## Study the Effect of the most Important Economic Variables on the Agricultural labor Market in Egypt

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**Abstract:** The results indicate that there is a statistically inverse relationship between the number of labors in the agricultural sector and the productivity of the agricultural labor at real prices, and the real wage of the non-agricultural labor, as it was found that each of them decreased by the unit amount leads to an increase in the demand for agricultural labor by 0.39 million labors, 0.02 million labors. It was also found that there is a statistically significant direct relationship between the number of labors in the agricultural sector and the real agricultural GDP, as it was found that by increasing the value of the real agricultural GDP by one billion pounds, it leads to an increase in the demand for agricultural labor by about 0.06 million labors. The results also showed that there is a statistically positive correlation between the agricultural labor supply and the demand for agricultural labor, and the productivity of the agricultural labor at real prices, as an increase in each of them by a unit leads to an increase in the agricultural labor force by about 1.30 million labors, 0.039 million labors. The results indicate the inefficiency of the human labor component and that the expansion of production depends on the use of agricultural technology, as the average value of the real agricultural labor's wage per year is about 8.98 thousand pounds, the marginal product value of the agricultural labor is 6.29 thousand pounds, and this indicates that the wage that the agricultural labor gets The value of marginal product exceeds it, that is, there is a decrease in the demand for agricultural labor, an intensification of the use of capital, and a substitution of the capital component at the expense of the labor component. It was also found that the variables affecting the agricultural labor market increased continuously during the forecast period, as the agricultural labor supply and the demand for agricultural labor increased from 7.83, 6.75 million labors in 2019 to about 8.28, 6.97 million labors in 2025. As shown by the increase in the agricultural labor's wages. From about 32.93 thousand pounds in 2019 to about 40.59 thousand pounds in 2025, and agricultural GDP and agricultural investments increased from about 424.35, 49.21 billion pounds in 2019 to about 477.40, 56.86 billion pounds in 2025, and an increase in the agricultural unemployment rate from 13.79% in 2019 To 16.68% in 2025.

**Introduction:**

Human resources are considered one of the most important productive factors that cannot be dispensed with in the different productive sectors in general and the agricultural sector in particular. The agricultural labor plays an important role in the agricultural sector, where the labor component is considered one of the most important economic resources as it is not possible to exploit the various production resources optimally unless Availability of the labor component, and then determining the optimal supply combination within the production process to achieve productive and economic efficiency.

The employment sector in agriculture is affected by economic changes, as is the case with all other productive sectors. Whereas, the state's economic policies and changes have affected the farm labor market, both in terms of demand for agricultural labor and the supply of agricultural labor, and it has

been evident that the percentage of workers in the agricultural sector to the total number of the republic has decreased from about 27.15% in 2005 to about 25.9% in 2019. Working in agriculture is increasing in general, as it increased from about 5.24 million workers in 2005 to about 6.75 million workers in 2019, and the state is working to increase agricultural production by expanding the reclamation of new lands, encouraging investment in various agricultural projects, improving worker productivity, creating job opportunities, and working. On the development of human resources to meet the needs of the labor market.

**Research problem:**

Despite the importance of the agricultural sector, it suffers from weak agricultural investments directed to it compared to other economic sectors, as the volume of agricultural investments directed to this sector amounted to about 28.93 billion pounds

during the average period (2016-2019) representing about 5.15% of the total investments in Egypt, which amount to About 517.7 billion pounds on the one hand, The decrease in the demand for agricultural labor, as well as the noticeable decrease in the wages of the agricultural worker compared to other workers in other economic sectors, as the average wage of the agricultural worker was about 29.71 thousand pounds compared to the wage of the non-agricultural worker of about 45.67 thousand pounds, an increase of about 15.96 thousand pounds representing About 53.71% of the agricultural worker's wages during the average period (2016-2019), which resulted in an increase in agricultural unemployment rates, as it increased from about 3.89% in 2005 to about 13.89% in 2019.

**Research objective:**
Based on the research problem, the main objective of the research is to study the effect of the most important economic variables on the agricultural labor market by achieving the following sub-objectives:

1- Study the current situation of agricultural labor in Egypt.

2- Study the development of the most important economic variables affecting the agricultural labor market.

3- Study the impact of the most important economic variables on the agricultural labor market.

4-.Study the effect of technological change on the substitution between capital - labor.

5- Forecasting the most important changes in the agricultural labor market in Egypt.

**Research Method and Data Sources:**
In order to achieve the objectives of the study, the inductive method was relied on in the economic analysis from both descriptive and quantitative terms, as some statistical analysis methods were used, such as simple and multiple linear regression, estimating the variance coefficient, as well as estimating production functions using the Cobb-Douglas model. and forecasting of the most important agricultural labor market variables using the ARIMA model.

