



## المجلة المصرية للاقتصاد الزراعي

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### الآثار الاقتصادية المترتبة لارتفاع أسعار الصرف على أسعار الآلات الزراعية لأهم المحاصيل الاستراتيجية في مصر

د. رشا محمد أحمد فرج\* د. رانيا خميس إبراهيم\*\*

\* باحث اول بقسم بحوث التحليل الاقتصادي للسلع الزراعية- معهد بحوث الاقتصاد الزراعي - مركز البحوث الزراعية

\*\* باحث أول- معهد بحوث الهندسة الزراعية - مركز البحوث الزراعية

بيانات البحث

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الكلمات المفتاحية:

مدخلات الإنتاج،  
تكاليف الإنتاج، صافي  
العائد، الجرارات  
والآلات الزراعية

تحمل المزارع في الفترة الأخير الكثير من الأعباء المالية، إلا أنه فوجئ بقرار تحرير سعر الصرف وارتفاع أسعار مدخلات الإنتاج بصفة عامة واسعار الآلات الزراعية بصفة خاصة، الأمر الذي أدى إلى ارتفاع تكاليف معظم العمليات الإنتاجية سواء بطريقة مباشرة أو غير مباشرة. ولكن هل الزيادة في مدخلات الإنتاج يتم استردادها من خلال الزيادة الموازية في سعر المنتج، وهل يحقق المزارع في ظل هذه الزيادة صافي عائد مرضى .

وأهم ما توصل إليه البحث أنه بالفعل تأثر كل من تكاليف تحضير الأرض للزراعة وأجور الآلات بارتفاع أسعار الآلات المستخدمة، حيث تبين الارتفاع الكبير لمعدلات التغير لكل من تكاليف تحضير الأرض للزراعة وتكلفة اجور الآلات بعد تحرير سعر الصرف عام 2017. كما أشارت النتائج إلى أن سعر الصرف تزايد خلال العشر سنوات الماضية بمعدل 12.7%، في حين ارتفعت أسعار الآلات بمعدلات تتراوح بين 5%: 17%، بينما تزايد إجمالي تكاليف إنتاج محصولي القمح والذرة الشامية بمعدل 13%، 11.8% لكل منهما على الترتيب. وفي المقابل يتناقص صافي العائد الذي يحققه المزارع لكلا المحصولين خلال الفترة (2011-2020) بمعدل بلغ نحو 4% للقمح، ونحو 0.9% للذرة الشامية. وأظهرت النتائج أن ارتفاع سعر الصرف له تأثير قوى ومعنوي احصائيا على كل من: أسعار الآلات الزراعية، تكاليف إنتاج الفدان (القمح، الذرة)، أسعار المنتج، وصافي الربح المحقق للمزارع. ومن تحليل قيم بنود التكاليف ارتفاع كافة العمليات الإنتاجية لمحصولي القمح والذرة الشامية الصيف بعد اتخاذ قرار تحرير سعر الصرف في نوفمبر 2016، حيث تبين ان جملة التكاليف المتغيرة للقمح والذرة الشامية زادت بمقدار 2986، 3355 جنيه/فدان أي بمعدل 86%، 91.7% لكل منهما على الترتيب.

الباحث المسنون: رشا محمد أحمد فرج

البريد الإلكتروني: [dr\\_rosha99@yahoo.com](mailto:dr_rosha99@yahoo.com)

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### Economic implications of high dollar exchange rates on agricultural machinery prices of some of strategic crops in Egypt

**Rasha Mohammed Ahmed Farag**Economic Analysis of Agricultural Commodities Research Department, Agricultural Economics Research Institute,  
Agricultural Research Centre, Egypt**Rania Khamis Ibrahim**

Agricultural Engineering Research Institute, Agricultural Research Centre, Egypt

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**ABSTRACT**

Farmers have borne much of the financial burden in order to increase per feddan productivity of agricultural crops, they have been surprised by the decision to liberalize the exchange rate, which have led to higher costs for most production processes. The research is aimed at identifying the effects of the decision to liberalize the exchange rate on the prices of tractors and agricultural machinery, the items of production costs.

The results indicated that The exchange rate has increased at a rate of 12.7%, while machinery prices have increased at rates of 5 - 17%, while production costs for wheat and maize crops have increased by 13%, and 11.8% . On the other hand, the yield to both harvests by a farmer (2011-2020) decreases by rate of about 4% for wheat, and by a rate of about 0.9% for maize. The productivity of wheat and maize in old lands is higher than in new lands, while the opposite occurs in the prices of machinery work to prepare the land for cultivation. An analysis of cost-item values concluded that all production of wheat and maize crops increased after the decision to liberalize the exchange rate by 86%, 91.7%.

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*Corresponding Author:* Rasha Mohammed Ahmed FaragEmail: [dr\\_rosha99@yahoo.com](mailto:dr_rosha99@yahoo.com)

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**Introduction:**

Over the past 10 years, the agricultural sector has experienced many challenges, making the state strives for agricultural development, that will try hard to maximum level of self-sufficiency and reduce imports of staple crops. Technical, economic and political considerations have already evolved in many variables, which have led the agricultural sector to face certain price policies that have significantly increased the prices of all inputs for agricultural production, including chemical peptides, fertilizers, energy, labor, tractors and other agricultural machinery, etc.

Wheat and maize crops, which are important strategic and import crops, have been selected because they are of great importance for human food security, animal feed and foreign trade. In 2019, wheat production was 8.559\* million tons, fulfill human consumption only 40.6%, and about 12.5 million tons were imported, representing about 59.4% of the 21.1 million tons available for all consumption. While maize production was 8.26 million tons, total consumption covered only 49.2% of total consumption, and about 8.02 million tons were imported. The average per capita of wheat in 2019 was about 149.5 kg/year, representing 70.7% of the per capita cereal crops. The average per capita maize was about 35.1 kg/year, representing about 16.1% of the total cereal per capita. This research paper focus on the implications of the decision to liberalize the dollar exchange rate on higher prices for inputs and certain mechanical service operations, which will directly or indirectly affect the costs incurred by farmers in the production process.

