002-2018), and to ensure the extent of their durability, and to determine the rank of the integration of each variable separately. Through Figure (01), it appears to us that both the (PRO) and (ENG) series are unstable, and to confirm or deny this, it was necessary to use unit root test. Despite the multiplicity of these tests, we relied in this study on two tests: the Augmented Dickey-Fuller test and the Phillips-Person test, and the results are shown in Table (02) and (03):

Tables (2) and (3) show the statistical results obtained from the two previous tests, which were made at the level and at the first difference. From the results of previous tests, it became clear that the two series are unstable at the level and contain a unitary root, given that the calculated values are completely less than the critical values of Mackinnon.

The results also indicate that the two series transformed by first-order differences are stable, given that the calculated values are completely greater than the critical values of Mackinnon, meaning that (PRO) and (ENG) are complementary of the first order. These results are consistent with the standard theory which assumes that most macroeconomic variables are not static at the level but they become static at the first difference.

3-2-2- The results of the joint integration analysis using the Angel-Granger method:

After ensuring that the FDI and EXC time series are stable at their first difference, it appeared that the most appropriate way to study the relationship is using the Angel Granger method that was developed by Granger in 1983. Enger and Granger 1987 is considered by many economists as one of the most important new concepts in the field of economic measurement as well as for the analysis of time series ⁵ (Jeffery, 2010). This method requires going through two steps. The first one is estimating the relationship in hand by the method of ordinary least squares, so we get the co-integral regression equation. Then we get the estimated residual regression residue ($\hat{u}_t$) which is the linear mixture generated from the regression of the long-run equilibrium relationship. While the second step is testing the residual stillness obtained from the first step according to the following:

A- First stage: OLS estimation for long-run relationship: ⁶ (Regis, 2012).

$$y_t = \hat{\alpha} + \hat{\beta}x_t + e_t \quad (ECM)$$

B- Second stage: OLS estimation of the dynamic model relationship (in the short run):

$$\Delta y_t = \alpha_1 \Delta x_t + \alpha_2 e_{t-1} + u_t \quad \alpha_2 < 0$$

Symbols explanation: ⁷ (Regis, 2012).

Δ : the first difference.

e_t : The threshold for error is an algebraic negative sign and statistically significant.

e_{t-1} : The error correction limit for the imbalance ratio in the previous period.

3-2-2-1- The results of the equilibrium relationship estimation in the long run. (co- integration declining):

the use of regular least squares method, and making the regression between potato production and the used natural fertilizers, gave us the following results (see table 04):

The above-estimated results showed the significance of the (ENG) coefficient according to the t-Statistic test, except for the constant run coefficient. The significance of the (ENG) coefficient means that there is a positive relationship between the two estimated variables. Each time the use of natural fertilizer increases by 1%, the potato production rises by 1.76%, which corresponds to economic theory.

The value of the determination coefficient, which indicates the independent variable, interprets and explains the very strong percentage of potato production at a rate of 98.08% (98.08% is explained by the use of fertilizers and other factors). In addition to the Fisher test value, we have the calculated statistic of Fischer equal ($F_{cal} = 768.20$), which is greater than Fischer's tabular value. Therefore, the model coefficients differ significantly from zero, which is confirmed by prob (F -statistic) = 0.000000.

This enables us to provide an initial judgment about the existence of a long-run balanced relationship between both the amount of fertilizers used and the production of potatoes during the studied period. This leads to the use of error correction model of Angel Granger, taking into account that this entire regression relationship represents a false or unreal relationship, and its interpretation cannot be trusted without relying on the error correction model (ECM).

Before examining the error correction model and providing the final judgment on the existence of a long-run and balanced relationship between both the amount of fertilizers used and the potato production in the study period (2002-2018), a static linear mixture of the model variables must be generated by examining the residual stability of the linear regression equation.

After obtaining the regression residues, several statistical tools were used to test the residual stillness, in addition to the equation estimation (**) to test the unit root, in order to confirm the results reached.

3-2-2-2- Results of the stability study for the remaining estimations series :

Examining the possibility of the existence of a long-run equilibrium relationship through the application of a common integration test between the studied variables will be based on the remaining estimation. We have to ensure the stability of the latter, and for this purpose, we

examined the residues of the estimated equation by using the extended Dicky Fuller and Philip Person tests to enhance the results reached.

