Trends and Decomposition Growth Analysis of the Most Important Cereal Crops in Egypt

El-Rasoul, Ahmed Abou El-Yazid and Shehab, Sameh M. Hassan and Maghraby, Heba El-Sayed

Department of Economics and Agribusiness, Faculty of Agriculture, Alexandria University, Egypt, Department of Economics and Agribusiness, Faculty of Agriculture, Alexandria University, Egypt, Agricultural Economics Research Institute, Al-Beheira Research Unit, Egypt

April 2020

Trends and Decomposition Growth Analysis of the Most Important Cereal Crops in Egypt

Ahmed Abou El-Yazid El-Rasoul[1] Sameh Mohamed Hassan Shehab[1]
Heba El-Sayed Maghraby Shalaby[2]
1 Department of Economics and Agribusiness, Faculty of Agriculture, Alexandria University, Egypt.
2 Agricultural Economics Research Institute, Al-Beheira Research Unit, Egypt.

Abstract: *This research aims to analyze the growth performance of the most important cereal crops of Egypt agriculture (wheat, rice, and maize) and the sources of the production growth of these crops during the period 1975-2017. This analysis is to implement appropriate policies that would enhance the production increase of these crops using component analysis. Based on the results of the Chow Breakpoint test, the study was divided into three periods: 1975-1986, 1987-2000 and 2001-2017, in addition to the full period 1975-2017.The results showed that the growth of wheat, rice and maize production during the study periods depends on changes in yield more than changes in area. So, the study emphasizes that the vertical expansion has a greater impact than the horizontal expansion. This is reflecting the effect of scientific research and development (R&D) on increasing cereal crops in Egypt.*

Key Words: *Compound growth rate, Decomposition analysis of growth, Effect of area and yield, Cereal crops trends in Egypt.*

Date of Submission: 20-03-2020 Date of Acceptance: 07-04-2020

I. Introduction

The agricultural growth has become a matter of concern to academics and policymaker's alike, as increasing total agricultural production with high rates of growth is one of the main objectives of development plans.This is a necessity to ensure the supply of basic food needs for the population, and to provide the industrial sector with many raw materials. Economic growth is considered to be one of the most significant factors that reflect the development of the agricultural sector's performance, and it is one of the main goals of economic and social policies. Economic growth could be an indicator of economic welfare, and it is linked to a set of attributes that are considered be suitable for its development.

The strategy of developing the agricultural sector in Egypt relied on two main axes. The first is horizontal expansion, which means increasing the area of agricultural lands by reclaiming more new lands. The second axis is the vertical agricultural expansion by raising the yield of the available agricultural resources by applying the latest technological methods that help in increasing the yield of many strategic and nutritional crops.

The trend towards measuring yield growth and analyzing the sources of growth in agricultural production is of great importance and a focus of attention for researchers and policy makers, as they are more accurate indicators for expressing economic performance, as they express outputs and inputs, and growth can also be divided into various components, including area, yield, price, and crop composition, Etc., also, it can provide an analysis of agricultural production behaviors in the past and an estimate of its growth rates as a basis for future projections of agricultural production. The importance of studying yield stems from the importance of economic growth as a central goal of economic policies, whereby yield is considered in its partial and total aspects as the most important source of economic growth, so yield gains special importance because the improvement of it represents one of the most important challenges facing the course of economic development at the level of macroeconomics and microeconomics in the Arab region (Babiker, 2007).

II. Research Problem

Despite the technological development witnessed by Egyptian agriculture, there is still a large gap that still exists in the yield of most agricultural crops, between what is achieved by the pilot and experimental fields and what is done through actual production at the agricultural and agricultural levels, and its counterparts in the countries of the world producing them with the exception of some crops. This means that there are great possibilities to raise the yield of many crops, but it is necessary to ensure a wider application of agricultural technology and modern methods in agriculture and the development of farmers' capacities through training with a view to absorbing advanced and modern technology and technologies.

III. Research Objectives

The research aims to analyze and identify trends and sources of growth in the production of the most important cereal crops in Egypt (wheat, rice, and maize) during the period 1975-2017, in order to implement appropriate policies that would enhance the growth of production of these crops.

IV. Data

The research based on time series data from 1975 to 2017 for the area, yield, production, prices and production value of wheat, rice and summer maize crops, which are the most important cereal crops in Egypt in terms of cultivated area or nutritional value or their importance in agricultural foreign trade, and these data were collected from the Agricultural Statistics Bulletin issued by the Ministry of Agriculture and Land Reclamation, Economic Affairs Sector. The study period was divided into three periods, namely 1975-1986, 1987-2000, 2001-2017, based on the results of the Chow Breakpoint test to determine the point of refraction of the time series and consequently the possibility of dividing it into periods based on the significance of both the calculated F ratio and the maximum probability ratio. Log LR It was found that both were significant at the probability level 0.01 as shown in Table No. 1, as the real values of price variables and the value of the result were estimated using the wholesale price index (2005 = 100).