**Research Problem:**

Recently, farmers have borne much of the financial burden in order to increase area offeddan (acre) productivity of agricultural crops, they have been shocked by the decision to liberalize the exchange rate, the high prices of production inputs in general and the prices of tractors and agricultural machinery in particular, which have led to higher costs for most production processes, either directly or indirectly. Therefore, the price of crops is high in general, and the problem of research is to answer the following question: Is the increase in the price of production inputs, including agricultural machinery being recovered through a parallel increase in the price of the products, and does the farmer achieve reasonable net return?

**Objective:**

The research is aimed at identifying the effects of the decision to liberalize the dollar exchange rate on the prices of tractors and agricultural machinery, the items of production costs for both wheat and maize, and the main factors affecting farm costs and the net return of wheat and maize crops. **So try to answer the following:**

- Is high exchange rates of dollar affect Agricultural Machinery prices (Wheat and maize)?
- Is high exchange rates of dollar affect the cost of Agricultural Production (Wheat and maize)?
- Is the high exchange rates of dollar affect the Product Prices (Wheat and maize)?
- Is the high exchange rates of dollar affect the Farmer's Net Profit (Wheat and maize)?

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\*Ministry of Agriculture and Land Reclamation - Economic Affairs Sector- Food Balance Sheet 2019.

**Methodology and data sources:**

Research to achieve its objectives has relied on descriptive and quantitative methods of data analysis and interpretation of results, using simple statistical tools such as: the rate of change, the computational medium, and the general time trend, as used by the stepwise regression, are the most important factors affecting the economics of wheat and maize crop production.

The published and unpublished data are based on the website of the Central Agency for Public Mobilization and Statistics and the Ministry of Agriculture and Land Reclamation, as well as on companies importing and manufacturing agricultural machinery in the Arab Republic of Egypt (Table 4 of the annex), Agriculture Mechanization Sector, Executive Authority for Land Improvement and the United Nations database, as well as on studies and scientific thesis relevant to the subject matter.

**Results and discussion****1) Dollar exchange rate and prices of tractors and agricultural machinery (used to prepare agriculture field):**

The research deals with the prices of some tractors and agricultural machinery used in preparing the land for cultivation of all crops. In addition to the development that took place in the costs of preparing the land and renting equipment for the wheat and maize crops cultivation during the past ten years (2011-2020).

Table (1) shows that the exchange rate is increasing annually at relatively close rates compared to 2011 (base year), when in 2016 its rate of change reached 201%, that is, after the decision to liberalize the exchange rate was issued, and then it began to change according to the global movement of the market, where its rate of change reached The year 2020 is about 161% compared to 2011 as a base year. While it became clear that the prices of machines in the old lands are increasing annually at increasing rates, where the rate of change in 2012 was about 6.9% compared to 2011 and increased at a rate of about 87% in 2020 compared to 2011. While the prices of machines in the new lands also increased at great rates, especially after a year 2016 where the rate of change in 2012 was about 7.6% compared to 2011. It increased at a rate of about 60% in 2017, and increased until it reached 199% in 2020 compared to 2011. When, the costs of preparing land for agriculture and renting machinery for wheat and maize crops are considered, it is found that they were affected by the increase in the prices of machinery Where the rate of change of land preparation costs for cultivation of wheat and maize in 2012 was about 7.1%, 12.8% compared to 2011 and increased at a rate of about 186%, 207% in 2020 compared to 2011. It was also found that the rental of machines for both wheat and maize is increasing annually as the rate of change in 2012 was about 4.1%, 20.9% compared to 2011, and increased at a rate of about 219%, 257% in 2020 compared to 2011.

The results indicate that the costs of preparing the land for cultivation and renting the machinery are indeed affected by the increase in the prices of hiring tractors and machinery, or in a way that shows the effect of the liberalization of the dollar exchange rate on those variables, as it was shown that the rates of change of both the costs of preparing the land for cultivating and the cost of renting machinery increased significantly after the dollar exchange rate liberalization in 2017. It can be seen on Figs (1&2).

**Table (1): Ratio of annual dollar exchange rate change, prices of agricultural machinery and some study variables for the period 2011-2020.**

Year	Exchange rate	**Machine's price		Costs of preparing land for cultivation		Machine rent	
		Old land	New land	Wheat	Maize	Wheat	Maize
2011*	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2012	4.8	6.9	7.6	7.1	12.8	4.1	20.9
2013	15.4	14.5	16.6	23.2	27.1	21.5	30.0
2014	18.7	20.7	26.3	37.9	23.3	32.3	34.1
2015	29.8	29.0	36.8	49.5	37.6	60.7	52.5
<b>2016</b>	<b>201</b>	<b>38</b>	<b>48</b>	<b>64</b>	<b>63</b>	<b>81</b>	<b>61</b>
<b>2017</b>	<b>194</b>	<b>48</b>	<b>60</b>	<b>105</b>	<b>156</b>	<b>124</b>	<b>188</b>
2018	197	60	112	136	156	212	188
2019	166	73	164	174	194	211	240
2020	161	87	199	186	207	219	257

Source: - Calculated from Table (1) and (2) in the Appendix.

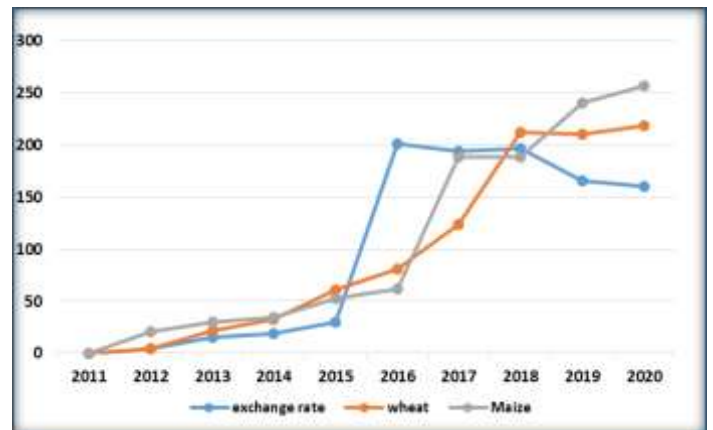
\* Base year

\*\* The machines are tractors, plows, Land leveler, and disc harrows.

