J. Agr. Sci. Tech. (2020) Vol. 22(1): 13-26

Land Use and Agricultural Support Policies: Evidence from Iran's Irrigated Wheat Planting

A. Alipour[1], S. H. Mosavi[1*], S. Khalilian[1], and S. A. Mortazavi[1]

ABSTRACT

The self-sufficiency policy for wheat production in Iran has increased external costs for the country besides causing the destruction of water and land resources. Nevertheless, due to various political, economic, and socio-economic reasons, self-sufficiency in wheat production in Iran is a binding policy. According to statistics, an average of about 67 percent of wheat production across the different regions of Iran is irrigated wheat. Thus, in this study, the effect of a guaranteed price policy on the distribution of irrigated wheat land-use in Iran during the period 2001–2016 was evaluated with an emphasis on the role of the regional differences using the pooled mean group approach. The results indicated that, in the long run, the increase in the irrigated wheat land use in the country would be sensitive toward the increase in the guaranteed price of wheat and the yield per hectare. However, with the rise in the price of barley, in the long run, the irrigated wheat land use would decrease further. In addition, in the short run, the increase in the irrigated wheat land use in most of the western provinces is sensitive to the increase in the yield per hectare, and in most of the central provinces, it is sensitive to the changes in the barley prices. Finally, in order to have adequate land for irrigated wheat in the country, both in the short and long run, it is proposed that the farmers' expectations regarding the guaranteed price policy and improvement in the yield per hectare of this product be satisfied.

Keywords: Guaranteed Price Policy, Pooled Mean Group (PMG), Wheat land use.

[DOR: 20.1001.1.16807073.2020.22.1.11.7]

INTRODUCTION

Agricultural support policies aim at guaranteed food supply, improving income in agriculture, price stability, product quality, product selection and employment. In particular, governments in developing countries pay subsidies to encourage domestic production of agricultural goods including price support, deficiency payments, support coupled to input factors, etc. (Hansen, 2016). In Iran, various agricultural policies are being adopted to support the production and planting of strategic agricultural products. The most important agricultural support policies include determining the guaranteed purchase price for products, paying subsidies for inputs, giving cheap loans, and providing products damage insurance (Mosavi *et al.*, 2017).

Wheat, as the most important agricultural commodity in Iran, plays a special role toward maintaining food security in Iran. The main reasons for this are wide adaptation of cultivation under different climatic conditions, relative ease of production, long run storage capability, usability in different forms, and especially high nutritional value. Wheat products are among the most important commodities with respect to nutrition in the Iranian households, accounting for about 25 percent of the share of consumption of goods in the nutrition basket (Iranian Ministry of Health, 2013). Therefore, supporting wheat production in the country has always been one of the most critical infrastructure policies of the Islamic Republic of Iran. Hence, according to the constitution of Iran, the government has been obliged to adopt strategic agricultural policies for realizing the goals of wheat self-sufficiency in the country. Among the agricultural policies, determination of the guaranteed purchase price of wheat has always been significant, which can

[1] Department of Agricultural Economics, Faculty of Agriculture, Tarbiat Modares University, Tehran, Islamic Republic of Iran.
[*]Corresponding author; e-mail: shamosavi@modares.ac.ir

directly affect the wheat land use. In Iran, like many developing countries, increasing available lands or, at least, not reducing the available lands, is one of the most important subjects of agricultural policies. According to Iran's Statistics Organization (2014), wheat accounts for about 40 percent of the total agricultural land use in the country. Therefore, it seems that the wheat land use in Iran has also been targeted by agricultural policies.

