An Econometric Estimate of Supply Response of Maize Crop in Nubaria region in Egypt

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Abstract

The expansion of the reclamation of new lands contribute to the increase of agricultural production, especially in the main crops whose low production is causing for increasing the food gap. This research aims to study maize production in Egypt, which was affected by cultivated area of maize crop in Nubaria region, El - Behaira Governorate, Egypt by studying Supply Response using Marc Nerlove model. The results show that: the most important variables affecting area cultivated of maize were farm price, production and production costs for the previous year using real value, leading to the shift of the supply function to the right. This indicates the need to increase farm price to encourage the expansion of maize in the new lands, and determinate appropriate quantities of elements that will contribute to increase of agricultural yield. Variables of competiting crops affecting maize, were production costs of Peanut and production costs of summer tomato. This will increase the cultivated area of maize during the period (2000-2015).

Keywords: **Cultivated area of maize, Marc Nerlove model, supply response, in Nubaria.**

1. Introduction

Maize crop consider one of the most important main cereal crops in Egypt, it occupies the second rank after wheat crop for its importance in the human nutrition (Abd Alaal 2013). Maize is also used in the dry feed industry representing about 70% in the manufacture of bread by 20%–(CAPMAS 2015). Due to rapid increase in population growth and consequently increase in production cost, government intend to increase agricultural area by reclaiming new lands, in order to increase the cultivated area and thus increase production and reduce the quantities imported its used as feeders, which amountes to about 5.9 million tons represent about $ 1.1 million in 2016 (FAO 2016). Nubaria is considered to be one of the reclaimed lands

that contributed to raising of the productivity during the study period to about 17.2 ard/fed in 2015(Ministry of Agriculture 2000-2015), indicating the need to pay attention to expand the cultivated area in the new lands for improving agricultural production and reducing food gap (El-Nakady and Shaheed 2017).

In spite of increasing cultivated area maize in Nubaria region (Boutros & et al, 2012), which represents about 12.7% from cultivated area in new lands in 2015, there are other factors affecting on the area of maize, including fluctuations in production and agricultural prices during the study period and it is still unable to reduce the food gap, irrespective of continuing many agricultural policies (Ghazala & et al, 2013). In addition to the increasing production cost in new lands this will affect the agricultural production and the achievement of self-sufficiency and the trend towards importation (Elsebaei, 2015).

The research aimed at estimating the supply response to cultivated area of Maize and the degree of response of some variables affecting them on the short and long- run and the amount of time required to achieve the full response, which helps to make agricultural policy decisions for some economic variables affecting cultivated area of maize in Nubaria during the period 2000-2015.

2. Source of data and Methodology

2.1. Source of data

The research is based on the published secondary data of the Ministry of Agriculture and Land Reclamation of the Economic Affairs Sector during the period (2000-2015), Central Agency for Public Mobilization and Statistics (CAPMAS) and data of International Network, including the website of Food and Agriculture Organization (F.A.O) and previous studies related to the subject of the study.

2.2. Methodology

The research was based on the method of descriptive and quantitative economic analysis using simple and multiple regression analysis and measurement of the supply response to cultivated area of the maize crop using the **Marc Nerlove** model in Nubaria region during the period (2000-2015), it is one of the most important models for the possibility of introducing many independent variables in the function, where it is assumed that the cultivated area affected by agricultural prices in the previous year and also the area cultivated in the previous year (Nerlove Marc, 1958). The research selected some variables using stepwise regression and detection of measurement problems to identify variables that affect the cultivated area of

maize. The model takes a period of lag one year, which it takes the following formula (Khairi and Ben Isa, 2015):

$\hat{Y^*}_t = \alpha + \beta X_{t-1} + \mu_t$

Where:

Y^*_t = Maize area in the current year (t).

X_{t-1} = Independent variables with one lag period (t-1).

μ_t = Random error.

Because the target area for cultivation in the current year (Y^*_t) is a non-spectral variable and cannot be estimated using this equation, so assume that the actual area (Y_t) is usually less than the target area cultivated (Y^*_t), and called (Partial Adjustment Model) as follow:

$(Y_t - Y_{t-1}) = \lambda (Y^*_t - Y_{t-1})$

$Y_t = \lambda Y^*_t + (1- \lambda) Yt_{-1}$

Supply Response Function will be as follow:

$Y_t = \alpha\lambda + b\lambda X_{t-1} + (1-\lambda) Y_{t-1} + \mu_t$

Where:

Y_t = actually cultivated area in the current year (t)

Y_{t-1}= actually cultivated area in the previous year (t-1)

X_{t-1}= independent variables with one lag period (t-1)

λ = coefficient of Adjustment.

μ_t = random error.