**Fig. (1) : Dollarexchange rate changes and land preparation costs for wheat and maize crops during the period (2011 - 2020)**



**Fig. (2): Dollarexchange rate changes and tractor and machinery price for wheat and maize crops during the period (2011-2020)**



## 2) The effect of the high dollar exchange rate on economic variables to study.

Exchange rates can play an important role in influencing some economic variables, whether positive or negative, and this is reflected in the growth of those variables, by studying the impact of the dollar exchange rate during the period (2011-2020) shows the following, Table (2):

- Studying the effect of the dollar exchange rate on the prices of agricultural machinery in the old lands (Equation 1), it was found that the increase in the dollar exchange rate by 1% results in an increase in the prices of machinery in the old lands by about 0.37%, and the statistical significance of this relationship has been proven, and this shows the strength of the relationship between them. And the study of the effect of the dollar exchange rate on the prices of agricultural machinery in the new lands (Equation2) shows that the significance of the estimated parameters and the significance of the function as a whole is stable, as an increase in the dollar exchange rate by 1% results in an increase in the prices of machines in the new lands by about 0.6%.
- And studying the effect of the dollar exchange rate on the production costs of feddan for wheat and maize crops (Equation 4&3), it was found that the increase in the dollar exchange

rate by 1% results in an increase in the production costs of wheat and maize by about 0.76% and 0.66%, respectively, and the parameters are significant. Statistically estimated and the significance of the function as a whole using the value of  $F_{test}$  or the value of  $R^2$ . and this shows the strength of the relationship between them.

- While it was found by studying the effect of the dollar exchange rate on the Net return of feddan achieved for the farmer from the wheat and maize crops (Equation 6&5), it was found that when the dollar exchange rate increases by 1%, it results in a decrease in the Net return of feddan of wheat and maize by about 0.34%, 0.26%, The estimated parameters were statistically significant.

**Table (2): The effect of the high dollar exchange rate on economic variables to study in Egypt during the period (2011-2020).**

N.Eq	The dependent variable	$\alpha$	Log $\beta$	$t_{\beta}$	F	$R^2$	
1	Machine's price	Old land	2.51	0.366	4.86	23.6	0.75
2		New land	2.37	0.604	3.6	12.97	0.62
3	Total cost	Wheat	3.05	0.756	6.1	37.8	0.82
4		Maize	3.11	0.666	6	36.04	0.82
5	Net return	Wheat	3.90	(0.34)	(3.02)	9.15	0.53
6		Maize	3.67	(0.268)	(1.77)	3.14	0.28

Note: ( ) negative value.

Source: compiled and calculated from Table (1&3) in the annexes.

### 3) The current status of study variables in Egypt:

The following research reviews the prices of some tractors and agricultural machinery used forland preparation for all crops, as well as some economic indicators for wheat and maize crops (crops farm gate price, total costs, total revenue value, net return). Reviewing data in Tables (3 and 4) of the different variables over the period (2011-2020), showed that, all variables tended to increase except for the net return of the wheat crop with different annual growth rates. Below is a description of each indicator separately:

- a- **Dollar exchange rate:** It increased by about 161% from the beginning of the period, and from Table (3), shows that the dollar exchange rate increases statistically annually by about 1.52 dollar/L.E as an average, or at a rate of 12.77% of the average exchange rate of about 11.9 dollar/L.E during the period (2011-2020).

**Table (3): The general trend of agricultural machinery prices forland preparation for crops cultivation during the period (2011-2020).**

Variable	$\alpha$	$\beta$	$t_{\beta}$	G*	$R^2$	Average
Exchange rate/(\$ L.E)	3.58	1.52	4.4	12.74	0.67	11.9
Tractor (92 HP) (1000 L.E)	215	26.9	14.4	7.4	0.96	363
Tractor (153 HP) (1000 L.E)	51.2	107.2	5.9	16.7	0.79	640
Plow (7 shanks ) (1000 L.E)	9.98	0.689	3.1	5.03	0.99	13.7
Land Leveler(12 feet) (1000 L.E)	12.1	2.918	4.4	10.3	0.98	28.2
Disk harrow (52 disk) (1000 L.E)	25.4	23.6	5.7	6.1	0.99	384

Note: (\*) calculated as  $(\beta \div \mu) \times 100$

Source: compiled and calculated from Table (1) in the annexes.

**b- Prices of agricultural machinery used forland preparation:**

- 1- **Agricultural tractor(imported):** The agricultural tractor is the main mechanical power that the farmer relies on to accomplish most of the agricultural operations, as it is the source of the movable ability to pull, push or manage various agricultural equipment. Tractor power is measured in horsepower. There are two types of tractors, the first: "92 horsepower tractor" (Russian production) is commonly used in the old lands, and the other: "153 horsepower tractor" (European Union or American production) is commonly used in the new lands. Table (1) in the annexes shows an increase in the dealer selling price of a 92-horsepower tractor during the period (2011-2020), which amounted to about 260 thousand Egyptian pounds in 2011, and then increased until 2020, reached 512 thousand Egyptian pounds; That is, an increase of about 97% over the beginning of the period, and from Table (3), it is clear that the price of a 92-horsepower tractor increases significantly annually by about 26.9 thousand Egyptian pounds, or at a rate of 7.4% of the average selling price of about 363 thousand Egyptian pounds during the period (2011-2020). It is clear that the selling price of a 153-horsepower tractor amounted to about 325 thousand Egyptian pounds in 2011, then increased until the year 2020 reached about 1.350 million Egyptian pounds, an increase equivalent to about 315% over the beginning of the period. Statistically significant annually by about 107 thousand Egyptian pounds, or at a rate of 16.7% of the average selling price of about 640.6 thousand Egyptian pounds during the period (2011-2020).
- 2- **Chisel plough (7shanks)local manufacture:** Plough attached to agricultural tractors are to prepare,land and break up soil, bury the plant residues, increase soil fertility and become more suitable for seeds cultivation. Ploughs have been ploughed depending on the quality of the agricultural soil in which they are used. Table (1) in the annexes shows that the sale price of a local manufacture plow increased during the period (2011-2020), reach about 11,000 Egyptian pounds in 2011, and up to 2020, the price raised up to 17,000 Egyptian pounds, equivalent to about 55% from the beginning of the period, 5% of the average selling price of about 13.7 thousand Egyptian pounds over the period (2011-2020).
- 3- **Disk harrows (52 Disk) (imported):** After plowing, the soil is not fully ready for cultivation because there are unbroken soil clods, especially after the use of the plough, which keeps the soil exposed to water loss, which affects the growth of seed germination. Therefore, work must be done by harrowing the soil using disk harrow. Table (1) in the annexes shows an increase in its sale price during the period (2011-2020), which stood at about 286.5 thousand Egyptian pounds in 2011 and increased until 2020, to about 500,000 Egyptian pounds, roughly 74% from the beginning of the period. Table (3) shows that the price of the disk harrow is statistically increasing by about 23.6 thousand Egyptian pounds annually, or at a rate of 6.1% of the average sale price of about 384,000 Egyptian pounds over the period (2011-2020).
- 4- **Land leveler (12 feet) local manufacture:** After plowing and smoothing the soil surface uneven, there are some high and low spots; this affects the flow of water during irrigation from one place to another, leading to dry soil surface of high-lying areas and the water saturation of low-lying areas. This requires land leveling to facilitate regular