However, the self-sufficiency policy for wheat planting in the country has resulted in external costs for the country and has led to the degradation of water and land resources. The acidification of groundwater resources and eutrophication are also among the most important environmental impacts of wheat production system in the country (Najafi Alamdarlo *et al.*, 2018; Khorramdel *et al.*, 2014). Nevertheless, considering the necessities of political economy such as many political tensions in the Middle East, and for socio-economic reasons such as agricultural employment, wheat planting in Iran is a binding policy. Therefore, the purchase of this product has been guaranteed in the form of a law based on the purchase of basic agricultural products in the country. Under this law, the purchase of basic agricultural products is guaranteed in order to support the production of wheat and prevent the loss to farmers. Therefore, the government is obliged to guarantee the procurement of this product every year and must announce the minimum guaranteed price before the start of the planting season. In addition, according to this law, the government is obliged to determine the guaranteed purchase price each agricultural year. This happens in such a way that the increase in price shall never be less than the inflation rate announced by the Central Bank of the Islamic Republic of Iran, in that particular year.

In this regard, surveying the statistics of the Central Bank of the Islamic Republic of Iran indicates that since the beginning of the implementation of this law, the guaranteed price of wheat purchase in the country has always increased, indicating an uptrend. For example, during the period 2004–2015, the guaranteed wheat price increased by an average 22 percent each year, which is roughly equivalent to average inflation rate. Nevertheless, the statistics of the Iranian Ministry of Agriculture indicate that wheat production in the country has fluctuated significantly during this period: it decreased from 14.5 million tons in 2004 to 11.5 million tons in 2015. Therefore, the key question is why, despite the significant increase in the guaranteed wheat price in the country over the years, the production volume of this product has decreased significantly? The study of the statistics has indicated that the ratio of arable to dry lands of wheat cultivation has remained almost constant at different time intervals in the country, such that about 39 percent of these lands are irrigated wheat and about 61 percent are rainfed wheat. On one hand, during the period 2004–2015, the area of wheat land use with respect to irrigation and rainfed decreased by 17 and 19%, respectively. On the other hand, the average of yield per hectare of the irrigated and rainfed lands decreased by about 7 and 16%, respectively. Therefore, the total amount of irrigated and rainfed wheat production in the country during the abovementioned period decreased by about 24 and 33%, respectively (Iranian Ministry of Agriculture, 2015).

Thus, it can be concluded that the reduction in yields and area of wheat land use in the country have been the root causes for the decrease in wheat production in the country, over the years. Regarding the wheat yield changes in the country, especially in relation to rainfed wheat, the decrease in rainfall in many parts of the country should be considered as one of the main reasons for the reduction in the yield per unit area of wheat production. In this regard, the World Bank statistics (2017) indicate that the average annual rainfall in the country dropped from 256 millimetres in 2004 to 197 millimetres in 2015. Therefore, it seems inherent that climate change in the country and the occurrence of drought-related phenomena has led to a somewhat inelastic allocation of land for the production of rainfed wheat in response to the increase in the guaranteed purchase price of this product (Akbari *et al.*, 2020; Shahvari *et al.* 2019). In addition, it can be implied that the reduction in irrigated wheat yield through the years has not been unrelated to the decrease in rainfall in the country. Therefore, taking into consideration that on average about 67 percent of the wheat production in the country is irrigated wheat, the study of the factors influencing the changes in the land use of this product is, especially with respect to the regional distinctions in the country, very important. This is because, unlike the wheat yield that has a significant dependence on climatic factors, wheat land use is more influenced by agricultural policies and government plans in different regions of the country. In addition, regional differences and characteristics are important regarding the distribution of wheat land use and can affect the efficiency of the agricultural support policies.

According to economic theories, the changes in agricultural land use indicate a significant dependence on the changes in the price of the products. In this regard, the partial adjustment model of Nerlove (1956), as one of the basic theories in this field, states that the land use of each product is, above all else, a function of the price of that product. According to this theory, the potential supply of each product is a function of the probable price of that product in that particular year, which ultimately leads to the allocation of land to produce it (Jennings and Young, 1980). Therefore, based on this theory, it can be said that the implementation of the agricultural price policies in Iran is an important factor toward allocating land for wheat production. This theory has been employed in many studies in order to survey the effects of the price policies on the changes in crop land, including Lin (1977), Muchapondwa (2009), Khan and Khair (2010), Laajimi *et al*. (2016), and Esam (2017). A review of these studies indicates that, in general, the use of Nerlove's Theory in surveying the response regarding agricultural land use toward the implementation of the pricing policies has been highly appreciated by the researchers.

