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POTATO SUPPLY RESPONSE TO CHANGES IN PRICE AND NON-PRICE FACTORS IN IRAQ DURING THE PERIOD (1989-2018)

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Abstract

The potato crop is one of the most important food commodities for the individual as it is widely consumed in most of the world as one of the main sources of carbohydrates and it occupies a distinct consumer position for the Iraqi individual. This study aims at quantifying Iraqi potato production response to changes in non-price and price factors as well as determining long and short-run price elasticity pertaining to potato production in Iraq using econometrics techniques. The basis for this study analysis has been chosen as the yield response function. Conceived this way, Iraqi potato growers are assumed to respond to price changes in some degree by virtue of extending the area and the intensive application of inputs. The model estimated contains production of potato as dependent variable with potato price, price lagged one year, potato production lagged one year, land usage lagged one year, technology, and the siege (dummy variable) as explanatory variables. The time period from 1989 till 2018 has been chosen as a historical time data to be applied by the modified Nerlovian partial adjustment model for estimating the supply response of this crop. Several diagnostic tests had been adopted by the researcher to deal with the ýexpected problems associated with time series data. The size of the adjusted coefficient of determination (adjusted) and the value is highly statistically significant at 1 percent significant level, the F-statistic shows the supply model's goodness of fit. Based on the volume of the adjusted coefficient of determination, the explanatory variables explain 82 percent of the variation in the dependent variable. According to the results, both the long and short-run supply elasticities were found to be inelastic. Also, both non-price and price factors were found through the results to have had the same influence on potato supply. These findings about potato supply response comply with results of other researches regarding other crops conducted in Iraq too. Additionally, the research proved that non-price factors like production lagged one year, technology and land usage have a positive impact on potato production but the siege has a negative impact on potato production in Iraq.

Key words: potato, price factors, non-price factors, Nerlovian, Supply.

Introduction

The economics of Iraq depend massively on agriculture which caters for employment income and food. This is more evident in rural areas of the country. Around 32% of Iraqis are employed within this sector while agriculture contributes to about 21.92% of GDP or Gross Domestic Product (Iraqi central Statistical Organization, 2001), hence, the ample concern directed for attaining growth in this sector, especially with escalating growth of population and rising incomes too. In addition, it is necessary to formulate agricultural policies designed to increase the production because this can meet the escalating demand. Somehow and quite lately, agricultural growth experienced a state of declination. Thus it is important to conceive the decisions of farmers for a better production policy.

Potato is one of the most essential staples grown in Iraq. As part of a family of cereals and grains; more than, 245 dunum are cultivated with potato crop with fields across all agro ecological regions of Iraq. (central Statistical organization, 2018). As for world, potato is regarded as one of few major economical crops of the country, rating fourth next to wheat, barley and rice. The acreage exploited for growing this crop fluctuates up and down from one year to the next. In 2013, a total of 750 ýacres were exploited, producing around, 3144 tons of potato crop, but this figure soon dropped down in 2018

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to, 245 acres while the production size jumped to, 1655 tons (Central Statistical organization, 2018). Out of all Iraqi provinces, Babylon comes first as per the acreage used for growing potato crop (Mahdi, 2010).

Problem Statement

Iraq is one of the developing countries that import potato in gross amounts to cover the local needs of this crop although its global prices are high. It is worth noting that the areas used to grow potato crop had been seeing a lot of changes due to price factors fluctuation (FAO, 2015).

Statistics ýhave been reflecting that the areas of plantation of this product increase in some year's and decrease in others. Another observation is that the siege imposed on Iraq from 1990 till 2003 has led to a downfall in the self-sufficiency of this crop. Most of the discourse on Iraq seemed to put an emphasis on comprehensive economic blockade that the United Nations' Security Council imposed on Iraq in the aftermath of the second Gulf War in 1990. According to New York Times, 6th of December, 1990, almost 90% of goods imported by Iraq had been effectively halted; same thing for 97% of Iraq's exports crippling Iraqi economy and causing severe hardships for Iraqi citizens (Alnasrawi, 2000).