seed cultivation and water distribution, and to facilitate the movement of other agricultural machinery while performing its field operation, such as planting, spraying and harvesting. Table (1) in the annexes shows an increase in the dealer sale price during the period (2011-2020), at about 16.5 thousand Egyptian pounds in 2011, the price increased until 2020, reached around 42.9 thousand Egyptian pounds, equivalent to 158.2% from the beginning of the period, and from Table (3) notices that the price of the land leveler machine increases by about L.E2.918 per year, or 10% of the average sale price of about L.E28.2 thousand over the period (2011-2020).

### C. Economic indicators for wheat and maize crops:

#### 1- Wheat Crop

**a-Farm gate price:** Farm gate price is the main determinant profitability which pays the product to grow, the crop but not the other, thus allocating the area under the crop in the subsequent year, and studying the evolution of the farm gate price of wheat during the period (2011- 2020), the average price increased for wheat in the Egyptian market ranged from a minimum of about 2347L.E in 2011 to a higher of about 4420L.E in 2020, and during the study period this price increased statistically by about 247L.E per year, representing about 7.7% of the average price of about 3206L.E, as shown in Table (4).

**b-Total revenue value:** indicates that, during the period (2011-2020), the total value of wheat feddan (acre) income in Egypt ranged from a minimum value of about 7.953thousand Egyptian pounds in 2011 to a higher value of about 14.912 thousand Egyptian pounds in 2019.

**c-Total costs:** appears that during the period (2011- 2020). The minimum total cost of wheat feddan(acre)in Egypt was about 4.069 thousand Egyptian pounds in 2011, while, the highest cost in 2020 at about 11.643 thousand Egyptian pounds.

**d-Net return:** The net return on wheat reflects the difference between the gross income of the feddan (acre) and the total cost of the wheat feddan (acre), shown in a Table (4).The Supplement states that during the period (2011-2020), the net return of wheat feddan (acre) ranged from a minimum of about 2.141 thousand Egyptian pounds in 2018 to a higher of about 4.358 thousand Egyptian pounds in 2012, as during the study period the net return of wheat per feddan (acre) decreased at a statistically significantly annual rate of about 144.5 Egyptian pounds about 4% of the average value of about 3.587 thousand Egyptian pounds.

#### 2- Maize Crop

**a-Farmgate price:** Studying the evolution of the farmgate price of maize in Table (4) during the period (2011- 2020), the average farm price per ton in Egypt ranged from a minimum of about 1929L.E in 2011 to a higher of about 3552L.E in 2020, as during the study period this was a statistically significantly increase of about 182.7L.E present 6.9% of the average price of about 2647L.E.

**b-Total revenue value:** Table (4) shows that during the period (2011-2020). The total value of maize income in Egypt ranged from a minimum of about 6740Egyptian pounds in 2011 to a higher of about 14299Egyptian pounds in2020, as during the study period this value increased at a statistically significantly annual rate of about 778 Egyptian pounds represents 8.3% of the average value of about 9375Egyptian pounds.



**Table (4): The general trend of some economic indicators of wheat and maize crops in Egypt during the period (2011-2020).**

	The dependent variable	$\alpha$	$\beta$	$t_{\beta}$	G	R <sup>2</sup>	Average	Min.	Max.
Wheat	Farmgate price (L.E/Ton)	1844	247	7.6*	7.7	0.86	3206	2347 Year2011	4420 Year2020
	Total revenue value (L.E/Fed)	6464	814	8*	7.4	0.87	10972	7953 Year2011	14912 Year2019
	Total cost (L.E/Fed)	2112	958.6	10.9*	13	0.93	7385	4069 Year2011	11643 Year2020
	Net return (L.E/Fed)	4382	(144.5)	(2.1)	(4)	0.28	3587	2141 Year2018	4358 Year2012
Maize	Farmgate price (L.E/Ton)	1641	182.7	8.6*	6.9	0.89	2647	1929 Year2011	3552 Year2020
	Total revenue value (L.E/Fed)	5096	778	6.5*	8.3	0.82	9375	6740 Year2011	14299 Year2020
	Total cost (L.E/Fed)	2373	800.6	11.3*	11.8	0.93	6777	4082 Year2011	10889 Year2020
	Net return (L.E/Fed)	2722	(22.6)	(0.32)	(0.9)	0.11	2598	1629 Year2016	3410 Year2020

Note: (\*) indicates statistical significant difference at the 5% level. (1) calculated as  $(\beta \div \mu) \times 100$

Source: compiled and calculated from Table (1) in the annexes.