In addition, several researchers have confirmed the causal relationship between agricultural policies and agricultural land use; Mattison and Norris (2005) reviewed the link between agricultural policy, land use and biodiversity. They stated that response to global agricultural policy is, therefore, a major driver of land use change. Van Meijl *et al.* (2006) surveyed the impact of different policy environments on agricultural land use in Europe. Their results showed that no drastic decrease in land for agricultural purposes is expected for the EU25 in the coming 30 years. Siad *et al.* (2017) studied the relationship between the Common Agricultural Policy (CAP), durum wheat market price, vegetation cover and land allocation. They found that the durum wheat land use was influenced by the CAP implemented by using profitability as the stimulus for the decision making of the farmer. Therefore, a review of previous studies shows that there is a meaningful relationship between agricultural policies and agricultural land use. However, to the authors' knowledge, there is no known study that has tackled the issue of the role of regional distinctions in the implementation of support policies with respect to the distribution of agricultural lands. Therefore, considering the importance of price policies regarding irrigated wheat land use distribution in Iran, the present study was conducted to evaluate the regional impact of the guaranteed price policy on irrigated wheat land use as the main factor, which influences wheat production in the country.

MATERIALS AND METHODS

In this study, Nerlove's partial adjustment model was considered as the basis for analysing the regional effects of the guaranteed price policy on irrigated wheat land use changes in Iran. Therefore, the Pooled Mean Group Model was applied in order to analyze the regional impact of the guaranteed price policy in different provinces of Iran. Many authors have used this method to explore the regional differences in their economic researches (Bassanini and Scarpetta, 2001; Goswami and Junayed, 2006; Tan, 2009; Bangake and Eggoh, 2012; Asafu-Adjaye *et al*., 2016; Chepng'eno, 2018).

Wheat Land Use and Price Policies

According to economic theories, the models of the response of agricultural production to the changes in the price and non-price factors can be explained by Equation (1) (Gerald, 1974):

$$Q_t = \eta_0 + \eta_1 P_t^e + \eta_2 Z_t \qquad (1)$$

In Equation (1), η refers to the model parameters, Q_t is the production amount at time t, P_t^e is the expected product Price, and Z refers to the non-price factors that affect the product supply. Most farmers react to changes in the prices of agricultural products with a shift in the production land use. Thus, the farmers' response to these price changes is usually determined by land use rather than the planned production and supply. In other words, production and supply are either planned or visible, and farmers do not have full control over it. Therefore, since the change in land use is a proportional response to the price change, it is generally considered in the supply response models instead of production and supply. Hence, in this study, the regional impacts of Iran's wheat guaranteed price policy have been surveyed through the specifications of Nerlove's partial adjustment model derived from the supply response model. In Equation (2), the transcendental logarithmic specification of the model has been stated. The transcendental function in logarithmic specification simultaneously contains independent variables as well as logarithms of independent variables (Debertin, 2012). However, it should be noted that because relation between variables and their logarithms is non-linear, the use of this functional form does not have significant issues in terms of multicollinearity.

$$Log(A_{it}^w) = \alpha_0 + \alpha_1 \mathrm{Log}(P_{it-1}^w) + \alpha_2 \mathrm{Log}(P_{it-1}^b) + \alpha_3 \mathrm{Log}(Y_{it-1}^w) + \beta_1 P_{it-1}^w + \beta_2 P_{it-1}^b + \beta_3 YC_{it-1}^w \quad (2)$$