Due to insufficiency and escalating need for this nutritious product, the Iraqi state opted ýfor expanding the local production of potato to increase in the self-sufficiency. This demanded expanding both horizontally through increasing the potato plantation acreage, and vertically too through boosting of productivity via studying a set of price factors and non-price factors that all led to Iraqi farmers feeling reluctant to grow potato, eventually leading to decreasing the acreage of this product.

Many researches emphasized the aspect of supply response to both non-price and price factors being applied for a wide spectrum of crops for periods spanning many years. Quite importantly, increasing the production can be secured through expanding cultivated areas which is a viable option (Molua, 2010). There had been many empirical studies since many years ago dealing with economic rationale of farmers as well as supply response in developing and developed agricultural ýeconomies, for instance; (Kalirajan *et al.,* 2001); (Rao 2003); Leaver (2003); (Muchapondwa 2009); (Madlul *et al.,* 2017) and else. Anyway, the extent and nature to which growers respond to changes in non-price ýand price factors is still a controversial issue. This research comes complete research for the efforts that preceded it on the response to ýdisplay some field crops and vegetable crops in Iraq. Moreover, the hardships facing cotton growers and limiting the production of cotton crop deserve a further research Mahdi (2013), Riaz, Ali *et al.,* 2014; Madlul *et al.,* 2017). However, the research gaps from previous studies are still not clear enough, thus, this study therefore aims to fill ýthese gaps. This research assesses supply response to both non-price and price factors pertaining to the production of potato in Iraq with the help of evolution study and applying econometric techniques, thus offering complete manner that is conducive to the identification of the basic problems that hinder potato cultivation. The significance of this research is that it can support policy makers and analysts as per allotting cultivation areas for potato production in this province the best manner.

The objectives of the study are:

1. To quantify Iraqi potato production response to alterations in price factors.
2. To quantify Iraqi potato production response to alterations in non- price factors.
3. To assess the long and short run price elasticities of potato production in Iraq.

The rest of this research has been divided in 3 sections; the second of them has been allotted for methodology and data while both results and discussion have been detailed in Section 3. The conclusion and relevant recommendations have been detailed in Section 4.

Materials and Methods

This study was conducted in Iraq. The researcher collected data pertaining to the identified variables relying on multiple sources and publications. All data relevant to potato land, yield, potato yield, productivity of potato and potato prices were obtained from Agriculture Statistics of Iraq for the years 1989 to 2018. The study applied the following techniques ranging from simple means to the use of econometric modeling applied for data analysis: the Durbin statistic, augmented dickey fuller test and Fully Modified ordinary least square regression (FMOLS) (Stata).

The Nerlovian Model

The Nerlovian model excels among all other economic models that had been used for estimating supply response of agricultural commodities. It is a very effective and prominent model as assessed by a huge number of researches that adopted this model (Leaver, 2003). The leading and unique effort of Nerlove (1958) in the field of supply response helps researchers in assessing values of long-run and short-run elasticities. It also offers the required flexibility to incorporate non-price shift variables within the model. Reaserchers like Rao (1989), Belete (1995), Leaver (2003), Wasim (2005) and Mythili (2008)

Madloul *et al*., (2017) all employed the partial adjustment lagged model for assessing the behaviour of crops producers since this model suits crop producers too.

Basic supply function, where quantity supply of potato is the function of price of potato and other factors, as follows:

$Y = F(P, Z)$

where:

P = The price

Z = Other factors such as non-price variables and others.

Log linear transformation of equation (1) becomes:

The expected supply Y_t^* is:

$$Log Y_t^* = \alpha + \beta_1 \text{ In } P_t^* + \beta_2 \text{ In } Z_t + ... + \beta_n \text{ In } Z_{nt} + \varepsilon_t$$

where:

t = time period

P_t^* = expected price.

Nerlove introduces the expected price P_t^* into the model, in equation :

$$P_t^* = P_{t-1}^* + \lambda\left(P_{t-1} - P_{t-1}^*\right)$$

where :

P_t^* = expected price in period t.

P_{t-1}^* = expected price in period t-1.

P_{t-1} = real price in period t-1.