Table (1): Chow Breakpoint test

Chow Breakpoint Test: Year 1986			
F-statistic	3.607	Probability	**
Log likelihood ratio	35.785	Probability	**
Chow Breakpoint Test: Year 2000			
F-statistic	2.976	Probability	**
Log likelihood ratio	24.444	Probability	**

The relative importance of crops under study:

Table No (2) shows the relative importance of the area of cereal crops under study, which amounted to about 40.45%, 23.89%, and 35.56% for each of wheat, rice, and maize, respectively. It was also found that the ratio of the three crop areas to the total crop area amounted to 37.50%, 39.24%, 42.01% and 39.49 during the periods 1975-1986, 1987-2000 and 2001-2017.

Table (2): The area of wheat, rice and maize crops during the period 1975-2017

Average for period	Total Area of the three crops (million Feddan)	Ratio of Wheat area (%)	Ratio of Rice area (%)	Ratio of Maize area (%)	Ratio of three crops area from total crop area (%)
1986-1975	4.187	31.352	24.173	44.475	37.495
2000-1987	5.064	41.353	24.560	34.088	39.236
2017-2001	6.371	46.365	23.140	30.495	42.014
2017-1975	**5.336**	**40.543**	**23.891**	**35.566**	**39.848**

Source: Compiled and calculated from: Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Agricultural Statistics Bulletin, Various Issues, Cairo.

V. Literature Review

A systematic scheme of growth trend analysis was introduced for the first time by both Minhas and Vaidyanathan (1965), which equaled or equaled changes in aggregate agricultural output by changes in four factors: area, yield, crop composition and overlap between the last two factors. Then Vidya (1977) later expanded component analysis into a methodology consisting of seven factors, by analyzing growth in agricultural production at the prevailing prices into three components: area, yield, price, and their interactions or interactions: (area-price, area-yield, yield- Price, area, yield, price. Dharm (1977) modified the Minhas and Vaidyanathan scheme by explicitly introducing the site component to explain the impact of yield on agricultural growth. In the economic literature, the previously mentioned methods are referred to as Additive Scheme models because they analyze the absolute growth in the value of the product, in addition to the addition models that were previously presented explicitly contain residual components called interfering or reaction components. An alternative approach is the Multiplicative Scheme, which analyzes the relative growth of production to the growth rates of the components.

It can be said that there are three general models for explaining the economic growth of countries (Al-Badawi, 2012):

- The most common model that relies on the traditional production function and is based on what Solow (1965) says: Here the output is a function of capital and work (inputs), and therefore an increase in output requires an increase in inputs (i.e. labor and capital elements or either of them), and is The only way to increase a higher level of output is by using the same amount of elements, in other words, it allows increasing the yield of the production elements.
- The model that relies on institutions as the determining factor for economic growth, which depends on what North (1990) and Landes (1998) came up with: This model is based on the consideration that the yield of any of the previous elements will be affected by the surrounding institutional climate, but the debate It has not been decided about the relative importance of the channels through which institutions influence economic growth. The model differentiates between formal and informal institutions (which are also called culture or social capital) and sometimes the influence of informal institutions is more important than the impact of formal institutions.
- The model that depends on geographical factors as the determining factor for economic growth (2003) Sachs: This model is based on considering that the factors of geography and location are the determining factor for economic growth, focusing mainly on three geographical factors: climate, the presence of a port on a shipping course, and the distance from global business capitals.

Several studies have addressed the subject of agricultural growth rate and analysis of its components and crop yield, including:

The paper presented by Kakarlapudi (2007) tried to understand the methodological changes and developments in the decomposition of agricultural growth, and the research has shown that the main factor that led to the decline in the rate of agricultural growth in India is the slowdown in the rate of expansion in the cultivated area and that the pattern of cultivation and growth varies according to natural conditions.

Shadmehri (2008) study aimed to analyze the growth trends of agricultural production in Iran, especially food grains; analyze the growth of main crop production, and the compound growth rates for area, production and yield have been estimated by synthesizing the time trend equation using data for the period 70 / 1971-1999 / 2000. It was found that the agricultural sector performed slightly better during the period 1970-1978 compared to the period 1979-2000, and that the rate of crop production growth per hectare of food grains was higher during the first period than the average during the second period, and that the main source of agricultural production growth during the period 1970 -2000 was the growth of the yield per hectare and the expansion in the irrigated areas.