In Equation (2), the change in irrigated wheat land use for each province at time t (A_{it}^w) is explained by the changes in the guaranteed purchase Price of wheat (P_{it-1}^w), the regional purchase Price of barley (P_{it-1}^b), and the Yield per hectare of the irrigated crop (YC_{it-1}^w) in the particular province in the previous year. It should be noted that despite the constant guaranteed price for wheat in the country every year, the guaranteed price of wheat varies widely across the different provinces due to the quantity and quality associated with the product purchased from the farmers in these provinces. After estimating the parameters of the transcendental function, partial elasticities of the variables are obtained. The partial elasticity associated with each of the three factors affecting the distribution of irrigated wheat land use, as represented in Equation (3), is one of the advantages of the transcendental function. Accordingly, the use of this function makes it possible to examine the changes in these elasticities over time (Debertin, 2012).

$$\pi_{kt} = \alpha_k + \beta_k \vartheta_{kt} \quad (3)$$

Where, π_{kt} and ϑ_{kt} refer to the partial elasticity and the value of each of the three explanatory variables in the year *t* for the provinces, respectively.

Pooled Mean Group Model (PMG)

Panel data analysis is an econometric method in which data are usually collected over time and over the same individuals (cross-sections) and then a regression is run over these two dimensions (Davies and Lahiri, 1995). Hence, the econometric methods used to analyze the panel data should be used in order to avoid the problems caused due to the cross-sections interdependence. In econometrics, a growing body of the panel data literature concludes that panel data models are likely to exhibit substantial cross-sectional dependence in the errors. Cross-sectional dependence may arise because of the presence of common shocks and unobserved components that ultimately become part of the error term, spatial dependence, and idiosyncratic pairwise dependence in the disturbances with no particular pattern of common components or spatial dependence. Therefore, if there is sufficient cross-sectional dependence in the data and this is ignored in estimation, the decrease in estimation efficiency can become so large (De Hoyos and Sarafidis, 2006). Under the interdependence conditions, traditional estimation models, such as fixed effects and random effects, will not be valid (Baltagi, 2005). Therefore, while determining the econometric estimates of the panel data, the dependency or non-dependency of the desired cross-sections should be tested (Al Mamun *et al*., 2014). Hence, in this study, the cross-sectional dependency test was performed by applying the CD statistic introduced by Pesaran (2004) using Equation (4).

$$CD = \sqrt{\frac{2T}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=j+1}^{N} \widehat{\rho_{ij}} \quad (4)$$

In Equation (4), $\widehat{\rho_{ij}}$ represents the Pearson correlation coefficients for the error terms. In econometrics, stationarity is an assumption underlying many statistical procedures used in time series and panel data analysis. This assumption emphasizes that, in order to avoid false regression, the mean and variance of variables should remain constant over times. Therefore, before making econometric estimates with time series or panel data, it is common to survey the stationary of the variables using the unit root tests (Gagniuc, 2017). The usual methods including the panel unit root test, known as the first-generation methods, are preferred to second-generation methods (Bai and Ng, 2004; Moon and Perron, 2004; Choi, 2006; Pesaran, 2007) in shorter periods (Pesaran and Smith, 1995; Pesaran *et al*, 1999). Therefore, the advantage of first-generation panel unit root tests is that they require small numbers of observations for the test to have power. However, the use of the first generation unit root methodology for identifying the order of integration of variables is not important in panel ARDL approaches (Al Mamun *et al*, 2014). Im *et al.* (2003) proposed one of the most efficient first-generation methodologies for investigating the presence of unit roots in panel data. Therefore, in this study, we used Im *et al.* (IPS) unit root test in accordance with Equation (5):

$$\Delta V_{it} = \delta_i + \sigma_i V_{i,t-1} + \sum_{j=1}^{p_i} \varphi_{ij} \Delta V_{i,t-j} + \tau_{it} \quad (5)$$