**b-Total revenue value:** Table (4) shows that during the period (2011-2020). The total value of maize income in Egypt ranged from a minimum of about 6740 Egyptian pounds in 2011 to a higher of about 14299 Egyptian pounds in 2020, as during the study period this value increased at a statistically significantly annual rate of about 778 Egyptian pounds represents 8.3% of the average value of about 9375 Egyptian pounds.

**c-Total costs:** It appears that during the period (2011-2020) the minimum total cost of maize was about 4082 Egyptian pounds in 2011, and its values were about 10889 Egyptian pounds in 2020. During the study period, the total cost of maize in Egypt increased by a statistically significant annual amount of about 800.6 Egyptian pounds, represent about 11.8% of the average cost of 6777 L.E/feddan (acre) of maize.

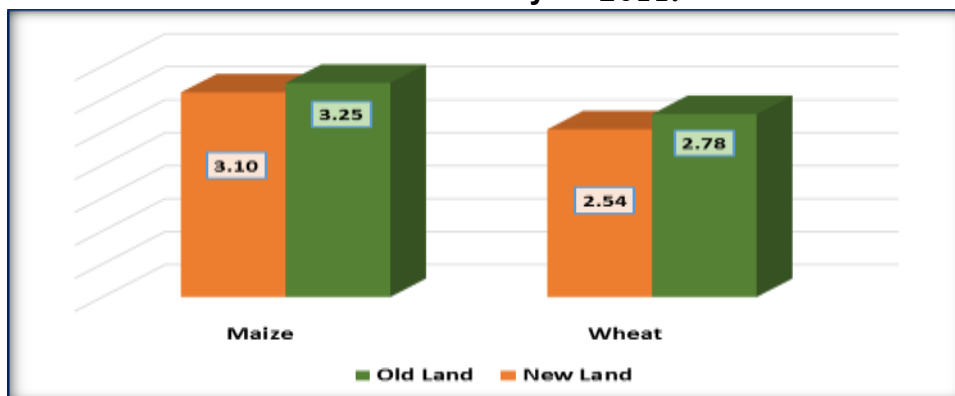
**d-Net return:** The net return of the maize reflects the difference between the gross income value of the feddan (acre) and the total cost value of the maize feddan (acre), Table (4) shows that during the period (2011-2020), the net return per acre of maize ranged between a minimum of about 1629 Egyptian pounds in 2016 and a maximum of about 3410 Egyptian pounds in 2020, where during the study period the net return of an acre decreased Maize with a statistically insignificant value of about (22.6) pounds, representing about 0.9% of the average value of about 2598 Egyptian pounds.

#### **D-The productivity of wheat and maize crops:**

Fig. (3) Indicates that the average productivity of wheat feddan (acre) in old land was about 2.78 tons/feddan (acre) in 2019, while the productivity of wheat feddan (acre) in new land was about 2.54 tons. The average productivity of maize feddan (acre) in old lands was 3.25 tons/feddan (acre) in 2019, while new land productivity was about 3.1 tons/feddan(acre).

The exchange rate has increased over the past 10 years at a rate of 12.7%, while machinery prices have increased at rates of 5 - 17%, while total production costs for wheat and maize crops have increased by 13%, and 11.8% each, respectively. On the other hand, the yield to both harvests by a farmer (2011-2020) decreases by a statistical significantly rate of about 4% for wheat, and by a rate of about 0.9% for maize, therefor it has not been statistically proven. The productivity of wheat and maize in old lands is higher than in new lands, while the opposite occurs in the prices of machinery used to prepare the land for cultivation, during the period 2011-2020.

**Fig. (3): Average productivity per feddan (acre) of wheat and maize crops in the old and new lands for the year 2011.**



#### 4) Analysis of the production costs of wheat and maize crops:

**a- According to the items for the production costs and requirements:** The analysis of the cost items' values aims at estimating the relative importance of these items to identify the most important factors affecting costs, and helps decision makers achieve the goal of minimizing costs and maximizing profits. Mechanized work is used in all production processes, starting from the land preparation for cultivation of all crops until harvesting and threshing some crops such as wheat and maize, and accordingly, the reason for the high production costs of any crop due to the high prices and cost of tractors and machinery.

Table (5) indicates that the cost of performing all production of wheat and maize crops increased after the November 2016 dollar exchange rate liberalization decision, showing that the total variable costs of wheat and maize increased by 2985 and 3355L.E /feddan (acre); a rate of 86%, 91.7% each, respectively, after the decision to liberalize the exchange rate, where it reached during the average period (2013-2016) About 3479, 3660 Egyptian pounds /feddan (acre), increased to about 6465, 7015 Egyptian pounds /feddan (acre) over the average period (2017-2020), while employment is found to account for about 36%, 45.4% of the total variable costs of both wheat and maize during the average period (2017-2020), showing an increase of 1023, 1547 Egyptian pounds /feddan (acre), representing about 78%, 94% over the average period (2013-2016). Equipment rent account for about 25%, 18.9% of the total variable costs of both wheat and maize during the average period (2017-2020), and show an increase of 794, 726L.E/feddan (acre) representing about 95.8%, 120.5% over the average period (2013-2016). Labor and machinery are among the most important items in terms of their contribution to production costs, accounting for about 61%, 64% of the total variable costs of both wheat and maize, respectively. The rest of the cost items, all of them increased after the exchange rate was liberalized, while the highest rate of increase for the organic manure item was for wheat, which increased during the average (2017-2020) by about 172% over the average period (2013-2016), and for maize, the highest rate of increase for pesticides, representing about 125% over the average period (2013-2016). It also represents the value of the increase in total costs plus the land rent value of about 4958,4146 Egyptian pounds /feddan (acre) for both wheat and maize, which was reached over the average period (2013-2016). About 5690, 5392 Egyptian pounds /feddan (acre) increased to an average of over the period (2017-2020) about 10649, 9538 Egyptian pounds /feddan (acre), an increase of about 87%, 77% over the average period (2013-2016) for both wheat and maize, respectively.