The research also relied on secondary data published in government agencies, the Ministry of Agriculture and Land Reclamation, the Central Agency for Public Mobilization and Statistics, and closely related research and studies were used. The value data of the variables have been modified with the general index number (2004/2005 = 100) to eliminate the effect of price inflation.

**First: A study of the current situation of agricultural labor in Egypt:**
By extrapolating the data of Table (1), as well as the statistical analysis in Table (2) of the development of the current situation of agricultural labor in Egypt during the period (2005-2019), as the following became clear:

**1- Agricultural labor force:**
The general average of the agricultural labor force in Egypt was about 7 million workers, and the minimum reached about 5.45 million workers in 2005, a decrease of about 22.10% from the general average for the study period, and the upper limit reached about 7.83 million workers in 2019, with an increase of Its rate is about 11.88%, compared to the general average. The estimation of the general time trend equation showed an increase in the value of the agricultural labor force by an annual statistically significant amount of about 0.12 million workers.

**2- Number of labor in agriculture:**
The general average number of labor in agriculture in Egypt was about 6.27 million labor, and the minimum reached about 5.24 million labor in 2005, a decrease of about 16.41% from the general average for the study period, and the upper limit reached about 6.88 million labor in 2009, with an increase of Its rate is about 9.75% of the general average. The estimation of the general time trend equation showed an increase in the number of labor in agriculture by an annual statistically significant amount of about 0.07 million labors.

**3- Wage of the agricultural labor:**
The general average of the wage value of the agricultural labor in Egypt was about 8.98 thousand pounds, and the minimum amount reached about 5.52 thousand pounds in 2008, with a decrease of about 38.45% from the general average for the study period, and the upper limit reached about 12.83 thousand pounds in 2015, with an increase Its percentage was about 42.93%, compared to the general average. The estimation of the general time trend equation showed an increase in the agricultural labor's wages by an annual statistically significant amount of about 0.28 thousand pounds.

**4- Productivity of the agricultural labor:**
The general average productivity of the agricultural labor in Egypt was about 16.45 thousand pounds, and the minimum reached about 12.13 thousand pounds in 2008, a decrease of about 26.28% from the general average for the study period, and the upper limit reached about 24.52 thousand pounds in 2018, with an increase of Its rate is about 49% of the general average. The estimation of the general time trend equation showed an increase in the productivity of the agricultural worker by an annual statistically significant amount of about 0.69 billion pounds.

**5- Rate of agricultural unemployment:**
The general average of the agricultural unemployment rate in Egypt was about 10.15%, and the minimum reached about 3.88% in 2006, with a decrease of about 61.78% from the general average

for the study period, and the upper limit reached about 14.08% in 2018, with an increase of about 38.82 % Of the overall average. The estimation of the general time trend equation showed an increase in the agricultural unemployment rate by a statistically significant annual rate of about 0.68%.

**Table (1):** The evolution of agricultural labor demand and supply agricultural labor wages, agricultural labor productivity, and agricultural unemployment rate at real prices in Egypt during the period (2005-2019).

| Years | Agricultural labor force | number labor in agriculture | wage of agricultural labor | Productivity of the agricultural labor | rate Agricultural unemployment |
|---|---|---|---|---|---|
| | Million labors | (Million labors) | (thousand pounds) | (thousand pounds) | (%) |
| 2005 | 5.45 | 5.24 | 7.75 | 12.83 | 3.89 |
| 2006 | 5.55 | 5.33 | 7.72 | 12.96 | 3.88 |
| 2007 | 5.74 | 5.43 | 6.15 | 14.27 | 5.32 |
| 2008 | 6.68 | 5.97 | 5.52 | 12.13 | 10.66 |
| 2009 | 7.6 | 6.88 | 7.97 | 13.36 | 9.45 |
| 2010 | 7.46 | 6.73 | 8.75 | 14.4 | 9.74 |
| 2011 | 7.45 | 6.82 | 7.61 | 14.64 | 8.43 |
| 2012 | 7.32 | 6.39 | 9.34 | 15.14 | 12.75 |
| 2013 | 7.47 | 6.65 | 10.68 | 15.63 | 10.94 |
| 2014 | 7.52 | 6.69 | 10.53 | 17.15 | 11.07 |
| 2015 | 7.56 | 6.57 | 12.83 | 20.79 | 13.13 |
| 2016 | 7.4 | 6.48 | 12.49 | 22.1 | 12.47 |
| 2017 | 7.44 | 6.5 | 9.65 | 20.38 | 12.59 |
| 2018 | 6.52 | 5.6 | 8.99 | 24.52 | 14.08 |
| 2019 | 7.83 | 6.75 | 8.65 | 16.52 | 13.79 |
| Average | 7 | 6.27 | 8.98 | 16.45 | 10.15 |
| standard deviation | 0.81 | 0.59 | 2.05 | 3.78 | 3.41 |
| Coefficient of variation | 11.56 | 9.37 | 22.89 | 22.97 | 33.63 |

**Source**:1- The data collected and calculated from the Ministry of Agriculture and Land Reclamation, Central Administration of Agricultural Economy, agricultural economy bulletin, various issues for the period (2005-2019).