In Equation (5), *t= 1, 2, ..., T* and *i= 1, 2, ..., N* represent the years and the provinces, respectively. In addition, *δ, φ, σ*, and *p* are the estimated coefficients and *τ* indicates the model error term. Moreover, *V* refers to the variables ($Log(A_{it}^{w})$, $Log(P_{it-1}^{w})$, $Log(P_{it-1}^{b})$, $Log(YC_{it-1}^{w})$, P_{it-1}^{w}, P_{it-1}^{b} and YC_{it-1}^{w}). In the panel data, as in the time series data, the long run relationship among the variables in the panel should be proved. Usually, when there is a cross-sectional dependency in the panel, it is recommended that the second-generation co-integration tests, such as the Westerlund test, be used to inspect the long run relationship. However, due to the short duration of the data used in this study, the use of this test is less preferable to the other conventional testing methods for long run relationships. Therefore, the long run relationship between the variables was investigated by using the Kao co-integration test. In order to estimate the panel models, Pesaran and Smith (1999) introduced a flexible method, called the Pooled Mean Group (PMG) model. They stated that, in this method, long run parameters along the cross-sections are homogeneous. At the same time, the short run coefficients and error correction coefficients vary throughout the cross-sections. Therefore, in this study, the PMG method was used to achieve the study objectives. Based on Pesaran and Smith's method, the *PMG* model can be written as in Equation (6):

$$Y_{it} = \theta_i \left(Y_{i,t-1} - \beta_i' X_{i,t-1} \right) + \sum_{j=1}^{m-1} \gamma_{ij} \Delta Y_{i,t-j} + \sum_{j=0}^{n-1} \gamma_{ij}' \Delta X_{i,t-j} + \mu_i + \varepsilon_{it} \quad (6)$$

In Equation (6), X_{ij} is the vector (k×1) of the explanatory variables for the province i and μ_i denotes the constant effects. In addition, β_i' represents the long run parameters and θ_i represents the Error Correction parameters (ECM). In addition, γ_{ij}' represents the short-run coefficients. In the PMG method, a limitation to the model is that the β' parameters are homogeneous between the cross-sections. In addition, all dynamic phrases and error correction coefficients can be freely modified. The estimation of the PMG model is based on the maximum likelihood method. The data used in this study, including the amount of wheat land use (hectare), the guaranteed purchase price of wheat (10 Rials), the purchase price of barley (10 Rials), and yield per hectare of irrigated wheat (kilograms), was prepared for 25 selected provinces of the country by referring to the databases of the Iranian Ministry of Agriculture for the period 2001–2016. The Eviews 9 software was used to determine the estimates. In order to assist in the analysis of the results, specification of the provinces investigated is presented in Figure 1.

RESULTS AND DISCUSSION

Descriptive Statistics of the data are listed in Table 1. As it is shown, the average wheat land use in the investigated provinces is about 251 thousand hectares per year. In addition, the average wheat yield of the provinces is about 3,513 kg per year. Another noteworthy thing about Table 1 is that in the studied provinces, the average purchase price of wheat has been about 20% higher than the average barley purchase price. This suggests that

Figure 1. Specifications of the investigated provinces.

maintaining a margin between the wheat and barley purchases prices has been an instrument of supportive policies for wheat production in the country.

As mentioned previously, in order to determine the econometric estimates using the panel methods, the cross-sectional dependence for the variables should be tested. The results of the Pesaran cross-sectional dependence test are presented in Table 2.

It can be deduced from the results in Table 2 that the null hypothesis is rejected on the basis of the lack of cross-sectional dependence on all the variables under consideration. Therefore, it is more acceptable to use the PMG approach in comparison with conventional panel estimation methods. Table 3 describes the results of the unit root test.

According to the results of Table 3, it was determined that apart from the variables of the logarithm of irrigated wheat land use, the logarithm of irrigated wheat yield per hectare and the irrigated wheat yield per hectare, other variables have the unit root and are stationary after one or two times differentiation. Therefore, considering that the variables used in the equation do not have the same order of integration, the use of PMG method is more justifiable. Because, unlike conventional panel methods, the order of integration of variables is not important in PMG approach (Al Mamun *et al*, 2014). The use of integration test is only to validate the long run relationships among the variables. Accordingly, the results of the Kao co-integration test are reported in Table 4.