**Table (5): Costs of labor, inputs for production of wheat feddan (acre) and maiz eunder Egyptian condition before and after exchange rate liberalization (L.E/feddan (acre)).**

Crop	Items	Before exchange rate liberalization (2013-2016)	After exchange rate liberalization (2017-2020)	%	Increase value	Increase %
wheat	WagesWorker's	1313	2336	36.1	1023.5	78.0
	<b>Machine rental</b>	<b>829</b>	<b>1624</b>	<b>25.1</b>	<b>794.3</b>	<b>95.8</b>
	Seed price	293	629	9.7	335.8	114.6
	Organic manure price	113	306	4.7	193.3	171.8
	Chemical Fertilizer price	495	821	12.7	326.5	66.0
	Pesticide price	118	161	2.5	42.8	36.2
	General expenses	319	589	9.1	259.8	79.0
	Variable costs	<b>3479</b>	<b>6465</b>	100.0	<b>2985.8</b>	<b>85.8</b>
	<b>Rent</b>	<b>2211</b>	<b>4183</b>		<b>1972.0</b>	<b>89.2</b>
	<b>Total costs</b>	<b>5690</b>	<b>10648</b>		<b>4957.8</b>	<b>87.1</b>
Maize	Workers'wages	1640	3187	45.4	1546.9	94.3
	<b>Machine rental</b>	<b>603</b>	<b>1328</b>	<b>18.9</b>	<b>725.9</b>	<b>120.5</b>
	Seed price	276	519	7.4	243.3	88.3
	Organic manure price	214	314	4.5	100.3	46.9
	Chemical Fertilizer price	530	900	12.8	370.7	70.0
	Pesticide price	83	187	2.7	104.3	125.6
	General expenses	320	579	8.3	259.5	81.2
	Variable costs	<b>3660</b>	<b>7015</b>	100.0	<b>3355.2</b>	<b>91.7</b>
	<b>Rent</b>	<b>1732</b>	<b>2523</b>		<b>791.0</b>	<b>45.7</b>
	<b>Total costs</b>	<b>5392</b>	<b>9538</b>		<b>4145.8</b>	<b>76.9</b>

Source: compiled and calculated from MALR, (2013-2020).

**b- According to the value items for agricultural operations:**

It has already been pointed out that mechanical work is effecting production cost, from seedbed preparing to crop harvesting and storage, and thus any increase in the equipment price will be reflected in the production process. Table (6) indicates that, all the increase in the costs of agricultural operations for both wheat and maize, with the cost of seedbed preparation for both wheat and maize contributing 7.7%, 10% over the average period (2017-2020), it increased by 211,362 L.E/feddan (acre) by 74%, 102% each after the exchange rate liberalization decision, reaching an average of over the period (2013-2016) approximately 285,355 Egyptian pounds /feddan (acre), increasing to about 495,718 Egyptian pounds /feddan (acre) over the average period (2017-2020), while the cost of irrigation increased by 304,424 L.E/feddan (acre); At an increase of about 75%, 94% for both wheat and maize respectively, during the average period (2013-2016) it was around 407,452 Egyptian pounds /feddan (acre) and increased to about 712,877 Egyptian pounds /feddan (acre) during the average period (2017-2020) respectively. The cost of harvesting increased by 419,407 L.E/feddan (acre), an increase of about 55%, 84% for both wheat and maize, with an average of about 765,482 L.E/feddan (acre) (2013-2016) and an average of about 118,889 L.E/feddan (acre) (2017-2020), respectively. The highest increase was observed in the cost of transporting the crop, increasing at a rate of about 156%, 122% for both wheat and maize, respectively, at an average of 228,203 Egyptian pounds /feddan (acre) (2013-2016), and increasing during the average period (2017-2020) to about 585,450 Egyptian pounds /feddan (acre), respectively.

**Table (6): Costs of the production operations of wheat feddan (acre) and maize (feddan) in Egyptian before and after exchange rate liberalization**

Crop	Item	Before exchange rate liberalization (2013-2016)	After exchange rate liberalization (2017-2020)	%	Increase value	% Increase
Wheat	Land preparation	285	495	7.7	210.8	74.1
	Seeding & planting	387	856	13.2	469.3	121.4
	Irrigation	407	712	11.0	304.5	74.8
	Fertilizer	738	1371	21.2	632.5	85.7
	crop service	117	239	3.7	122.3	104.7
	Pesticide	237	436	6.7	198.5	83.8
	Harvesting	765	1184	18.3	419.3	54.8
	Transportation	228	585	9.0	356.5	156.4
	Other costs	316	589	9.1	272.3	86.1
	<b>Total cost</b>	<b>3479</b>	<b>6465</b>	<b>100.0</b>	<b>2985.8</b>	<b>85.8</b>
Maize	Land preparation	355	718	10.2	362.5	102.0
	Seeding & planting	451	852	12.1	401.6	89.1
	Irrigation	452	877	12.5	424.5	93.9
	Fertilizer	891	1539	21.9	648.3	72.8
	crop service	357	756	10.8	399.0	111.8
	Pesticide	167	355	5.1	187.9	112.4
	Harvesting	482	889	12.7	406.7	84.3
	Transportation	203	450	6.4	247.8	122.4
	Other costs	302	579	8.3	276.8	91.6
	<b>Total cost</b>	<b>3660</b>	<b>7015</b>	<b>100.0</b>	<b>3355.2</b>	<b>91.7</b>

Source: compiled and calculated from MALR, (2013-2020).

##### 5) the main factors affecting the economics of wheat and maize crops production:

The most important factors affecting the farm gate price and net return of wheat and maize crops during the period have been identified from 1999 to 2020, the value of labor, the value of the mechanical work, the price of seeds, the price of organic manure, the price of chemical fertilizers and the price of pesticides, all at constant prices, and in order to prevent the problem of Multi-collinearity, and the problem of serial – autocorrelation, the Derben-Watson test was carried out to ensure that, there was no problem of self-autocorrelation using Stepwise Regression. The model is expressed as shown in Table (7) indicate the strongest independent variables affecting the dependent variable:

After applying the best models, the results of the indicators in Table (7) show that about 99% of changes in the farm gate price of wheat are explained by the variables of: The value of human work, the value of mechanical work, the value of seeds, the value of organic manure, the value of chemical fertilizer and the value of pesticides. Where the significance of the estimated model was shown, and with regard to the significance of the variables, it was found from the model that all the variables were statistically significant except for the value of the chemical fertilizer, and that the farm gate price of wheat was inversely proportional to the value of mechanized work and the value of seeds, as the decrease in the value of mechanical work and the value of seeds by one unit leads to an increase The farm gate price of wheat is about 1.82 and 2.38 Egyptian pounds / ton each, respectively. The decrease in the value of mechanized work may be due to its high cost, therefore the farmer resorts to human labor. It is also clear from the results that an increase in the value of human labor, the value of organic manure, and the value of pesticides by about one unit leads to an increase in the farm gate price of wheat by about 1.8, 1.35, and 1.89 Egyptian pounds / ton, respectively.