FAO study prepared by Lerman and Sedik (2009) in the Central Asian region, a case study (Tajikistan, Uzbekistan) to identify agricultural production, yield growth and changes in the agricultural structure in Central Asia The Solo Model was used to evaluate sources of growth and analyze growth in production through growth of the resource base or what is known as comprehensive growth, growth in yield or what is known as intensive growth.

Pattnaik and Shah (2015) study focused on analyzing the main factors contributing to the high performance of growth that included price, region, crop pattern, and yield, and the results show that most crops that experienced a significant increase in price showed a change in yield and region.

The aim of Sharma, Parihar and Kapadia (2017) study was to identify trends in onion production growth in Rajasthan, India using a component analysis model. The study data period was divided into three periods: 1984-1995, 1996-2005 and 2006-2015. Analysis of the growth components indicates that the effect of onion yield is the main source of growth in the period 1984-1995 and 1996-2005 except for the period 2006-2015 in which the impact of the area was the main source in Rajasthan. Nationally, the growth of onion yield was the effect of yield. The results of analyzing growth components have important policy implications because each growth component alone has a limited scope for expanding overtime. The potential for land growth (the impact of area) is limited by the scarcity of water resources in Rajasthan. As such, efforts should be directed towards increasing crop yield. Future government policy should focus on developing new high-yielding varieties with drought-resistant varieties in Rajasthan.

Verma, Gulati and Hussain (2017) study aimed to analyze the sources of agricultural growth in Uttar Pradesh, India during the period 2000/2001-2013/2014 by analyzing the value of agricultural production and related activities. The research on sources and engines of agricultural growth in the state indicated that it has the ability to double its agricultural growth from 2.5% to 5% annually, and that this can be achieved if the state government focuses on establishing a strong purchasing system for wheat and rice while ensuring the minimum price to support farmers; encouraging the dairy sector by raising levels of milk processing; rationalizing sugarcane pricing; and introducing innovative agricultural practices and techniques in the cultivation of fruits and vegetables. These policies can be supported by infrastructure investments in rural roads, energy supply to rural areas, and improved irrigation methods.

VI. Methodology

The absolute and relative changes in the area, yield, and production were estimated with the study periods, and some statistical measures were used, such as the correlation coefficient estimate, the compound growth rate (CGR) to analyze and compare the trend of crop growth under study between different periods, and estimate the significance of the compound growth rate by t test)). To study the effect of area and yield and their interaction effect on the overall change in the production of wheat, rice and maize crops, a Decomposition Analysis Form was used, which was used by a number of researchers in previous studies, including:

Vidya (1977 and 1980) & Chaudhry, et al. (1996) & Kakarlapudi (2007) & Lerman and Sedik (2009) & Rehman and Salam. (2011) & Dupare, et al. (2014) & Pattnaik and Shah (2015) & Verma, Gulati and Hussain (2017) & Sharma, Parihar and Kapadia (2017).

$$\Delta P = A_o \Delta Y + Y_o \Delta A + \Delta A \Delta Y$$

From the previous equation, it is observed that the total change in production is attributed to the change in both area and yield, which can be analyzed into three effects: the area effect and the effect of Yield effect and the interaction or interaction between them (Interaction effect) between them due to the change in yield and area. The effect of area means increasing production in the absence of any changes in yield, and the effect of yield appear in the effect of yield changes on production in the absence of changes in area, and the third element depicts the effect of changes in both area and yield on production.

VII. Results and discussion

First: **Analysis of absolute and relative changes in the area, yield and price of the study crops:**

1- Analysis of changes in wheat crop:

The data presented in Tables (3) and (4) show that there is a noticeable increase in the average cultivated area, yield, production, farm price and production value of wheat crop during the study periods, and the average area during the whole period was about 2.224 million Feddan during the whole period, while the average yield is about 2.215 tons, and the average farm price is about 944.455 LE/ton. In addition the absolute and relative changes in area, yield, and farm price are positive, and the maximum absolute change and relative change were achieved during the third period (2017-2001), and there is a positive and strong relationship between the cultivated area and the amount of production.

2- Analysis of changes in rice crop:

The data presented in Tables (3) and (4) show that there is a noticeable increase in the average cultivated area, yield, production, farm price and production value of the rice crop during the study periods compared to the first period 1975-1986, and the average area during the period 1995-1995 was about 1.269 million Feddan, while the average yield was about 2.808 tons, and the average farm price was about 848.785 LE/ton, as absolute and relative changes in area, yield, and farm price were positive, and the maximum absolute change and relative change in the cultivated area and farm price were achieved during the third period 2017- 2001, the second period 1987-2000 recorded the maximum absolute and relative change in yield, as there is a strong positive relationship statistically significant between the cultivated area and the amount of production during the period 2017-1995.