The current supply, Y_t

$$Y_t = Y_{t-1} + \delta\left(Y_t^* - Y_{t-1}\right)$$

Use equations (3.2) and (3.3) into equations (3.4) to get the reduced form of Nerlove model of supply response:

$$Y_t = \alpha_0 + \alpha_1 \text{ In } P_{t-1} + \alpha_2 \text{ In } Y_{t-1} + \alpha_3 \text{ In } Y_{t-2} + \varepsilon_t$$

where:

α_0 = Intercept

α_0 ..... α_3 = The coefficient of the factors.

If we include the non-price factors into the model, then the new model becomes short- run model of supply response:

$$Lny_t = \alpha_0 + \alpha_1 LnP_t + \alpha_2 LnP_{t-1} + \alpha_3 LnY_{t-1} + \alpha_4 LnA_{t-1}\ \alpha_5 T + \alpha_6 D$$

where:

Y_t = Production of potato in time (dunum)

P_t = Potato price (dinar/kg)

P_{t-1} = One year lag price of potato (dinar /kg)

Y_{t-1} = Yield of potato with one year lag (ton/ dunum)

A_{t-1} = Area under potato with one year lag (dunum)

D_t = Dummy variable (the siege)

T_t = Technology

ln = Natural log

For the long run price elasticity of the model could be adduced as follows:

$$E = \beta 1 \frac{\overline{P}}{\overline{Y}} = \frac{a_1}{1 - a_2 - a_3} \cdot \frac{\overline{P}}{\overline{Y}}$$

Descriptive Statistics

Potato Production

The figure shows that potato production has been showing a fluctuation trend with an increase in some years and decrease in other. Maximum production was in 1999 reaching 3906 tons due to expanding of land usage soon, however, the level of production declined during 2014 to reach 440 tons, this has been linked to various factors such as reduced productivity, government policies, unstable macroeconomic environment, the wars in Iraq in 1995, 2003, 2014, 2015 that all led to Iraqi farmers feeling reluctant to grow potato, eventually leading to decreasing the acreage of this product and therefore, decrease potato production.

Potato Prices

Fig. 2 shows a rising potato price trend over time. However, the price of potato was almost stagnant at a very low price from 1989-2018. From there onward, the price of potato showed ýan increasing trend. Farmers respond in different ways to increasing and unstable potato prices as well as other non-price factors. The degree of responsiveness to both market and non-market factors

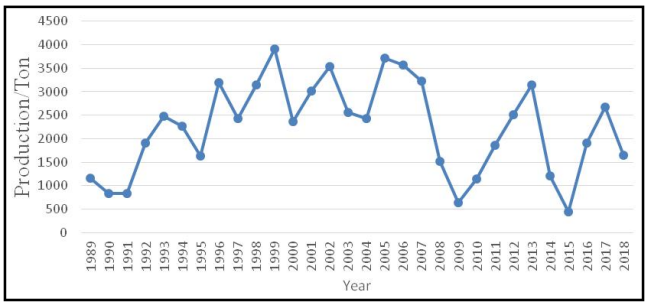

Fig. 1: Iraqi production of potato crop in Iraq (1989-2018). Source: Ministry of Agricultural of Iraq

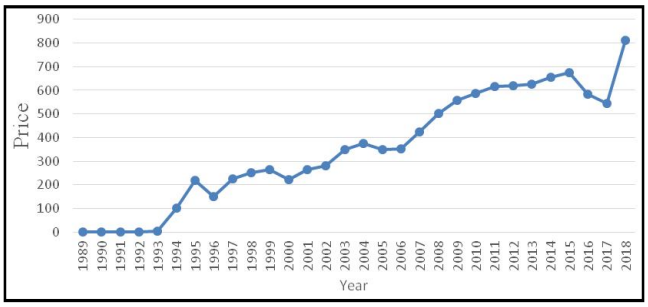

Fig. 2: Iraqi price of potato crop in Iraq (1989-2018). Source: Ministry of Agricultural of Iraq.