A- The examination results of the regression equation residues of the Joint integration:

For this purpose, we have plotted a graph for the estimation residue values, and obtained the Figure (see figure 02) :

The latter shows that the series of regression equation residues of the Joint integration is stable because "the series stability occurs if it fluctuated around constant arithmetic mean, with a variation that has no relation to time." ⁸ (Guy, 1990).

B- Philip Byron and Dickey Fuller's Extended Test Results :

To confirm previous results, we performed the Dickey Fuller Extended Test (ADF) and Philip Byron (PP) on the residual estimation. The results of the two tests are shown in Table (05):

The latter results show the stability of the regression equation residues of the Joint integration when comparing the t tabular value (critical) (-1.95) with the ADF test value, without a residual vector or breaker (model 3) which is equal to (3.03). This result is also enhanced by Philip Byron's test when comparing the t tabular value (-1.95) with the PP test value without a residual vector or breaker (Model 3) which is equal to (3.03), at the significance level of 5%. The critical probability value (0.005) leads us to reject the null hypothesis that assumes the existence of a unitary root, and therefore Model 3 illustrates the stability of the residual series.

On the basis of the reached results out of the standard study, it can be said that there is a positive direct relationship between the use of natural fertilizers and potato production in the long term. This means if we increase the amounts of natural fertilizers used in balanced and moderate proportions while emphasizing on the good quality of the fertilization, this necessarily increases the productivity in Potato crop continuously, not to forget the other factors affecting the potato crop cultivation process.

3-2-3- Estimating the short-run equilibrium relationship model (ECM error correction):

Through estimating the error correction model in Angel Granger methodology we want to show the relationship between the use of natural fertilizers and potato production for the studied period (2002-2018) in the short run. The following table (see table 06) shows the results reached.

The error correction limit slowdown coefficient reveals the speed or slow return of the variables to the equilibrium state, and this coefficient must be significant and negative to detect the existence of a common integration among the variables. The absolute value of the error correction limit coefficient indicates the speed of restoring the equilibrium state, while the negative sign shows the kinetic model convergence in the short run. The negative and significant coefficient associated with slowing the error correction limit is a very effective way to demonstrate joint integration⁹ (Chikhi, 2012).

In this model, the value of the error correction coefficient is (-0.915), and it is significant (prob = 0.0223). Therefore, it can be said that 0.915% of short-run errors can be corrected in one year in order to return to the long-run equilibrium position. This means that any 91.5% deviation of potato production in the short run from its balanced value is subjected to correction in the time

period (t) approved in the study for one year, which confirms the accuracy and validity of the balanced relationship in the short run

3-2-4- Model Quality Diagnostic Tests:

The validity of the model used in economic analysis and its absence from standard problems is confirmed by conducting several diagnostic tests that reveal the presence or the absence of statistical problems. Here is the most common and important tests that have been tested:

3-2-4-1- The test of the normal distribution of random error: To verify the condition for following the estimated residue of the model, (Jarque-Bera) test was used. The results are shown in the following figure (see figure 03).

The test showed that Jarque-Bera's probability was 2.970356 and it is greater than the 5% level of significance. This result leads us to accept the null hypothesis which assumes that the residues are naturally distributed.

3- 2-4-2- Heteroscedasticity Test: In order to verify that Heteroscedasticity doesn't exist in the model, the ARCH test is used, and the results are shown in the following figure (see figure 04):

The Heteroscedasticity Test indicates that Fischer's probability is 0.5332 which is greater than the 5% level of significance, which leads us to accept the null hypothesis that assumes the absence of Heteroscedasticity.

3-2-4-3- Serial correlation test: The results of the Breusch-Godfrey serial correlation LM test showed no serial correlation problem for the residue, and the results are shown in the following figure (see figure 05):

In comparison with Fischer's probability of 0.6567, it is greater than 5%. This result leads us to reject the alternative hypothesis that assumes no serial correlation problem for the regression equation residuals.

As a summary of the above diagnostic tests, it can be said that the model is generally statistically significant, which proves the validity of the model and its safe use to explain the studied phenomenon.