3- Analysis of changes in maize crop:

The data presented in Tables (3) and (4) show that there is a noticeable increase in the average cultivated area, yield, production, farm price and production value of maize during the study periods compared to the first period 1975-1986, excluding the average cultivated area for the second period 1987-2006. Slight compared to the first period 1975-1986, and the average area during the period 1995-1995 was about 1.843 million Feddan, while the average yield was about 2.701 tons, and the average farm price was about 827,570 LE/ton, as it was found that the absolute and relative changes in area, yield and farm price Positive, has The maximum absolute change and relative change were achieved during the third period, and there is a statistically significant positive relationship between both the cultivated area and the quantity of production during the period 1995-2017.

Table (3): Annual average area, yield, production and farm price for wheat, rice and maize crops during the period 1975-2017

Crops	1986-1975	2000-1987	2017-2001	2017-1975
Wheat:				
Average area (million Feddan)	1.373	2.111	2.961	2.224
Average yield (ton/Feddan)	1.447	2.255	2.723	2.215
Average production (million ton)	1.895	4.823	8.070	5.290
Average current farm gate price (LE/ton)	97.561	528.248	1885.020	944.455
Average current production value (LE/ton)	184.883	2719.257	5922.473	7231.866
Correlation between area and production	0.565*	0.956**	0.959**	0.990**

Rice:				
Average area (million Feddan)	1.061	1.252	1.465	1.269
Average yield (ton/Feddan)	2.344	3.130	2.871	2.808
Average production (million ton)	2.366	3.971	4.164	3.599
Average current farm gate price (LE/ton)	108.668	521.459	1640.782	848.785
Average current production value (LE/ton)	257.389	2243.963	6806.749	3493.463
Correlation between area and production	0.348^{ns}	0.895^{**}	0.362^{ns}	0.835^{**}
Maize:				
Average area (million Feddan)	1.863	1.801	1.945	1.843
Average yield (ton/Feddan)	1.709	2.745	3.365	2.701
Average production (million ton)	3.182	4.655	6.528	4.985
Average current farm gate price (LE/ton)	116.389	472.173	1622.259	827.570
Average current production value (LE/ton)	379.452	2257.036	10929.011	5161.514
Correlation between area and production	0.657^{*}	0.006^{ns}	0.956^{**}	0.435^{**}

ns not significant * significant at 0.05 ** significant at 0.01

Source: Compiled and calculated from: Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Agricultural Statistics Bulletin, Various Issues, Cairo.

Table (4): The absolute and relative change in the area, yield and farm price of wheat, rice and maize crops during the period 1975-2017

Crops	1986-1975	2000-1987	2017-2001	2017-1975
Wheat:				
Absolute change in area (million Feddan)	0.003	0.741	1.591	0.854
Relative change in area (%)	0.23	54.08	116.10	62.35
Absolute change in yield (million Feddan)	0.077	0.885	1.353	0.845
Relative change in yield (%)	5.63	64.60	98.79	61.66
Absolute change in price (million Feddan)	50.63	481.31	1838.09	897.52
Relative change in price (%)	107.87	1025.53	3916.38	1912.33
Rice:				
Absolute change in area (million Feddan)	0.008	0.20	0.41	0.216
Relative change in area (%)	0.77	18.90	39.13	20.50
Absolute change in yield (million Feddan)	0.212	0.998	0.739	0.68
Relative change in yield (%)	9.93	46.82	34.65	31.71
Absolute change in price (million Feddan)	72.67	485.46	1604.78	812.78
Relative change in price (%)	201.85	1348.50	4457.73	2257.74
Maize:				
Absolute change in area (million Feddan)	0.108	0.046	0.190	0.088
Relative change in area (%)	6.16	2.63	10.82	5.00
Absolute change in yield (million Feddan)	0.204	1.241	1.860	1.196
Relative change in yield (%)	13.54	82.43	123.62	79.49
Absolute change in price (million Feddan)	65.60	421.38	1571.47	776.78
Relative change in price (%)	129.17	829.72	3094.26	1529.50