2-The Central Agency for Public Mobilization and Statistics, the International Information Network, and the Internet.

**Table (2):** The statistical parameters of the variables related to agricultural labor at real prices in Egypt during the period (2005-2019).

| Variables | Average | minimum | maximum | Coefficient (a) | Coefficient (b) | value (t) calculated | R2 | value (F) calculated | Rate of change (%) |
|---|---|---|---|---|---|---|---|---|---|
| Agricultural labor force (Million labor) | 7 | 5.45 | 7.83 | 6.03 | 0.12 | (3.25)** | 0.44 | 10.56 | 1.71 |
| number labor in agriculture (Million labor) | 6.27 | 5.24 | 6.88 | 5.74 | 0.07 | (2.08)* | 0.25 | *4.34 | 1.12 |
| wage of the agricultural labor (thousand pounds) | 8.98 | 5.52 | 12.83 | 6.68 | 0.28 | (2.89)** | 0.39 | **8.37 | 3.12 |
| Productivity of the agricultural labor (Thousand pounds) | 16.45 | 12.13 | 24.52 | 10.9 | 0.69 | (5.20)** | 0.67 | **26.99 | 4.19 |
| Rate Agricultural unemployment (%) (%) | 10.15 | 3.88 | 14.08 | 4.71 | 0.68 | (7.08)** | 0.79 | **50.23 | 6.7 |

**Source**: calculated from table (1) at search.

**Second: The development of the most important economic variables that affect agricultural labor in Egypt:**

By extrapolating the data of Table (3), as well as the statistical analysis thereof in Table (4), which shows the development of the most important economic variables affecting the agricultural labor

market in Egypt during the period (2005-2019), as the following became evident: -

**1- Crop Area:**

The general average of crop Area in Egypt was about 15.52 million feddans, and the minimum reached about 14.91 million feddans in 2005, a decrease of about 3.96% from the general average for the study period, and the upper limit reached about 16.10 million feddans in 2019, with an increase of about 3.71% of the general average. The estimation of the general time trend equation showed an increase in the crop area by an annual statistically significant amount of about 0.08 million feddans.

**2- The value of agricultural production requirements:**

The general average of the value of agricultural production requirements in Egypt was about 38.36 billion pounds, and the minimum amounted to about 29.61 billion pounds in 2006, a decrease of about 22.83% from the general average for the study period, and the upper limit reached about 48.47 billion pounds in 2016, with an increase Its percentage was about 26.35%, compared to the general average. The estimation of the general time trend equation showed an increase in the value of agricultural production inputs by an annual statistically significant amount of about 1.31 billion pounds.

**3- The value real agricultural GDP:**

The results showed an increase in the value real agricultural GDP in Egypt during the study period, and the general average of the value of the real agricultural GDP in Egypt was about 103.42 billion pounds, and the minimum amount reached about 67.24 billion pounds in 2005, a decrease of about 34.98% from the general average. The highest is about 143.19 billion pounds in 2016, an increase of about 38.45% over the general average. The estimation of the general time trend equation showed an increase in the value real agricultural GDP by an annual statistically significant amount of about 5.18 billion pounds.

**4- The value of agricultural consumption:**

The general average of the value of agricultural consumption in Egypt was about 90.86 billion pounds, and the minimum reached about 61.52 billion pounds in 2005, with a decrease of about 32.29% from the general average for the study period, and the upper limit reached about 122.83 billion pounds in 2015, with an increase of Its rate is about 35.20% from the general average. The

estimation of the general time trend equation showed an increase in the value of agricultural consumption by a statistically significant annual amount of about 3.49 billion pounds.

**5- wage of the non-agricultural labor:**

The general average wage for a non-agricultural labor in Egypt was about 13.75 thousand pounds, and the minimum wage was about 8.73 thousand pounds in 2005, with a decrease of about 36.46% from the general average for the study period, and the upper limit was about 19.93 thousand pounds in 2015, with an increase Its rate is about 44.99%, compared to the general average. The estimation of the general time trend equation showed an increase in the non-agricultural labor's wages by an annual statistically significant amount of about 0.57 thousand pounds.

**6- Net agricultural income:**

The general average of net agricultural income in Egypt was about 90.33 billion pounds, and the minimum amounted to about 59.67 billion pounds in 2005, a decrease of about 33.95% from the general average for the study period, and the upper limit reached about 109.71 billion pounds in 2015, with an increase of Its rate is about 21.45%, compared to the general average. The estimation of the general time trend equation also revealed an increase in net agricultural income by a statistically significant annual amount of 1.48 billion pounds.