While the results of Table (7) show that about 92% of the changes in the net return of wheat achieved by the farmer are explained by the variables: the value of human labor, the value of mechanical work, the value of chemical fertilizer and value of pesticides, as the significance of

the estimated model was shown, and it was found from the model that all the variables were proven Statistically significant, and that the net return of wheat is inversely proportional to the value of the mechanical work, as it was found that the value of the mechanical work decreased by about one unit, which leads to an increase in the net return of wheat about 9.14 Egyptian pounds / ton. The results also showed that the increase in the value of human labor, the value of chemical fertilizer, and the value of pesticides by about one unit leads to an increase in the net return of wheat by about 3.23, 7.81, 24.4 Egyptian pounds / ton, respectively, and the reason for this due to the increase in the productivity of the crop.

It was also shown after the stability of the statistical significance of the estimated model and all the variables that about 98% of the changes in the farm gate price of maize are explained by the variables: the value of human labor, the value of mechanical work, chemical fertilizer, and that the increase of both the value of human labor and chemical fertilizer by about 1% leads to Increasing the farm gate price of maize by about 0.95%, 0.46%, respectively, as it was found that when the value of the mechanical work decreases by 1%, the farm gate price increases by 0.5%.

While, the results show that about 98% of the changes in the net return of maize achieved by the farmer are explained by the variables: the value of the organic manure, the value of the pesticides, as it shows the statistical significance of the estimated model and all the variables. It is also clear that the net return of maize is inversely proportional to the value of pesticides, as it was found that a decrease in the value of pesticides by about 1% leads to a rise in the net return of maize by about 0.47%, and it is also clear that an increase in the value of organic manure by about 1% leads to an increase in the net profit of maize About 1.4%.

**Table (7): Effects of some factors on the farm gate price and net yield of wheat and maize during the period (1999-2020).**

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**farmgate price of wheat**

$$P_w = 116.5 + 1.8L - 1.82 M - 2.38 S + 1.35 MF + 4.28CF + 1.89 Pes$$

(4.18) (-4.47) (-1.89) (1.16) (0.56) (4.16)

F = 733 , R<sup>2</sup>= 0.99, D.W= 2.63

**Net return of wheat**

$$N_w = 445.4 + 3.23L - 9.14M + 7.81CF + 24.44 Pes$$

(4.79) (-6.74) (2.44) (2.44)

F = 61.7 , R<sup>2</sup>= 0.92 , D.W= 2.29

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**Farmgate price of maize**

$$P_m = 0.654 + 0.95 \log L - 0.51 \log M + 0.47 \log MF$$

(3.4) (-2.2) (4.2)

F = 1414 , R<sup>2</sup>= 0.98, D.W= 2.05

**Net return of maize**

$$N_m = 0.98 + 1.4 \log MF - 0.47 \log Pes$$

(7.01) (-2.6)

F = 229 , R<sup>2</sup>= 0.98 , D.W= 2.18

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L: The value of human workers (L.E/feddan), M: the value of mechanization (LE/feddan).  
S: The value of seeds (L.E/feddan) , MF: The value of Organic manure s (L.E/feddan)  
CF: The value of chemical fertilizers (L.E/feddan), Pes: The value of pesticides (L.E/feddan)

## Summary

Over the past 10 years, the agriculture sector has experienced many challenges, making the state strive for agricultural development, that will ensure a minimum level of self-sufficiency and reduce imports of staple crops. Technical, economic and political considerations have already evolved in many variables, which have led the agricultural sector to face certain price policies that have significantly increased the prices of all inputs for agricultural production, including chemical pesticides, fertilizers, energy, labor, tractors and other agricultural machinery, etc.

Farmers have borne much of the financial burden in recent times in order to increase per feddan (acre) productivity of agricultural crops, they have been surprised by the decision to liberalize the dollar exchange rate, the high prices of production inputs in general and the prices of tractors and agricultural machinery in particular, which have led to higher costs for most production processes, either directly or indirectly. Therefore, the problem of research is to answer the following question: Is the increase in the price of production inputs, including agricultural machinery being recovered through a parallel increase in the price of the product, and does the farmer achieve reasonable net return?. The research is aimed at identifying the effects of the decision to liberalize the dollar exchange rate on the prices of tractors and agricultural machinery, the items of production costs for both wheat and maize, and the main factors affecting farm costs and the net return of wheat and maize crops.

The most important results of the research are the costs of preparing the land for cultivation and renting the machinery are indeed affected by the increase in the prices of the rent machines, or in a way that shows the effect of the liberalization of the dollar exchange rate on those variables, as it was shown that the rates of change of both the costs of preparing the land for cultivation and the cost of renting machinery increased significantly after the dollar exchange rate liberalization in 2017.

The results indicated that The exchange rate has increased over the past 10 years at a rate of 12.7%, while machinery prices have increased at rates of 5 - 17%, while total production costs for wheat and maize crops have increased by 13%, and 11.8% each, respectively. On the other hand, the yield to both harvests by a farmer (2011-2020) decreases by a statistical significantly rate of about 4% for wheat, and by a rate of about 0.9% for maize, but it has not been statistically proven. The productivity of wheat and maize in old lands is higher than in new lands, while the opposite occurs in the prices of machinery work to prepare the land for cultivation, during the period 2011-2020.