3-3- Analysing the sustainability of the potato crop in Oued Souf region (the economic interpretation of the model)

Achieving sustainability in the productivity of the potato crop in Oued Souf region will require taking into account many affecting factors, such as the use of natural fertilizers in a balanced

manner, both in terms of quantity and quality, the good use of arable land, as well as the irrigation methods and the use of arable water. All of these factors, if optimally exploited, contribute to the sustainability of potato production and even other agricultural crops in the region, which guarantees the right of future generations to benefit from agricultural production.

This study made it clear that the use of natural fertilizers has, directly and indirectly, affected the sustainability of potato crop production in Oued Souf through:

- The steady increase in potato production in terms of quantity and quality in the long term.
- The good quality of natural fertilizers used in the crop cultivation process greatly contributed to its sustainability, despite the use of other organic fertilizers.
- Increasing the life cycle of arable land exploitation, which helps in producing additional crops.
- The good use of irrigation water used in the potato crop cultivation process.
- Preserving the agricultural lands environment and the related natural and ecological resources.
- The high quality of the crop which leads to the preservation of human health and the environment.
- The spread of sustainability culture and the preservation of agricultural environmental resources among many farmers.
- The availability of advanced technologies and modern methods that help in the process of growing crops, especially the use and sustainability of irrigation water, which increases its utilization capacity for more years.

IV- Conclusion:

The success of the experiment of potato crop cultivation in Oued Souf, increasing its productivity and achieving its sustainability is due to many main factors, including the optimal use of natural fertilizers in arable land in terms of quantity and quality in addition to the modern helpful techniques and methods.

After we studied the relationship between the effect of the use of natural fertilizers on the productivity and sustainability of the potato crop in the region, we reached the following important results:

- The standard study showed us that there is a positive and balanced direct relationship between the use of natural fertilizers and the productivity of the potato crop in the region in the long term, after applying the necessary model and testing the hypotheses of the study variables.
- The increase in the productivity of the potato crop in the region is largely due to the appropriate amount of natural fertilizers used in terms of quantity and quality, without neglecting the other physical and technical factors that help in the crop cultivation process, thus increasing its productivity and achieving its sustainability.

- The use of natural fertilizers in a balanced and proportionate manner, according to the necessary agricultural needs, ensures the sustainability of arable land, irrigation water, and all environmental and natural resources associated with the production of the potato crop and other agricultural crops.
- The potato crop in Oued Souf is characterized by a high-level quality and covers 50% of the national needs. It also has a competitive ability over other crops, which enhances its exporting opportunities, as the case today with the beginning of the first export shipments (to France and some countries Gulf) in the year 2018.
- The spread of awareness among many farmers, as well as sustainability and conservation culture of environmental and agricultural resources, enabled them to make optimal use of agricultural lands and irrigation water. This is due to the adoption of modern techniques and methods that help increase the life span of the use of agricultural lands and water sources.
- Material and moral support from the government (financing, agricultural equipment, electricity networks, water wells, and agricultural housing) has continuously encouraged the cultivation of potato crops and other agricultural crops in the region.

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Appendix:

Table (01): presents the potato production volume and the amount of natural fertilizers used between 2002-2018

Fertilizers (quintal)	Production (quintal)	Area (hectare)	Years
138000	360580	1687	2002
200000	568880	2563	2003
656000	1164900	4433	2004
824000	1550705	6749	2005
980000	1818366	7392	2006
1390000	1791893	7217	2007
1440800	2708890	11415	2008
2682400	3588962	14200	2009
3160000	6206320	18800	2010
3428000	7221700	24000	2011
5367000	11176000	30200	2012
6720000	11725000	35000	2013
6357000	10890000	33000	2014
6412000	10960000	33600	2015
6430000	11180000	34000	2016
6570000	11530000	35000	2017
6500000	11360000	36200	2018

Source: agriculture department annual report of El Oued province. Adapted.

Table (02): Stability Test Results of the Series using AFD.

Result	At the first difference			At the level			Variable
	No Breaker or time vector	Breaker and time vector existed	Breaker Existed	No Breaker or time vector	Breaker and time vector existed	Breaker Existed	
Stable at the first difference	-2.323	-2.777	-2.868	1.358	-2.207	-0.668	PRO
Stable at the first difference	-2.289	-2.872	-2.971	1.515	-2.275	-0.620	ENG

Source: Prepared by researchers using Eviews10.