**7- Agricultural investments:**

The general average of the value of agricultural investments in Egypt was about 6.35 billion pounds, and the minimum amounted to about 2.75 billion pounds in 2012, a decrease of about 56.69% from the general average for the study period, and the upper limit reached about 13.34 billion pounds in 2018, with an increase of Its rate is about 110% of the general average. The estimation of the general time trend equation showed an increase in the value of agricultural investments by a statistically significant annual amount of about 0.36 billion pounds.

**8- Agricultural loans:**

The general average of the value of agricultural loans in Egypt was about 8.41 billion pounds, and the minimum amounted to about 4.53 billion pounds in 2019, a decrease of about 46.13% from the general average for the study period, and the upper limit reached about 13.83 billion pounds in 2005, with an increase of Its rate is about 64.48%, compared to the general average. The estimation of the general time trend equation showed that the value of agricultural loans decreased by a statistically significant annual rate of about 0.55 billion pounds.

**Table (3):** The evolution of the value of agricultural production requirements, the value real agricultural GDP and the value of agricultural consumption, net agricultural income, agricultural investments, loans, value of exports agricultural, at real prices in Egypt during the period (2005-2019).

| Years | Crop area | value agricultural production requirements | value real agricultural GDP | value of agricultural consumption | wage of the non-agricultural labor | Net agricultural income | Agricultural investments | Agricultural loans | value of agricultural exports |
|---|---|---|---|---|---|---|---|---|---|
| | (Million acres) | (Billion pounds) | (Billion pounds) | (Billion pounds) | (thousand pounds) | (Billion pounds) | (Billion pounds) | (Billion pounds) | (Million pounds) |
| 2005 | 14.91 | 30.44 | 67.24 | 61.52 | 8.73 | 59.67 | 6.63 | 13.83 | 6.04 |
| 2006 | 14.92 | 29.61 | 69.06 | 64.28 | 9.54 | 86.49 | 6.79 | 12.89 | 5.28 |
| 2007 | 15.18 | 30.73 | 77.48 | 68.02 | 9.29 | 90.16 | 6.04 | 12.51 | 6.76 |
| 2008 | 15.24 | 31.31 | 72.41 | 67.65 | 10.06 | 87.58 | 5.17 | 10.57 | 7.6 |
| 2009 | 15.5 | 34.86 | 91.9 | 81.68 | 12.2 | 93.69 | 4.66 | 7.92 | 16.61 |
| 2010 | 15.33 | 35.3 | 96.91 | 84.88 | 12.4 | 83.14 | 4.06 | 6.54 | 9.95 |
| 2011 | 15.35 | 36.91 | 99.82 | 87.46 | 13.06 | 79.11 | 3.59 | 7.78 | 15.95 |
| 2012 | 15.57 | 39.25 | 96.71 | 98 | 15.39 | 92.06 | 2.75 | 7.68 | 12.94 |
| 2013 | 15.49 | 38.95 | 103.94 | 106.89 | 16.86 | 94.55 | 4.15 | 6.75 | 16.62 |
| 2014 | 15.69 | 38.82 | 114.72 | 108.22 | 17.77 | 96.82 | 5.52 | 7.63 | 14.96 |
| 2015 | 15.64 | 46.41 | 136.57 | 122.83 | 19.93 | 109.71 | 6.58 | 9.09 | 16.48 |
| 2016 | 15.8 | 48.47 | 143.19 | 120.19 | 19.25 | 100.99 | 7.31 | 7.92 | 20.18 |
| 2017 | 16.04 | 47.34 | 132.49 | 102.93 | 14.34 | 109.44 | 5.76 | 5.11 | 29.56 |
| 2018 | 16.06 | 48.41 | 137.33 | 97.92 | 13.69 | 89.69 | 13.34 | 5.36 | 25 |
| 2019 | 16.1 | 38.63 | 111.49 | 90.38 | 13.67 | 81.88 | 12.93 | 4.53 | 19.5 |
| Average | 15.52 | 38.36 | 103.42 | 90.86 | 13.75 | 90.33 | 6.35 | 8.41 | 14.89 |
| standard deviation | 0.38 | 6.66 | 25.67 | 19.73 | 3.57 | 12.37 | 3.04 | 2.86 | 7.04 |
| Coefficient of variation | 2.44 | 17.36 | 24.82 | 21.71 | 25.97 | 13.69 | 47.87 | 34.07 | 47.28 |

**Source**:1- The data collected and calculated from the Ministry of Agriculture and Land Reclamation, Central Administration of Agricultural Economy, agricultural economy bulletin, various issues for the period (2005-2019). 2-The Central Agency for Public Mobilization and Statistics, the International Information Network, and the Internet.