The results showed that the high exchange rates of dollar has a strong and statistically significant effect on the prices of agricultural machinery, the cost of production per acre (wheat, maize), product prices (wheat, maize) and the net profit of the farmer.

An analysis of cost-item values concluded that all production of wheat and maize crops increased after the decision to liberalize the dollar exchange rate in November 2016, showing that the total variable costs of wheat and maize increased by 2986, 3355 Egyptian pounds per feddan (acre) by 86%, 91.7% each, respectively.

The most important factors affecting the farm gate price and net return of wheat and maize crops during the period have been identified from 1999 to 2020, After applying the best models, the results of the indicators that about 99% of changes in the farm gate price of wheat are explained by the variables of: The value of human work, the value of mechanical work, the

value of seeds, the value of organic manure, the value of chemical fertilizer and the value of pesticides. And about 92% of the changes in the net return of wheat achieved by the farmer are explained by the variables: the value of human labor, the value of mechanical work, the value of chemical fertilizer and value of pesticides shown after the stability of the statistical significance of the estimated model and all the variables that about 98% of the changes in the farm gate price of maize are explained by the variables: the value of human labor, the value of mechanical work, chemical fertilizer. While, the results show that about 98% of the changes in the net return of maize achieved by the farmer are explained by the variables, the value of the organic manure, and the value of the pesticides.

#### **Recommendation:**

- 1- Price support to compensate farmers in unexpected crises.
- 2- Cash support to farms linked to crop productivity and quantity supplied.
- 3- Further researches studies should be conducted on the economic effects of fiscal policies on agricultural mechanization prices.

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## Annexes

Table (1) Exchange rate and prices of some agricultural machinery during the period 2011–2020

Year	Exchange rate (EGP/USD)	Price of Tractor (Eastern Block 92 Hp ), L.E	Price of Tractor (Western Block 153 Hp ), L.E	Price of Plough (7 shanks) , L.E	Price of Land leveller (12 feet) , L.E	Price of Disk harrow (52disk) , L.E
2011	6.02	260,000	325,000	11,000	16,500	286,551
2012	6.31	279,000	353,000	11,500	18,500	304,842
2013	6.94	300,000	388,000	11,875	21,000	324,300
2014	7.14	312,500	426,500	12,500	23,000	345,000
2015	7.81	335,000	468,650	13,250	25,500	367,000
2016	18.13	360,000	515,000	14,000	28,500	390,000
2017	17.68	385,000	560,000	14,750	32,000	415,000
2018	17.87	423,500	860,000	15,500	35,000	442,000
2019	15.99	466,000	1,160,250	16,250	39,000	470,000
2020	15.68	512,500	1,350,000	17,100	42,950	500,000

Source: 1) General Authority of the Executive Body for Land Improvement Projects – Ministry of Agriculture and Land Reclamation.

2) Bulletin of the Central Bank of Egypt, various issues.

– United Nations, National Accounts Statistics data-base, Statistics Division.  
(<http://unstats.un.org/unsd/snaama/SelectionQuick.asp>)

Table (2) Land preparation costs for agricultural tractors and machinery for wheat and maize during the period (2011–2020)

Year	Land Preparation cost (L.E. / feddan (acre) )		Machinery costs (L.E. / feddan (acre) )	
	Wheat	Maize	Wheat	Maize
2011	198	258	557	417
2012	212	291	580	504
2013	244	328	677	542
2014	273	318	737	559
2015	296	355	895	636
2016	325	420	1,008	673
2017	405	660	1,249	1,203
2018	467	660	1,737	1,203
2019	542	759	1,731	1,418
2020	567	792	1,777	1,490

Source: compiled and calculated from MALR, (2013-2020).

Table (3) Economic indicators of summer wheat and maize crops during the period 2011–2020.

Year	wheat				Maize			
	Price	Total cost	Total revenue	Net return	Price	Total cost	Total revenue	Net return
	(L.E/Ton)	(L.E/feddan (acre))	(L.E/feddan (acre))	(L.E/feddan (acre))	(L.E/Ton)	(L.E/feddan (acre))	(L.E/feddan (acre))	(L.E/feddan (acre))
2011	2347	4069	7953	3884	270.0	4082	6740	2658
2012	2520	4425	8783	4358	303.0	4340	7560	3220
2013	2580	4808	9082	4274	314.0	4735	7773	3038
2014	2740	5271	9318	4047	317.0	4927	7848	2921
2015	2753	5627	9568	3941	322.0	5268	7502	2234
2016	2773	7054	9627	2573	343.0	6638	8267	1629
2017	3760	8991	12815	3824	2900	7952	9736	1784
2018	3760	10631	12772	2141	3400	9063	11248	2185
2019	4407	11326	14912	3586	3264	9877	12780	2903
2020	4420	11643	14889	3246	3552	10889	14299	3410

Source: compiled and calculated from MALR, (2011-2020)



Table ( 4 ): List of Egyptian Local companies produce

No.	company Item	Tanta Motors	Mabrouk Inter.	Raga Egypt	Mitto for trading	Abousamra	Etmeed	EINasr Co.	MM	Diamond	EI -Gaiar	Others (small worksh ops)
	Location	Tanta	Tanta	BaniSueif	Tanta	Damiatta	Asuet	Cairo	Alex	Sadat City	Kena	
1	cheisl plow	√	√	√	√		√				√	√
2	Disc Harrow	√			√							
3	Field Leveler	√	√	√	√						√	√
4	Bidder & Ditcher	√	√		√							√
5	Agri. Trailers	√	√	√	√	√	√			√	√	√
6	Water Tank trailers	√	√	√	√	√	√			√		√
7	Chemical sprayers	√		√	√	√				√		√
8	Chopper Machine	√	√		√							√
9	Front monnted Loader	√	√									√
10	Agri. Backhoe	√										
11	Rice mills											√
12	Corn Griners	√	√		√							√
13	Cattel Feed Mixers		√		√							√
14	Environment Equipment		√				√					
15	Tractor assambly							√	√			
16	Wheat thresher	√	√							√	√	√
17	Paddy Rice Threshers	√	√								√	√
18	Irrigation Pumps Assembly			√								√
19	Compost Turner	√	√		√							