Table (03): Stability Test Results of the Series using Phelps Peron Test (PP)

Result	At the first difference			At the level			Variable
	No Breaker or time vector	Breaker and time vector existed	Breaker Existed	No Breaker or time vector	Breaker and time vector existed	Breaker Existed	
Stable at the first difference	-2.326	-2.756	-2.854	0.907	-1.641	-2.728	PRO
Stable at the first difference	-2.279	-2.764	-2.925	1.23	-1.472	-0.648	ENG

Source: Prepared by researchers using Eviews10.

Table (04): the results of estimating the long-run coefficients

variable	coefficient	Sts.Error	t-Statistic	prob
ENG	1.764	0.0636	27.716	0.0000
C	75432.09	274718.5	0.2745	0.7874
PRO = 75423.0892758 + 1.76435220628*ENG				
R ² = 0.9808				
F-statistic = 768.2042 / prob(F-statistic) = 0.000000				

Source: Prepared by researchers using Eviews10 and appendix (01)

Table (05): Results of the estimation residue series test using Dickey-Fuller and Philip Byron test.

Result	Philip Byron test			Dickey-Fuller test			Test
	At the level			At the level			Variable
	No Breaker or time vector	Breaker and time vector existed	Breaker Existed	No Breaker or time vector	Breaker and time vector existed	Breaker Existed	
Stable at the level	-3.03	-2.82	-2.92	-3.03	-2.8	-2.92	estimation residue u_t

Source: Prepared by researchers using Eviews10.

Table (06): The results of estimating the error correction model ECM (short run).

variable	coefficient	Sts.Error	t-Statistic	prob
C	-106057.7	2299300.3	-0.462528	0.6513
DENG	2.022	0.389	5.196	0.0002
Ut(-1)	-0.915	0.353	-2.59	0.0223
DPRO = -106057.748821 + 2.022094437*DENG - 0.915674714713*U(-1)				

Source: Prepared by researchers using Eviews10.

Table (07): Statistical outputs of the estimated regression model for the relationship between the use of natural fertilizers and potato production.

Dependent Variable: PRO				
Method: Least Squares				
Date: 12/26/18 Time: 00:56				
Sample: 2002 2018				
Included observations: 17				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	75423.09	274718.5	0.274547	0.7874
ENG	1.764352	0.063657	27.71650	0.0000
R-squared	0.980848	Mean dependent var		6219541.
Adjusted R-squared	0.979571	S.D. dependent var		4680830.
S.E. of regression	669029.6	Akaike info criterion		29.77518
Sum squared resid	6.71E+12	Schwarz criterion		29.87320
Log likelihood	-251.0890	Hannan-Quinn criter.		29.78492
F-statistic	768.2042	Durbin-Watson stat		1.520608
Prob(F-statistic)	0.000000			

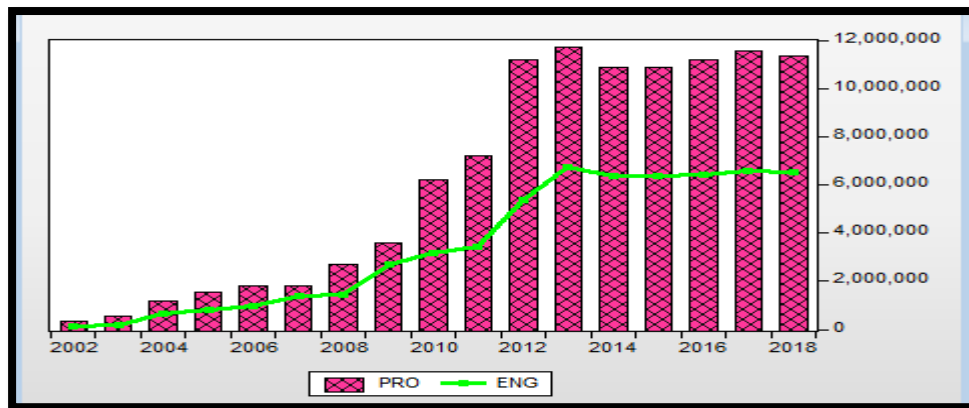
Source: Prepared by researchers using 10Eviews.