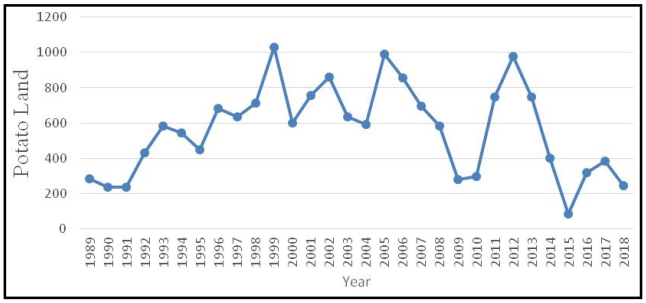

Fig. 3: Potato crop land usage in Iraq (1989-2018). Source: Ministry of Agricultural of Iraq.

requires empirical research in order to substantiate existing theoretical frameworks that have been developed and adopted to explain the dynamics of supply response in agriculture (Madlul *et al.*, 2017). In Iraq, this is the case in that there is the assumption that non-price and price factors influence potato donum response but there is the lack of robust empirical evidence to support the assumption. This study, therefore, aimed to understand how potato farmers respond to prices and non-price factors using empirical evidence.

Potato Land

The Fig. 3 shows that the acreage exploited for growing this ýcrop fluctuates from one year to the next. In 2012, a total of 980 donum were exploited. There was a slight increase during 1989-2018 *i.e.*, about 5.6% due to expanding measures because of technological advances such as the adoption of new varieties, greater application of fertilizers and irrigation. However, this figure soon dropped in 2015 to 82 donum. This has been linked to various factors such as reduced productivity, government policies, unstable macroeconomic environment, the wars in Iraq in 1995, 2003, 2014, 2015 and the pricing policy.

Table 1: The results of the trend equations of the total land, production, productivity, and prices in Iraq during (1986-2018).

growth rate %	F	R^2	T	Equation	Parameters
2.7*	5.06*	0.63	2.25*	v = 52456.5 + 8543.2x	Total Land
5.3**	15.2**	0.72	3.9**	v = 456783.8 + 9894.5 x	Production
1.8**	21.2**	0.75	4.6**	v = 346.2 + 10.7 x	Productivity
22.1*	84.6**	0.83	9.2**	v = 213.5 + 24.6 x	Prices

** Significant at the 1% level *significant at the 5 % level.

Table 2: Regression results for supply response of Potato in Iraq. (Dependent Variable = Log production).

Dependent variable: L productionObservations = 30		
Explanatory variables	**Coefficient**	**t-value**
Constant	27.6	6.59**
LnP_1	0.47	5.36**
LnP_{t-1}	0.39	3.96**
LnA_{t-1}	0.84	4.49**
Lny_{t-1}	0.09	3.86**
D_t	-0.08	-4.28**
T_t	0.08	4.36**
Adjusted R^2 = 0.82 Durbin - Watson = 2.74 F = 76.69		

** Significant at the 1% level. Durbin-h statistic = 1.23

Note: All variables except technology and siege are in logarithmic form.

Table1 presents the results of the trend equations regarding Potato production, land usage, productivity and price of Iraq. In the 1989 to 2018 period, Potato production, land usage, productivity and price, all experienced a positive growth in Iraq. The growth rate of Potato production reaches 5.4%, area contributed 2.7%, productivityý1.8%, price 22.1% of the total output, and it shows that the increase of Potato price is the main contributor to the increase of the total yield for Iraq Potato.

Regression Analysis Potato Supply Response

Results and Discussion

The basis for analyzing supply response in this study has been made as the yield response function. Based on that, potato growers in Iraq had been presumed to respond to price changes in some amount through rigorous application of inputs as well as area extending. The model estimated contains production of Potato as dependent variable with Potato price, price lagged one year, Potato production lagged one year, land usage lagged one year, technology and the siege as explanatory variables.

The size of the adjusted coefficient of determination (adjusted) and the -value is highly statistically significant at 1 percent significant level; the F-statistic shows the supply model's goodness of fit. Based on the volume of the adjusted coefficient of determination, the explanatory variables explain 89 percent of the variation in the dependent variable.