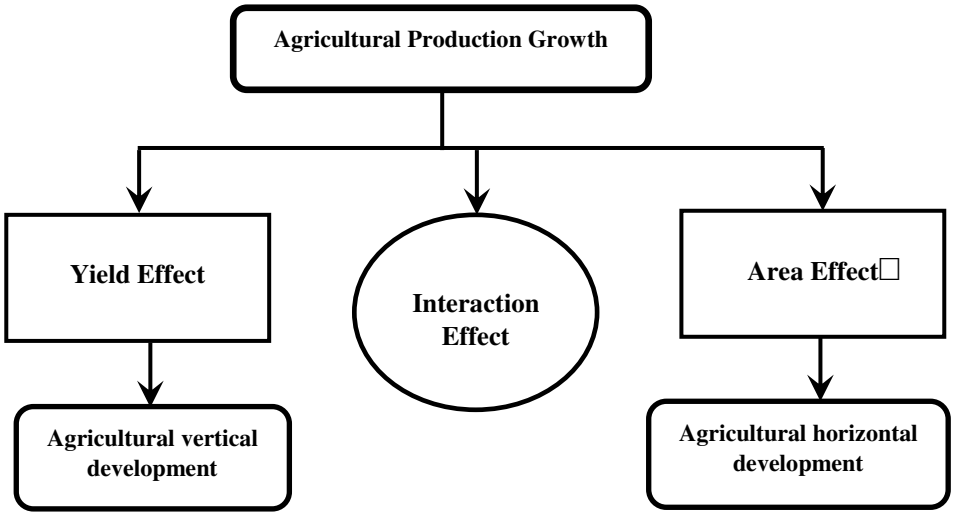
Source: Compiled and calculated from: Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Agricultural Statistics Bulletin, Various Issues, Cairo.

Second: **Analysis of the sources of cereal crop production:**

The increase of cereal crops production can be attributed to (1) the expansion of the area at the same level of yield, (2) the increase in yield while maintaining the area, (3) interaction effect representing the increase in yield with Expansion of land. (Bahloul, 2006). Figure no. (1).

Despite the importance of vertical development in increasing yield of cultivated area, it has serious negative effects represented in increasing unemployment. Therefore, the global trend in light of the United Nations development goals is an attempt to balance the positive and negative effects to ensure the preservation of resources in the long term, which is known Sustainable development, which means getting the highest possible return on resources in the short term while preserving it for future generations (Keishk, 1999).

Figure (1): Agricultural Development Paths



Source: Prepared by the researchers.

1- Analysis of the growth sources of wheat crop:

The data in tables (5), (6) and figures (2), (3) and (4) show that the changes in wheat production during the period 1975-1986 can be divided into about 3.39% due to area changes, at an annual decrease rate of it reached about 1.20%, and about 95.85% due to yield changes with an annual growth rate of it reached about 1.22%, while the interaction effect of them contributes about 0.22%. This indicates that the effect of vertical expansion has a greater impact than horizontal expansion, reflecting the impact of scientific research and development R&D on increasing the growth of wheat crop production.

While it was found that the growth rate of wheat production reached about 6.85% during the period 1987-2000, and that changes in the growth of wheat production can be divided into about 35.21% sourced from area changes, with a growth rate of about 4.50%, and about 42.05% due to yield changes With a growth rate of about 2.25%, while their interaction effect contributes about 22.74%, which indicates that the impact of vertical expansion has a greater impact than horizontal expansion, reflecting the impact of scientific research and development R&D on increasing the growth of wheat crop production.

The results also showed that the growth rate of wheat production reached about 2.26% during the period 2001-2017, and that changes in the growth of wheat production can be divided into about 35.23% sourced from area changes, with an annual growth rate of about 2.00%, and about 29.97% due to changes Yield, while their interaction effect contributes 34.80%. This indicates that the impact of horizontal expansion has a greater impact than vertical expansion, reflecting increased employment opportunities for agricultural workers.

The results also indicate that the growth rate of wheat production reached about 4.82% during the period 1995-2017, and that changes in the growth of wheat production can be divided into about 38.38% due to area changes, with an annual growth rate of about 2.74%, and about 37.95% due to yield changes With an average annual growth rate of 2.02%, while their interaction effect contributes about 23.67%. This indicates that the ratio between the effect of vertical expansion and horizontal expansion on the growth of wheat crop production.

2- Analysis of the growth sources of rice crop:

The data provided in tables (5), (6) and figures (2), (3) and (4) show that changes in rice production during the period 1975-1986 can be divided into about 7.10% sourced from area changes, at an annual rate of decrease of About 0.83%, and about 92.19% due to yield changes with an annual growth rate of about 0.83%, while the interaction effect of them contributes about 0.71%. This indicates that the impact of vertical expansion has a greater impact than horizontal expansion, reflecting the impact of scientific research and development R&D on increasing the growth of rice crop production.