Table (08): The results of estimating the error correction model (Short Term)

Dependent Variable: DPRO				
Method: Least Squares				
Date: 11/15/19 Time: 17:38				
Sample (adjusted): 2003 2018				
Included observations: 16 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-106057.7	229300.3	-0.462528	0.6513
DENG	2.022094	0.389103	5.196813	0.0002
U(-1)	-0.915675	0.353076	-2.593420	0.0223
R-squared	0.684652	Mean dependent var		687463.8
Adjusted R-squared	0.636137	S.D. dependent var		1138001.
S.E. of regression	686454.8	Akaike info criterion		29.88383
Sum squared resid	6.13E+12	Schwarz criterion		30.02869
Log likelihood	-236.0706	Hannan-Quinn criter.		29.89125
F-statistic	14.11213	Durbin-Watson stat		2.014981
Prob(F-statistic)	0.000552			

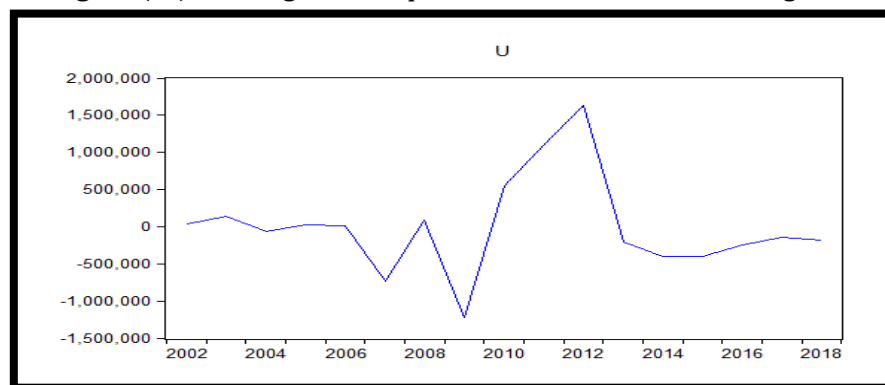
Source: Prepared by researchers using 10Eviews.

Figure (01): graphs of the study variables



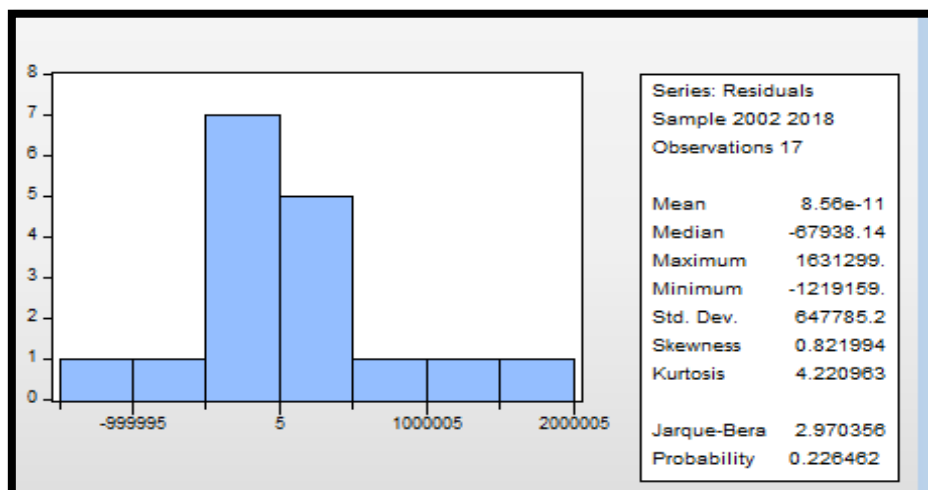
Source: Prepared by researchers using Eviews10.

Figure (02): The regression equation residues of the Joint integration



Source: Prepared by researchers using Eviews10.

Figure (03): Testing the normal distribution of random errors



Source: Prepared by researchers using Eviews10.

Figure (04): Heteroscedasticity Test

Heteroskedasticity Test: ARCH			
F-statistic	0.408173	Prob. F(1,14)	0.5332
Obs*R-squared	0.453269	Prob. Chi-Square(1)	0.5008

Source: Prepared by researchers using Eviews10.

Figure (05): Serial correlation LM test

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	0.434421	Prob. F(2,13)	0.6567
Obs*R-squared	1.065000	Prob. Chi-Square(2)	0.5871

Source: Prepared by researchers using Eviews10.

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