Effect of Price on Potato Supply

The effect of price was tested against potato supply; the value of coefficient of the price variable

is 0.45 with a positive sign. It also is significant at the 1 percent level which signifies that an increase in potato production will follow in the next period. There is a significant response of yields to prices. This way; growers will carry on cultivating potato crop if the price is good. Result is similar to that of Bailey & Womack (1985), Bhowmick & Ahmed (1993), Mesfin (2000), Alemu *et al.*, (2003), Rao (2003), Leaver (2004), Mahmood *et al.*, (2010), Muchapondwa (2009), Ogazi (2009), Molua (2010), Baker (2010), Bhatti *et al.*, (2011), AL Obaidi (2013) and Shoko (2014) as they all reached the conclusion that price factor represents a significant variable that can explain changes in production. Nevertheless, it does not comply with the results of Gulati and Kelly (1999),

Effect of Price Lagged One Year on ýthe Potato Supply

The effect of Price lagged one year was tested against potato supply; the results indicate a positive relationship between the two variables, The estimate potato price lagged one year the positive coefficient of potato price lagged one year 0.39 in the production equation bears significant relationship with potato production, Such a behaviour is attributed to farmers presumably including their past experience while forming their expectations for production. This result was supported by observation of Mahmood (2010), Baker (2010), Bhatti *et al.*, (2011), AL Obaidi (2013).

Effect of Land Usage Lagged One Year on the Potato Supply

The effect of land usage lagged one year was tested against potato production; the results indicate a positive relationship between the two variables, the value of the coefficient of the land usage 0.84 is statistically significant at one percent level with a positive sign. This means that an average increase of about 3.84 cent in potato production is to be there for every one cent increase in land usage. Such a behavior can be ascribed to the fact that potato growers (presumably) rely on their experiences of past production while shaping their current production expectations. This result was supported by observation of Mahmood (2010), Baker (2010), AL Obaidi (2013).

Effect of One Year Lagged Production on ýthe Potato Supply

For production to be lagged once it means that for a specific time duration, any increase in production is to be followed by a counter increase in production during the next interval of time. It confirms the hypothesis of Nerlovian partial adjustment model stating that growers avoid adjusting their yield instantaneously for changes in technology and prices. Instead of that, they adjust their production to the optimum yield level over time. These findings comply with results reached by Alemu *et al.*, (2003) and Ogazi (2009). Their studies were conducted in the same field too. The coefficient of lagged yield is 0.09 which is significant at 1 percent level.

Effect of Dummy Variable on the Potato Supply

The dummy variable represents the siege in 1990-2003. The coefficient is negative with a value of -0.08 and significant at 1 percent level. The negative effect of siege on potato production could be by virtue of alterations in price policies which urge farmers to cultivate another crop of more importance, also, non-availability of inputs and other services, non-peace condition. The negative effect of the siege on potato production in Iraq indicate that most farmers opted to quit their profession and indulge in military service since the siege era witnessed a lot of military activities. This led to decreasing the cultivated areas allocated for potato crop, leading eventually to decreasing the potato output in general.

Effect of Technology on Potato Supply

Technological change causes shifting of the potato supply function having an annual value of 0.08%. This coefficient is significant and positive at 1% level. Technological change causes shifting of the potato supply function having an annual value of 0.08 %. This coefficient is significant and positive at 1% level. We can deduce from the positive and significant relationship between both potato production and this variable that the adaptation of new technology led over time to increasing potato production in Iraq, yet the low technology coefficient value suggests that Iraqi potato farmers may be averse to new technology solutions, a reaction that must have led to a low production response.

Determining the Long and Short-Run Non-Price and Price Elasticities

Table 3 lists the estimated long and short-run elasticities for yield response regarding potato production in Iraq. It is evident from the crop elasticity for yield that the quantity of ýpotato yield increased by 0.52 percent in the long run and 0.47 percent in the short run for an increase by 1 percent in potato price during the analysis period. Both long and short-run elasticities with respect to the lagged price variable ýare inelastic and significant, their degrees fall conform to the range of elasticities given in other researches. These results show that it will not be easy for Iraqi potato growers to react swiftly to changes in price.

As expected; elasticity value for long-run is more than it for short-run marking a prominent characteristic

of elasticities for individual crop supply. Its occurrence is because some of the short-run factors of production are fixed unlike the case with long-run where all factors are variable (Leaver, 2003).