**9- The value of agricultural exports:**

The general average value of agricultural exports in Egypt was about 14.89 billion pounds, and the minimum was about 5.28 billion pounds in 2006, with a decrease of about 64.58% from the general average for the study period, and the upper limit reached about 29.56 billion pounds in 2017, with an increase of Its rate is about 98.47%, compared to the general average. The estimation of the general time trend equation showed an increase in the value of agricultural exports by an annual statistically significant amount of about 1.38 billion pounds.

**Third: The results of the statistical assessment of the most important factors affecting the agricultural labor market in Egypt: -**

To determine the most important economic variables affecting the agricultural labor market, the research followed the Stepwise regression method, which depends on the following steps:

- Making a matrix of partial correlation between the most important economic variables as a dependent variable and each of the independent variables that are believed to influence this dependent factor in order to isolate the explanatory variables that have a strong correlation between them.

- Conducting simple regression in different forms (linear, semi-logarithmic, double logarithmic) between the dependent variable and the independent variables that were tested in the previous step, each separately in order to determine the variables that have a significant effect on the dependent variable by using the value of the R Square and the calculated T values .

- Conducting a relationship between the dependent variable and the independent variables that were tested in the second step, using the method of multiple and multi-stage regression in a different way.

- Determine the best functions that express the relationship between the dependent variable and the most important variables explaining it, which are consistent with economic and statistical logic, by using economic theory, the value of R Square and the value of F of the estimated model.

**Table (4):** Statistical parameters of development the value of agricultural production requirements, value real agricultural GDP and the value of agricultural consumption, net agricultural income, agricultural investments, loans, value of exports agricultural, at real prices in Egypt during the period (2005-2019).

| Variables | Average | Minimum | Maximum | Coefficient (a) | Coefficient (b) | value (t) calculated | R2 | value (F) calculated | Rate of change (%) |
|---|---|---|---|---|---|---|---|---|---|
| Crop area (Million acres) | 16.1 | 14.91 | 16.1 | 14.86 | 0.08 | (14.11)** | 0.94 | **198.98 | 0.52 |
| value agricultural production requirements (billion pounds) | 38.36 | 29.61 | 48.47 | 27.92 | 1.31 | (6.57)** | 0.77 | **43.18 | 3.41 |
| the value real agricultural GDP (Billion pounds) | 103.42 | 67.24 | 143.19 | 61.95 | 5.18 | (7.58)** | 0.81 | **57.42 | 5.01 |
| value of agricultural consumption (billion pounds) | 90.86 | 61.52 | 122.83 | 62.91 | 3.49 | (4.68)** | 0.63 | **21.89 | 3.84 |
| wage of the non-farm labor (Thousand pounds) | 13.75 | 8.73 | 17.77 | 9.19 | 0.57 | (3.66)** | 0.5 | *13.38 | 4.15 |
| Net agricultural income (Billion pounds) | 90.33 | 59.67 | 109.71 | 78.45 | 1.48 | (2.29)* | 0.29 | *5.26 | 1.64 |
| Agricultural investments (Billion pounds) | 6.35 | 2.75 | 13.34 | 1.45 | 0.36 | (2.22)* | 0.28 | *4.93 | 5.67 |
| Agricultural loans (Billion pounds) | 8.41 | 4.53 | 13.83 | 12.78 | 0.55- | (5.93-)** | 0.73 | **35.17 | 6.54- |
| value of agricultural exports ( million pound) | 14.89 | 5.28 | 29.56 | 3.83 | 1.38 | (6.61)** | 0.77 | **43.70 | 9.27 |

**Source**:Calculated from Table (3) by research.

**1- The value real agricultural GDP:**

The value of the value real agricultural GDP is affected by a set of factors, including the number of labor in the agricultural sector, crop area, agricultural consumption, agricultural investment, productivity of the agricultural labor, the wage of the agricultural labor, the rate of agricultural unemployment, the wage of the non-agricultural labor, the size of agricultural loans at real prices. The most appropriate economic variables in terms of economic, statistical and analogies, using the staged regression method, show that the linear image is the best statistical picture, and that the most important factors that affect the value real agricultural GDP ($\hat{Y}t$) are crop area ($X_2$), agricultural consumption ($X_3$), and productivity of agricultural factor ($X_5$). The significance of this relationship was statistically proven at the level of 0.01.