While it was found that the growth rate of rice production reached about 6.28% during the period 1987-2000, and that changes in the growth of rice production can be divided into about 25.34% due to area changes, with a growth rate of about 4.36%, and about 62.79% due to changes Yield with a growth rate of about 1.84%, while their interaction effect contributes about 11.87%. This indicates that the impact of vertical expansion has a greater impact than horizontal expansion, reflecting the impact of scientific research and development R&D on increasing the growth of rice crop production.

The results also showed that the changes in the growth rate of rice production during the period 2017-2001 can be divided into about 44.81% due to changes in the area, and about 39.67% due to yield changes,

while the interaction effect of them contributes by 15.52%. This indicates that the effect of horizontal expansion has a greater impact than vertical expansion.

The results also indicate that the growth rate of rice production growth reached about 1.84% during the period 1975-2017, and that the changes in the growth of rice production can be divided into about 34.91% sourced from area changes, with an annual growth rate of about 1.20%, and about 54.02% due to yield changes at a rate Annual growth of about 0.64%, while the interaction effect of them contributes by 11.08%. This indicates that the impact of vertical expansion has a greater impact than horizontal expansion, reflecting the impact of scientific research and development R&D on increasing the growth of rice crop production.

3- Analysis of growth sources of maize crop:

The data provided in tables (5), (6) and figures (2), (3) and (4) show that the rate of growth of maize yield reached about 1.75% during the period 1986-1975, and that changes in the growth of wheat production could It is divided into about 30.01%, due to area changes, and about 65.93% due to yield changes with a growth rate of about 2.17%, while the interaction effect of them contributes to about 4.07%. This indicates that the effect of vertical expansion has a greater impact than horizontal expansion, reflecting the impact of scientific research and development R&D on increasing the growth of maize production.

While it was found that the rate of growth of maize yield reached about 3.40% during the period 1987-2000, and that the changes in the growth of maize production could be divided into about 3.01% sourced from area changes, and about 94.51% due to yield changes with a growth rate of about 3.58 %, While their interaction effect contributes to 2.48%. This indicates that the effect of vertical expansion has a greater impact than horizontal expansion, reflecting the impact of scientific research and development R&D on increasing the growth of maize production.

Table (5): Area growth rate, yield, production, farm price and production value of cereal crops in Egypt during the period 1975-2017 (%)

Items	1986-1975	2000-1987	2017-2001	2017-1975
Wheat:				
Area growth rate	-1.20*	4.50**	2.00**	2.74**
Yield growth rate	1.22**	2.25**	0.25ns	2.02**
Production growth rate	0.021ns	6.85**	2.26**	4.82**
Price growth rate	13.07**	7.80**	10.99**	10.61**
Production value growth rate	13.09**	15.18**	13.50**	15.94**
Rice:				
Area growth rate	-0.83*	4.36**	0.91ns	1.20**
Yield growth rate	0.83*	1.84*	0.78ns	0.64**
Production growth rate	-0.005ns	6.28**	-0.13ns	1.84**
Price growth rate	16.76**	9.10**	9.37**	10.02**
Production value growth rate	16.76**	15.96**	9.23**	12.05**
Maize:				
Area growth rate	-0.42ns	-0.17ns	2.07**	0.29*
Yield growth rate	2.17**	3.58**	-0.49**	2.18**
Production growth rate	1.75*	3.40**	1.57**	2.48**
Price growth rate	14.59**	5.58**	10.01**	9.54**
Production value growth rate	16.60**	9.17**	11.73**	12.26**

ns not significant * significant at 0.05 ** significant at 0.01

Source: Compiled and calculated from: Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Agricultural Statistics Bulletin, Various Issues, Cairo.

The results also showed that the rate of growth of maize production amounted to 1.57% during the period 2017-2001, and that changes in the growth rate of maize production can be divided into about 7.32% sourced from area changes, with an annual growth rate of about 2.07%, and about 83.63% due to changes Yield, with an annual decline rate of about 0.49%, while their interaction effect contributes about 9.05%. This indicates that the effect of vertical expansion has a greater impact than horizontal expansion, reflecting the impact of scientific research and development R&D on increasing the growth of maize production.

The results also indicate that the growth rate of maize production reached about 2.48% during the period 1995-1995, and that the changes in the growth of maize production can be divided into about 5.65% sourced from area changes, with an annual growth rate of about 0.29%, and about 89.86% due to changes Yield with an annual growth rate of 2.18%, while their interaction effect contributes about 4.49%. This indicates that

the effect of vertical expansion has a greater impact than horizontal expansion, reflecting the impact of scientific research and development R&D on increasing the growth of maize production.