While the low response of potato supply with regard to its own price in the long-run and short run; this does not necessarily mean that the supply of domestic potato is unresponsive to its price. Yet, it is probable that non-price incentives could be hindering the transformation of price incentives to stimulate the supply of potato in Iraq. This observation is to acknowledge that non-price factors may dominate price factors in factors affecting decision-making process (Mythili, 2008).

Elasticity for long run and short run potato price lagged one year is of significant influence and equal to 0.43 and 0.39, respectively. Long and short run elasticity of significant variable, lag potato yield is 0.10 and 0.09, respectively. Under siege, response variable (production) is inelastic with no significant influence to the independent variable (siege). In the short run, total production is decreased by -0.08 per cent for a 1% increase in siege whereas it decreases -0.09 percent in the long run. Siege appears to have a negative effect on the decision of growers regarding allocation of potato production. In long run, the production is inelastic to the land usage lagged one ear, *i.e.* nearly 0.84 percent increase in production allocation to potato crop is caused by 1% increase in land usage lagged one year.

Elasticity pertaining to potato production shows that there had been a 0.08% increase in short -run production size as a result of 1% increase in the technology during the analysis duration. It can be clearly noticed through analyzing both inelastic long and short-run price elasticities that there is a package of alternative non price-factors in addition to price factors that are all stimulating potato farmers in Iraq perhaps eliciting better responses.

Conclusion and Recommendations for

Table 3: Short and Long-Run Elasticities for potato production in Iraq During (1989-2018).

Variables	Short run elasticities	Long run elasticities
LnP	0.47	0.52
LnP_{mt-1}	0.39	0.43
LnA_{mt-1}	0.84	0.92
Lny_{mt-1}	0.09	0.10
D	-0.08	-0.09
T	0.08	0.09
Adjustment coefficient	0.91	

Source: Estimates from data, 1989– 2018.

Further Research

This research has examined the effect of six factors and potato supply in Iraq, and the subsequent effect on Iraqi economy. It contributed to a better comprehension of factors affecting potato supply in Iraq, since this issue had not received sufficient emphasis within the literature of this study. Multiple Regression was applied in this study so as to test independent variables related to the relationship between independent variables (potato price, one year lagged price as price factors and one year lagged land usage, one year lagged production, technological factors, and the siege as non-price factors) and potato supply. A significant and positive influence is evident here between potato price, one year lagged price as price factors and one year lagged land usage, one year lagged production, technological and potato supply. But the study found negative and significant effect between the siege and potato supply. Regressioný analysis indicated that potato supply was significantly explained by the six independent variables, which proved the robustness of the model used in the study.

This study calls for future empirical studies to carry on with its objectives. Future studies may include this study's framework to overcome any limitations and strengthen the current findings. Various crops like rice, barley and/or wheat may be included as other variables for the intended studies.

Quite certainly, while considering alternative behavior groups, the findings can vary accordingly. Thus, cross-behavior research should be followed for future researches which indicates a need for future studies so as to determine if growers reflect the same behavior all over the globe or not, and also whether Iraqi farmers are unique due to their behavior.

The national historical time series data that had been applied in this research can be limiting. Thus, it is important here for future studies to care for narrowing down to farm level analysis so that they can capture household facets such as socioeconomic characterization of farmers and technical efficiency using cross-sectional data. Input cost variables had not been included in this research since relevant data was not made available to the researcher. Hence, more explanatory variables such as labour force and fertilizers costs are advised to be included in future studies Therefore future studies should include more explanatory variables like costs of potato seeds, fertilizer and labour force due to their considerable influence on supply of this crop. Also, the study recommends a further future analysis of factors affecting potato production to be organized on an institutional level to include aspects

like market access so as to assess the impact of institutional activities, particularly for post- siege period.

Moreover, further researching is needed as per welfare effects and measures of protection of various agricultural policies on potato producing households. More researching is also needed to evaluate the degree of integration using high frequency data as opposed to the annual data used here in this research. The high frequency data could be monthly or weekly trade data which was found to provide more accurate elasticities. Low frequency data has been found in literature to overestimate price transmission elasticities.

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