According to the results of Table 4, the null hypothesis is based on the absence of a long run relationship, which is rejected at the 99 percent level. Hence, it can be deduced that the variables in the model tend to have a long run relationship. Thus, Table 5 demonstrates the results of the long run relationship estimations. Before interpreting the model estimation results, it should be noted that the Ramsey RESET test (See Greene, 2012) showed that the functional form of the model has been chosen appropriately. Therefore, since the model passed the Ramsey RESET test and panel data used (400 observations) are the best available, the model can explain the relationship between independent and dependent variables. It also means that the model is not misspecified. The results indicate that all estimated coefficients are significant at the 99 percent level. Due to the fact that the partial elasticity of each variable in the transcendental function is inconstant, in order to calculate the elasticity in the long

Table 1. Descriptive statistics of data used for the selected provinces. [a]

	Irrigated wheat land use (Hectare)	Irrigated wheat yield (Kg)	Wheat purchase price (10 Rials)	Barley purchase price (10 Rials)
Mean	251255	3513	366	308
Median	210190	3508	234	215
Maximum	864740	6113	1191	1436
Minimum	9406	1173	33	10

[a] Source: Iranian Ministry of Agriculture.

Table 2. Pesaran cross-sectional dependence test.

Variable	CD Stat	P-Value
$Log(A_{it}^{w})$	13.9	0.000
$Log(P_{it-1}^{w})$	68.2	0.000
$Log(P_{it-1}^{b})$	64.8	0.000
$Log(YC_{it-1}^{w})$	25.5	0.000
P_{it-1}^{w}	68.8	0.000
P_{it-1}^{b}	66.4	0.000
YC_{it-1}^{w}	23.6	0.000

Table 3. Results of unit root test.

Variable	Stat IPS	Stationary
$Log(A_{it}^{w})$	-1.7	I(0)
$Log(P_{it-1}^{w})$	9.5	I(1)
$Log(P_{it-1}^{b})$	8.03	I(1)
$Log(YC_{it-1}^{w})$	-4.8	I(0)
P_{it-1}^{w}	12.4	I(2)
P_{it-1}^{b}	13.2	I(1)
YC_{it-1}^{w}	-4.2	I(0)

Table 4. Results of Kao co-integration test.

	Estimated value	Probability
ADF [a]	-5.3	0.000
Residual variance	0.03	
HAC variance	0.01	

[a] Augmented Dickey–Fuller test

Table 5. Results of long run relationship estimation.

Variable	Coefficient	Standard Error	t-Stat	P-Value
$Log(P_{it-1}^{w})$	-1.08	0.2	-3.6	0.000
$Log(P_{it-1}^{b})$	0.8	0.2	3.02	0.002
$Log(YC_{it-1}^{w})$	1.7	0.04	37.4	0.000
P_{it-1}^{w}	0.005	0.001	4.5	0.000
P_{it-1}^{b}	-0.005	-0.001	-4.09	0.000
YC_{it-1}^{w}	-0.0004	0.00002	-18.74	0.000

[DOR: 20.1001.1.16807073.2020.22.1.11.7]

run, the period 2012–2016 was considered in this study.

After estimating the long run relationships of the PMG model (estimating the α_k and β_k parameters), the effects of the factors influencing the distribution of irrigated wheat area in the country is presented in Table 6. As indicated by the results of Table 6, the guaranteed price of wheat in the long run has a positive impact on the distribution of irrigated wheat area in the country. Therefore, it can be assumed that the policy of guaranteed purchase of wheat is appropriate in the long run and will lead to an increase in the level of irrigated wheat area in the country. This result is also proven in the studies of Taheri *et al.* (2009) and Laajimi *et al.* (2016). In addition, the results of Table 6 indicate that, in the long run, with the increase in the purchase price of barley, the irrigated wheat area will decrease in the country. This confirms the results of Garshasbi *et al.* (2012). Compared to the mentioned studies, the main advantage of this study is that the analysis of the effect of price factors on wheat land area has been investigated with regard to short run and long run and considering regional differences. This illustrates the superiority of the PMG method used in comparison with ordinary econometric methods such as conventional panel data analysis.