Table (6): Results of the analysis of the growth sources of cereal crops in Egypt during the period 1975-2017

Effect	1986-1975	2000-1987	2017-2001	2017-1975
Wheat:				
• Area Effect	3.93	35.21	35.23	38.38
• Yield Effect	95.85	42.05	29.97	37.95
• Interaction Effect	0.22	22.74	34.80	23.67
Total	100.00	100.00	100.00	100.00
Rice:				
• Area Effect	7.10	25.34	44.81	34.91
• Yield Effect	92.19	62.79	39.67	54.02
• Interaction Effect	0.71	11.87	15.52	11.08
Total	100.00	100.00	100.00	100.00
Maize:				
• Area Effect	30.01	3.01	7.32	5.65
• Yield Effect	65.93	94.51	83.63	89.86
• Interaction Effect	4.07	2.48	9.05	4.49
Total	100.00	100.00	100.00	100.00

Source: Compiled and calculated from: Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Agricultural Statistics Bulletin, Various Issues, Cairo.

Figure (2): The effect of changes in the cultivated area on the growth of cereal crops production in Egypt during the period 1975-2017

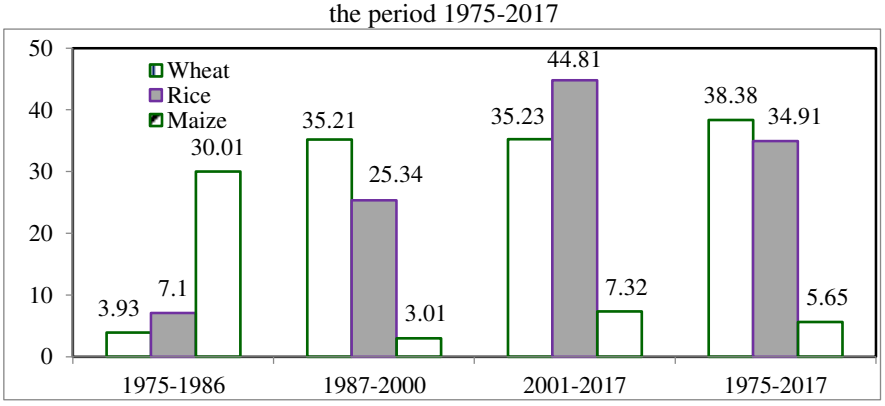


Figure (3): The effect of changes in the yield on the growth of cereal crops production in Egypt during the period 1975-2017

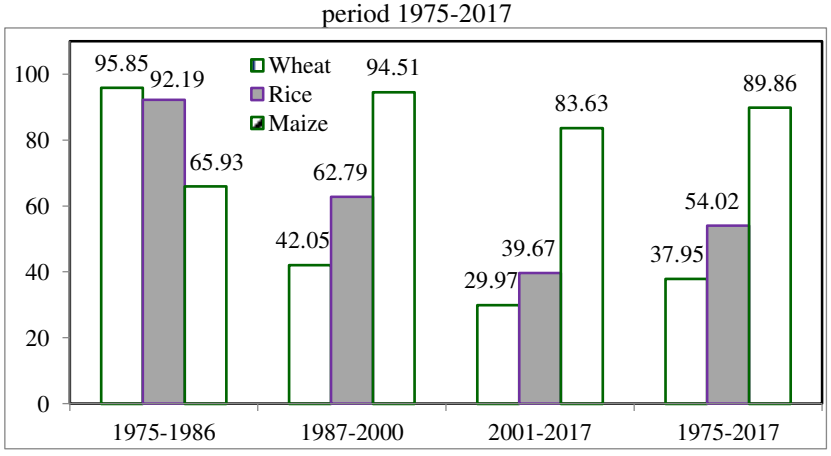
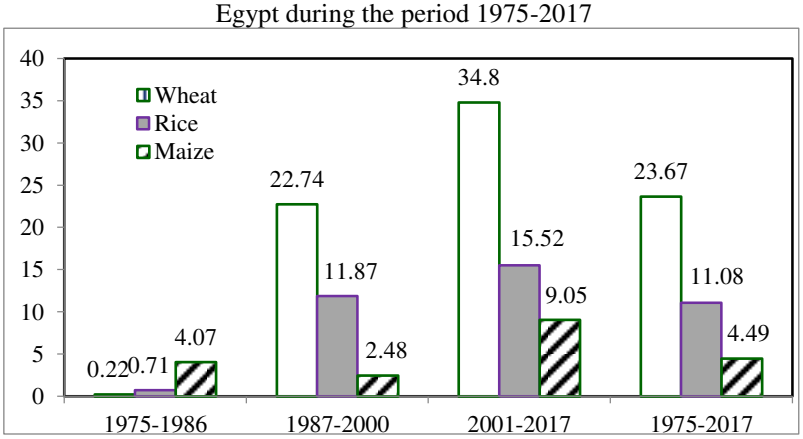


Figure (4): The interaction effect of changes in the production area on the growth of cereal crops production in Egypt during the period 1975-2017



References

[1]. Al-Badawi, Osama Mohamed (2012). "Institutional Reform as an Economic Approach, Concepts of the Scientific Basis of Knowledge", International Center for Future and Strategic Studies, No. (96), Eighth Year, Cairo, December. (In Arabic).