It is estimated that there is a statistically significant direct relationship between the value real agricultural GDP and the crop area, where the value real agricultural GDP increases by about 14.30 billion pounds for each increase in the crop area by one million feddans, and the equation also indicates a statistically significant direct relationship between the value real agricultural GDP and the real value of agricultural consumption,Where the increase in the real value of agricultural consumption by one billion pounds leads to an increase in the value real agricultural GDP by about 0.52 billion pounds, and the equation also indicates a statistically direct positive relationship between the value real agricultural GDP and the productivity of the agricultural factor, where the value real agricultural GDP. Agricultural productivity of EGP 3.17 billion

for each increase in the productivity of the agricultural labor by one thousand pounds. The value of R Square indicates that about 98% of the changes in the real value of agricultural GDP are due to these three variables, and the rest of the changes are due to other factors not measured by the function.

$$\hat{Y}t =217.75+ 14.30X_2+ 0.52\ X_3+3.17\ X_5$$
$$(3.11)** \ (2.88)** \ (5.64)** \ (5.91)**$$
$$F = 170.50** \qquad R^2 = 0.98$$

**2- The real value of agricultural investments:**

The real value of agricultural investments is affected by a set of factors, including the number of labors in the agricultural sector, the value real agricultural GDP, agricultural exports, agricultural investment in the previous year, the wage of the agricultural labor, the productivity of the agricultural labor, the value of agricultural loans, the value of agricultural savings at current and real prices, and the most appropriate economic variables have been selected from Economic, statistical and measurement aspects.

It is estimated that there is a statistically significant positive relationship between the real value of agricultural investments and the real value of agricultural investment in the previous year, as the real value of agricultural investments increases by about 0.83 billion pounds for each increase in the real value of agricultural investment in the previous year by one billion pounds, as the equation indicates To the existence of a statistically significant direct relationship between the real value of agricultural investments and the productivity of the agricultural labor at real prices, where the increase in the productivity of the agricultural labor at real prices by

one thousand pounds leads to an increase in the real value of agricultural investments by about 0.37 thousand pounds. The change in these variables explains about 71% of the changes in the real value of the aforementioned agricultural investments.

$$\hat{Y}t = 4.69 + 0.83X_{4t\text{-}1} + 0.37 X_7$$
  (2.05)* (4.29) ** (3.01)**
**F = 15.13**          $R^2 = 0.71$**

### 3- Number of labor in the agricultural sector (agricultural labor demand):

The demand for agricultural labor is affected by a set of factors, including the value of agricultural investments, the wage of the agricultural labor, the productivity of the agricultural labor, the value real agricultural GDP, the wage of the non-agricultural worker, the crop area at current and real prices. The most appropriate economic variables have been selected in terms of economics, statistics and standards.

It is estimated that there is a statistically inverse relationship between the the number of labors in the agricultural sector and the productivity of the agricultural labor at real prices, as it was found that the productivity of the agricultural labor decreased by one thousand pounds, leading to an increase in the demand for agricultural labor by 0.39 million labors annually due to the increase in the skill, experience and efficiency of the agricultural labor.The equation also indicates the existence of a statistically significant direct relationship between the number of labors in the agricultural sector and the value real agricultural GDP, as it was found that an increase in the value of the real agricultural GDP by one billion pounds leads to an increase in the demand for agricultural labor by about 0.06 million labors. The change in these variables is explained by about 96% of the changes in the demand for agricultural labor mentioned above. The equation also indicates that there is a statistically inverse relationship between the number of labors in the agricultural sector and the wages of the non-agricultural labor at real prices, as an increase in the wage of a non-agricultural labor by one thousand pounds leads to a decrease in the demand for agricultural labor by 0.02 million labors.

$$\hat{Y}t = 6.08 - 0.39X_3 + 0.06 X_4 - 0.02 X_5$$
**(36.53)** ( -13.26) ** (11.63)** ( -2.12)*
**F = 98.89**          $R^2 = 0.96$**

### 4- Agricultural labor force (agricultural labor supply):

The agricultural labor supply is affected by a set of factors including the demand for agricultural labor, the wage of the agricultural labor, the productivity of the agricultural labor, the wage of the non-agricultural labor, the crop area, the rate of agricultural unemployment, the net agricultural income at current and real prices, and time. The most appropriate economic variables have been selected in terms of economics, statistics and measurement.

It is estimated that there is a statistically direct significant relationship between the supply of agricultural labor and the demand for agricultural labor, as the increase in agricultural labors by about one million labors leads to an increase in the agricultural labor force by about 1.30 million labors annually, and the equation also indicates a positive relationship Statistically significant between the agricultural labor force and the productivity of the agricultural labor at real prices, as the increase in the productivity of the agricultural labor by one thousand pounds leads to an increase in the supply of agricultural labor by about 0.039 million labors. The change in these variables explains about 97% of the changes in the aforementioned agricultural labor supply. $\hat{Y}t = 1.28 + 1.30X_1 + 0.039 X_4$
       (4.39)** (20.34) ** (4.01)**
     **F = 229.89**          $R^2 = 0.97$**

### 5- Wage of the agricultural labor:

The agricultural labor supply is affected by a set of factors, including the value real agricultural GDP, the productivity of the agricultural labor, the real wage of the agricultural labor, the volume of agricultural investments, the rate of agricultural unemployment, the demand for agricultural labor, the supply of agricultural labor at current and real prices. The most appropriate economic variables have been selected in terms of economics, statistics and standards.