3. Results and Discussion

3.1. Estimation of general trend function in the evolution of some economic variables of maize crop

The study shows that maize production during the period (2000-2015), that it increased from about 175 thousands ardab to about 525 thousands ardab as shown in Table .1 with a significant annual growth rate of about 7.1% in Table 2, due to the increasing of cultivated area in Nubaria region from about 19 thousands fed in 2000 to about 30.6 thousands fed in 2015 with an annual growth rate of statistically about 3.5%, this indicating the role of land reclamation to increase maize production. However, it was found that the relative importance of the maize cultivated area of the new lands was unstable during the study period where it decreased from about 18.3% in 2000 to about 12.7% in 2015 that indicates the presence of factors affecting the

cultivated area from maize, including farm price, production, costs and others. All these factors led to the stability of yield maize with an average of about 12.8 ard/fed during study period with an annual statistically growth rate of significant about 3.5%, This change causes an increase in productivity of maize with about 3.5%., which represented about 19.2% of the cultivated area of maize in the new lands in 2007, then this ratio dropped to 12.7% in 2015, due to excessive use of production elements.It refers to need to increase cultivated area of maize in Nubaria region, thus increasing yield and reducing imports.

Table 1. Development of economic variables of maize during 2000-2015.

Years	Production (1000ard)	cultivated area (1000fed)	Total Reclaim Lands (1000fed)	% maize area to reclaim Lands	Yield ard/fed
2000	175	19.0	104	18.3	9.2
2001	174	20.5	117	17.5	8.5
2002	203	21.5	155	13.9	9.5
2003	249	20.7	129	16.0	12.1
2004	356	27.6	150	18.4	12.9
2005	368	31.1	166	18.7	11.8
2006	342	24.1	126	19.1	14.2
2007	383	29.6	154	19.2	13.0
2008	436	33.1	198	16.7	13.2
2009	429	32.6	241	13.5	13.2
2010	458	34.1	185	18.4	13.4
2011	392	30.6	180	17.0	12.8
2012	402	31.2	223	14.0	12.9
2013	491	33.7	224	15.0	14.6
2014	548	32.2	233	13.9	17.0
2015	525	30.6	241	12.7	17.2
Average	371	28.3	177	-----	12.8

Source: Collected and calculated from, Ministry of Agriculture and Land Reclamation, Economic Affairs Sector during the period (2000-2015).

Table2. Rates of the growth of the economic variables of maize during 2000-2015.

Factor	Equation	%Growth rate	F	R^2	t
Production	$Y=e^{12.2+ 0.071 t}$	7.1	63.5^{***}	0.82	7.9^{***}
cultivated area	$Y=e^{9.9+ 0.035 t}$	3.5	29.6^{***}	0.68	5.4^{***}
yield	$Y=e^{2.2+ 0.035 t}$	3.5	40.8^{***}	0.74	6.3^{***}

Notes: Y: dependent variable t: time from 1 to 16

(***) statistically significant difference at the 0.001.

Source: **Analysis of the results table (1) using SPSS.**

3.2. Measurement of the Supply Response to cultivated area of the maize crop.

3.2.1. Maize crop

The estimation of the supply response functions (Haridy et al 2013), which takes the multiple linear images between cultivated area with maize in current year as a dependent variable and variables affecting it, including production, farm prices and production costs for a previous year, showed that increasing the production of maize

(X_1) lead to increase the cultivated area (Y_t) by about 0.43 thousands fed, the increase in farm price (X_2) leads to an increase in cultivated area by about 0.37 thousands fed under the influence of other variables, and that the increase in production costs (X_3) leads to a decrease of cultivated area by 0.62 thousands fed under the influence of variables. And about 82% of the changes in the cultivated area were due to production, farm price and production costs in real value in previous year, according to (Al-Mokdad and Al-Rifa`ee 2016) in estimating the response to the supply of vegetable crops, the factors affecting cultivated area were farm prices and cultivated area in previous year. According to **(**Tchereni and Tchereni 2013) using Nerlove model that farmers are responsive to crop's own price and non-price incentives in Malawi. This indicated to need to increase farm price to encourage farmers to expand maize cultivation and thus increase the amount produced and reduce its import.

$$Y_t = 2.3 + 0.43X_{1t-1} + 0.37X_{2t-1} - 0.62X_{3t-1}$$

$$(6.3)^{***} \quad (2.8)^{*} \quad (-6.7)^{***}$$

$$R^2 = 0.82 \qquad R^{-2} = 0.79 \qquad F = 27.3^{***}$$

Table 3 shows price elasticity maize crop for its price in short and long run was estimated at about 1, 0.57, so the increase in production of about 1% lead to increase in cultivated area by 1 and 0.57%, and 1% increase in farm price lead to an increase cultivated area by 1.4%, 0.88% in short and long term, and decline in costs of maize production 1% which lead to an increase cultivated area by 3.7%, 6% in the short-run, according to (Mahmood 2010) necessity of working on the efficiency of farm price in determining cultivated areas and neglecting them leads to inaccurate production decisions. While showing in (Shoko et al 2016) the cultivated area of maize was less sensitive to price changes than non-price incentives such as rainfall and technology. So, according to (Ogundari 2016) it is likely that nonprice determinants such as rainfall or weather-related factors may be hindering the translation of price induce policies to stimulate maize supply in Nigeria.