[2]. Babiker, Mustafa (2007). "Productivity and Measurement", Arab Planning Institute in Kuwait, Development Bridge Series, No. (61), sixth year, Kuwait, March. (In Arabic).

[3]. Bahloul, Ahmed Qadri Mukhtar (2006). "The Egyptian Wheat Policy", The Egyptian Journal of Agricultural Economics, Vol. (16), First Issue, Cairo, March. (In Arabic).

[4]. Chaudhry, M. Ghaffar, Ghulam M. C. and Muhammad A. Qasim (1996). "Growth of Output and Yield in Pakistan's Agriculture: Trends, Sources, and Policy Implications", The Pakistan Development Review,35: 4 Part II, pp. 527-536.

[5]. Dharm, Narain (1977). "Growth of Yield in Indian Agriculture", Indian Journal of Agricultural Economics, Vol. 32, No.2, January-March, pp. 20-32.

[6]. Dupare, B. U., Billore, S. D. Sharma, A. N. and Joshi, O. P. (2014). "Contribution of Area, Yield and their Interaction Towards Changing Oilseeds and Soybean Production Scenario in India", Legume Res., 37 (6), pp. 635-640.

[7]. Kakarlapudi, Kiran K., (2007). "Decomposition Analysis of Agricultural Growth: A Review of Measurement Issues", Centre for Development Studies, Prasanth Nagar, Ulloor, Trivandrum, Kerala, India, 27, March.

[8]. Keishk, Mohamed Atef (1999). "Land and Water in Egypt: A Study on the Use and Management of Resources in the Egyptian Agriculture", Meret for Publishing and Information, Cairo, 2nd edition. (In Arabic).

[9]. Lerman,Zvi and Sedik,David (2009). "Sources of Agricultural Yield Growth in Central Asia: The Case of Tajikistan and Uzbekistan", FAO Regional Office for Europe and Central Asia Policy Studies on Rural Transition No. 2009-5, September.

[10]. Minhas, B. S. and Vaidyanathan, A. (1965). "Growth of Crop Output in India 1951-54 to 1958-61: An analysis by Component Elements", Journal of the Indian Society of Agricultural Statistics, Vol. 17, No. 2, December, pp. 230-252.

[11]. Pattnaik,Itishree and Shah,Amita (2015)."Trends and Decomposition of Agricultural Growth and Crop Output in Gujarat: Recent Evidence",Ind. J. of Agri. Econ, Vol.70, No.2, April-June.

[12]. Rehman, F., I. Saeed and A. Salam. (2011). "Estimating Growth Rates and Decomposition Analysis of Agricultural Production in Pakistan: Pre and Post Sap Analysis", Sarhad J. Agric. 27(1): 125-131.

[13]. Shadmehri, M. T. A., (2008). "Estimating Growth Rates and Decomposition Analysis of Agricultural Production in Iran (1970-2000)", Trends in Agricultural Economics, 1: 14-26.

[14]. Sharma,Hemant, Parihar, T.B. and Kapadia, K.,(2017)."Growth Rates and Decomposition Analysis of Onion Production in Rajasthan State of India", Economic Affairs, Vol. 62, No. 1, March.

[15]. Verma, Smriti, Gulati, Ashok and Hussain, S. (2017). "Doubling Agricultural Growth in Uttar Pradesh: Sources and Drivers of Agricultural Growth and Policy Lessons", Indian Council for Research on International Economic Relations, Working Paper 335, March.

[16]. Vidya, Sagar (1977). "A Component Analysis of Growth of Agricultural Yield in Rajasthan: 1956-61 to 1969-74", Indian Journal of Agricultural Economics, Vol. 3, No. 1, January- March, pp. 108-119.

[17]. Vidya, Sagar (1980). "Decomposition of Growth Trends and Certain Related Issues", Indian Journal of Agricultural Economics, Vol. 35, No.2, April-June, pp. 42-59.

Ahmed Abou El-Yazid El-Rasoul, et al. "Trends and Decomposition Growth Analysis of the Most Important Cereal Crops in Egypt." *IOSR Journal of Mathematics (IOSR-JM)*, 16(4), (2020): pp. 01-09.