It is estimated that there is a statistically positive correlation between the real wage of the agricultural labor, the value real agricultural GDP, and the demand for agricultural labor. Whereas, by increasing the value real agricultural GDP by about one billion pounds, this leads to an increase in the average real wage of the agricultural labor by about 0.26 thousand pounds annually. It was also found that by increasing the demand for agricultural labor, the average real wage of an agricultural labor would increase by about 0.035 thousand pounds annually. The change in these variables explains about 69% of the changes in the wages of the aforementioned agricultural labor.

$$\hat{Y}t = 2.13 + 0.26X_1 + 0.035 X_3$$
**(2.67)** (3.96) **(1.99)*
**F = 28.78**          $R^2 = 0.69$**

**Fourth: The impact of technological change on the substitution between capital - labor**

To find out the effect of technological change on the demand for agricultural labors, the efficiency of the labor component has been studied through the deviation of the value of the marginal product of the labor component from the wage of the labor, the

marginal productivity of the capital component, and the estimation of the substitution elasticity between capital and labor, by using the following model:

Cobb-Douglas Production Function

LnY = B0 + B1 ln k + B2 ln L

To estimate the effect of technological change on substitutions between capital - work by using production functions given the value of the marginal product of the two components of agricultural labor, capital, as well as estimating the productive elasticities of them, and then knowing the return on capacity in agricultural production according to Cobb-Douglas production functions, and always the substitution elasticity In the Cobb-Douglas production function between money and labor costs equal to the correct one, which means that there is a constant substitution between capital and labor to reach a certain production level. The research reached the following results:

It was found from the Cob-Douglas production function in Table (5) that the value of the model F was about 44.4, meaning that the function was statistically proven at a level of 0.01, and that the value of the coefficient of determination amounted to about 0.88 and indicates that about 88% of the changes in the value of agricultural production are explained by The two components of capital and labor and that 12% of the changes are due to other factors not assessed by the function. It has been found that an increase in the capital component by one pound leads to an increase in the value of agricultural production by about 1.89 pounds, and the productivity elasticity of the capital component is about 0.54, meaning that the increase in the use of

capital Money by 1% increases the value of production by 0.54% while all other factors remain constant at a certain level.

It was also found that an increase in the labor component by one labors leads to an increase in the value of agricultural production by about 6.29 pounds, and the productive elasticity of the labor component reached about 0.29, meaning that an increase in the use of the labor component by 1% leads to an increase in the value of production by 0.29% with the rest of the other factors remaining at a certain level. . It was found that the total elasticity amounted to about 0.83, which means that there is a decrease in the return on capacity in Egyptian agriculture, meaning that the rate of increase in the value of agricultural production is at a rate less than the rate of increase in production elements, and the marginal rate of technological substitution was about 0.30 and the substitution elasticity substitution between capital / labor towards 0.99.

The results indicate the inefficiency of the human labor component and that the expansion of production depends on the use of agricultural technology, as the average value of the real agricultural labor's wage per year is about 8.98 thousand pounds, the marginal product value of the agricultural labor is 6.29 thousand pounds, and this indicates that the wage that the agricultural labor gets The value of marginal product exceeds it, that is, there is a lack of demand for agricultural labor, an intensification of the use of capital, and a substitution of the capital component at the expense of the labor component.

**Table (5):** Results of the estimation of the two functions of Cobb - Douglas, Solo of the effect of capital substitution in the agricultural sector in Egypt during the period (2005-2019)

| Model | Production function | $R^2$ | F | marginal product of capital | Marginal product of labor | Elasticity of capital | Elasticity of work | Total Elasticity |
|---|---|---|---|---|---|---|---|---|
| Cobb-Douglas | $\ln\hat{Y} = 2.43 + 0.535 \ln K + 0.291 \ln L$<br>(9.2) ** (7.2) **  (2.2) * | 0.88 | 44.4 | 1.9 | 6.29 | 0.535 | 0.291 | 0.826 |

**Whereas:**

$\hat{Y}$ = the value of agricultural production (million pounds).

L = Number of labors in agriculture (one million labors).

K = the capital in the form of the value of the agricultural production requirements (million pounds).

$Mp_k = B_1 (\hat{Y} / \bar{K})$

$Mp_l = B_1 (\hat{Y} / \bar{L})$

$\varepsilon_K = \partial \ln Y / \partial \ln K = B1$

$\varepsilon_L = \partial \ln Y / \partial \ln L = B2$

$\varepsilon_g = \varepsilon_K + \varepsilon_L = B1 + B2$

$MRTS = Mp_k / Mp_L$

$\sigma = (\varepsilon_K / \varepsilon_L) \frac{MRTS}{} = (\bar{L} / \acute{a} \bar{K})$

- Numbers in parentheses and below the regression coefficients indicate the calculated (t) values.