Table3. Price elasticity in the short and long run of the explanatory variables for maize crop during 2000-2015.

Variables	Annual Response Factor(1-B)	Offer response period(1\1-B)	Elasticity short-term E_1	Elasticity Long-term E_2
Production X_1	0.57	1.7	1	0.57
farm price X_2	0.63	1.6	1.4	0.88
production costs X_3	1.62	0.62	(3.7)	(6)

Notes: B: Regression coefficient of variable. (-) decreasing

$E_1 = B*x\backslash y$ $E_2 = E_1*(1-B)$

Source: **Compiled and calculated from the variables of the supply response function.**

3.2.2. Competing crops

The estimation of supply response of cultivated area of maize in current year as a dependent variable and independent variables in previous year of its competing crops (peanut and summer tomatoes):

1. **Peanut crop**: Increasing in the production of peanut (X_1) in the previous year by one ardab lead to a decrease of cultivated area of maize (Y_t) this year by about 0.45 thousands fed under the influence of other variables, while increasing the production costs (X_2) in previous year by one pound lead to an increase cultivated area of maize this year by about 0.55 thousands fed under the influence of other variables, therefore about 79% of the changes in cultivated area of maiz in the present year are due to the production and production costs of peanut in last year.

$$Y_t = 3.6-0.45\ X_{1t-1}+ 0.55\ X_{2t-1}$$
$$(-2.3)^{*} \qquad (5.6)^{***}$$
$$R^2 = 0.79 \qquad R^{-2} = 0.76 \qquad F = 23.2^{***}$$

2. **Summer tomato crop**: It was found that increasing the production costs (X_3) of tomato in previous year by one pound led to increase in cultivated area of maize in the present year by about 0.41 thousand fed under the influence of other variables, so that about 60% of changes in cultivated area of maize in the present year are due to production costs of tomato in last year.

$$Y_t = 3.5+ 0.41\ X_{3t-1}$$
$$(4.4)^{**}$$
$$R^2 = 0.60 \qquad R^{-2} = 0.57 \qquad F = 19.2^{**}$$

Table 4 shows Price elasticity of maize crop for its price to change in variables of the competing crops, that the increase in production of peanut by 1% leads to a decrease in cultivated area of maize this year of about 1.53%, but increased production costs of Peanut and summer tomato by 1%, led to an increasing the cultivated area of maize by about 4.1 and 2.5%, according to (Bawady 2015) that variables of competing crops in new lands effect on cultivated area of vegetable crops. Therefore, it is necessary to take into consideration variables of competing crops in effect on cultivated area of maize when making productive decisions.

Table4. Price elasticity of crop variables competing for maize crop during the period 2000-2015.

Variables	Annual response factor(1-B)	Offer response period(1\1-B)	Elasticity supply response
production of peanut X_1	1.45	0.69	(1.53)
production costs of peanut X_2	0.45	2.2	4.1
production costs of tomato X_3	0.59	1.7	2.5

Notes: B: Regression coefficient of variable (-) decreasing E_1= B*x\y

Source: **Compiled and calculated from the variables of the supply response function.**

4. Conclusion

The study showed that reclaim lands contributed to increasing cultivated area of maize during the study period, it is major crops in Egypt, but there is instability in cultivated area in study area, and decline in yield to about 17.2%, due to excessive use of production elements. And found from estimate Price elasticity that including many variables: farm price, produced quantity and production costs in previous year, also competing crops (peanut and tomato). The study of Supply Response of maize affects these variables, which cause a decrease of cultivated area of maize in Nubaria and thus reduced production and trend to import.

So, research suggests extreme attention to increase farm price to encourage farmers to expand cultivation area of maize and determinate appropriate quantities of elements to increase yield, and it helps for accurate production decisions.

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التقدير القياسى لاستجابة العرض لمحصول الذرة الشامية فى منطقة النوبارية فى مصر

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الملخص

استهدف البحث دراسة استجابة عرض محصول الذرة الشامية فى منطقة النوبارية ف محافظة البحيرة وذلك باستخدام نموذج العرض لنيرلوف للتعرف على المتغيرات التى تؤثر على المساحة المنزرعة منه وكذلك المحاصيل المنافسة له. وقد تبين ان السعر المزرعي والإنتاج وتكاليف الإنتاج للذرة الشامية فى العام السابق هى أهم العوامل المؤثرة على المساحة المنزرعة فى العام الحالى وهذا بالإضافة إلى أن تكاليف الانتاج لكل من محصولى الفول السودانى والطماطم الصيفي (المحاصيل المنافسة) لها تأثير على المساحة المنزرعة من الذرة فى العام الحالى.

ولذلك يقترح البحث ضرورة العمل على زيادة السعر المزرعى لمحصول الذرة الشامية فى منطقة النوبارية باعتبارها من المناطق الجديدة التى تساهم فى زيادة المساحة المنزرعة وذلك لتشجيع الزراع على زيادة المساحة المنزرعة من الذرة الشامية وبالتالى كمية الانتاج لتقليل الاعتماد على الاستيراد.