- (*), (**) denotes the significance of the regression coefficient at the level of (0.05), (0.01)

**Source:** compiled and calculated

**Fifth: forecasting the most important changes in the agricultural labor market in Egypt-:**

-This part aims to predict the most important variables of the agricultural labor market in Egypt during the period (2021-2025) by using the Box - Jenkins "ARIMA" model. Autoregressive Integrated Moving Average (ARIMA) where the original data were signed in a graph to see the path of the time series of the data and the extent of the existence of stability in the data in terms of mean and variance or not.

-The Autocorrelation (AC), Partial Autocorrelation (PAC) plotting was performed for certain periods of slowdown of the graphic signature of each of the AC 'PACs and through the Ljung- Box Statistic for all correlation coefficients or partial testing (for each correlation factor separately) which are limits Accept the null hypothesis of the insignificance of the sum of the squares of the correlation coefficients.

-The autocorrelation coefficients (AC) and the partial self-correlation coefficients (PAC) were examined using Correlation and through (PAC) the degree of autoregressivity (AR) can be determined, while through the coefficients of (AC), the degree of the moving average (MA) can be determined.

It was found from Table (6) that the ARIMA (0, 1, 1) model is the most suitable for predicting the strength of agricultural labor, the number of agricultural workers, agricultural investments, and the rate of agricultural unemployment, while the

model (1.1, 0) ARIMA is the appropriate model. To forecast agricultural labor wages and Gross Domestic Production agricultural.

It was also found that the variables affecting the agricultural labor market increased continuously during the forecast period, with an average estimated of about 8.03, 6.82 million labors for the agricultural labor force, and the number of labors, respectively, as indicated by the increase in the agricultural labor supply (labor force), and the demand for agricultural work (the number of employed) From 7.72, 6.66 million workers in 2019 to 8.28, 6.97 million labors in 2025, an increase estimated at 5.75% and 3.26%, respectively.

It was also found that the wage of the agricultural labor increased at an average of about 37.97 thousand pounds, and increased from 32.93 thousand pounds in 2019 to 40.59 thousand pounds in 2025, the increase rate was estimated at 23.26%, and the average Gross Domestic Production agricultural and agricultural investments amounted to about 477.40, 56.86 billion pounds each during The forecast period, where Gross Domestic Production agricultural and agricultural investments increased from about 424.35 and 49.21 billion pounds in 2019 to about 477.40, 56.86 billion pounds in 2025, with an increase of about 19.97% and 23.31% for each of them, respectively, as it was also found that the rate of agricultural unemployment It increases during the forecast period with an average of about 15.77% and increased from 13.79% in 2019 to 16.68% in 2025.

**Table (6):** The results of forecasting the most important variables of the agricultural labor market in Egypt during the period (2021-2025).

| Years | agricultural labor supply (Million labor) MA(0,1.1) | agricultural labor demand (Million labor) MA(0,1.1) | wage of the agricultural labor (Thousand pounds) AR(1,1.0) | real value of agricultural GDP (Billion pounds) AR(1,1.0) | agricultural investments (Billion pounds) MA(0,1.1) | Agricultural unemployment ( % ) MA(0,1.1) |
|---|---|---|---|---|---|---|
| 2021 | 7.72 | 6.66 | 35.18 | 445.77 | 53.04 | 14.86 |
| 2022 | 7.93 | 6.74 | 36.74 | 461.53 | 54.95 | 15.31 |
| 2023 | 8.05 | 6.82 | 38.02 | 477.38 | 56.86 | 15.77 |
| 2024 | 8.17 | 6.89 | 39.31 | 493.24 | 58.77 | 16.22 |
| 2025 | 8.28 | 6.97 | 40.59 | 509.09 | 60.68 | 16.68 |
| Average | 8.03 | 6.82 | 37.97 | 477.4 | 56.86 | 15.77 |
| *2019 | 7.83 | 6.75 | 32.93 | 424.35 | 49.21 | 13.79 |
| Change from 2019 (%) | 5.75 | 3.26 | 23.26 | 19.97 | 23.31 | 20.96 |

* These variables were forecasting at current prices.
**Source**:1- The data collected and calculated from the Ministry of Agriculture and Land Reclamation, Central Administration of Agricultural Economy, agricultural economy bulletin, various issues for the period (2005-2019).
2-The Central Agency for Public Mobilization and Statistics, the International Information Network, and the Internet.
**This data was calculated using the ARIMA model using Minitab.

**Recommendations:**

1- Paying attention to vocational and professional training for labors in the agricultural sector to raise their productive efficiency, and the marginal product value of the agricultural labor is greater than or equal to the wage he receives, and thus the demand for agricultural labor increases.

2- Encouraging investment in agricultural projects to increase the wages of the agricultural labor and improve his standard of living.

3- Using intensive technological methods in using agricultural labor to increase the number of labors, and then overcome the problem of agricultural unemployment.

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