Given what has been said, with respect to the amount of the computed elasticity, it can be observed that barley, as a product, is a serious competitor to the production of irrigated wheat in the country for various reasons, especially the similarities in planting and production conditions. This is important because the supply and demand of barley in the country is usually overseen in the free market. Therefore, the results of this study emphasize that supportive policies related to the irrigated wheat area in the country in the long run should be adopted and implemented in light of the changes in the equilibrium price of barley in the open market. In this regard, it should be noted that the terms of trade relation of the prices of wheat and barley in the country is a major factor influencing the wheat land area, which is determined by agricultural policies. Therefore, maintaining the price ratio of wheat to barley is very important in pricing policies; because, increasing the relative price of wheat to barley increases the wheat land area and vice versa. This policy recommendation has also been emphasized in the study by Alipour *et al.* (2018). In addition, the results presented in Table 6 indicate that, in the long run, the land area of wheat can be increased by increasing the yield per hectare of irrigated wheat in the country. Therefore, it is evident that increasing the yield of irrigated wheat production using different methods contributes to increasing the efficiency of the policy of guaranteed purchase price of this product in the long run. In addition to increasing the efficiency of the guaranteed purchasing policy, wheat productivity improves wheat self-sufficiency in the country.

The results of estimating short run relationship between the variables (estimating γ'_{ij} parameters) is presented in Table 7. The results of this table indicate the average effect of the variables in the provinces. In addition, the results of Table 7 prove that most of the estimated coefficients are statistically significant. Moreover, these results indicate that the error correction term has a negative sign and is statistically significant. This illustrates the existence of a long run equilibrium relationship among the variables. Accordingly, the process of adjustment from the short run to the long run in the provinces would take 4.7 years on an average. The content of Table 7 is also calculated for each of the 25 provinces studied, which can be seen in the appendix file. Therefore, the content of Table 8 is calculated based on the variables' coefficients by the provinces.

Table 8 describes the details of the calculated elasticity for the short run for the different provinces. For this purpose, short periods during the years 2015 and 2016 were considered. The results of Table 8 indicate that, in general, in the short run, the increase in the irrigated wheat land area is not very sensitive to the changes in the guaranteed price of this product. In other words, the rising guaranteed wheat purchase prices will not be able to meet farmers' expectations, in the short run, toward increasing their irrigated wheat land area. One of the reasons is the delay in the government's declaration of the guaranteed purchase price for wheat at the start of the planting. This is an important factor because until the prices are announced, the farmers expect the prices to increase at a similar rate as the previous year. Because, the guaranteed purchase law states that the increase in wheat price would be equal to, at most, the country's rate of inflation in that year. Therefore, in the short run, it seems that this

Table 6. Long run elasticities of the factors influencing irrigated wheat area in Iran.

Variable/Year	2012	2013	2014	2015	2016	Average
P^w_{it-1}	0.7	1.04	2.9	4.1	4.6	2.7
P^b_{it-1}	-1.07	-1.5	-2.9	-3.3	-3.8	-2.5
YC^w_{it-1}	0.4	0.5	0.2	0.4	0.2	0.4

Table 7. Results of short run relationship estimation.

Variable	Coefficient	Standard Error	t-Stat	P-Value
ECM	-0.2	0.06	-3.3	0.001
$Log(P^w_{it-1})$	0.2	0.1	2.5	0.011
$Log(P^b_{it-1})$	-0.1	0.09	-1.5	0.132
$Log(CY^w_{it-1})$	-1.9	0.9	-2.04	0.042
P^w_{it-1}	-0.001	0.0002	-3.6	0.000
P^b_{it-1}	0.0008	0.0004	2.01	0.045
YC^w_{it-1}	0.0006	0.0002	2.1	0.029

Table 8. Short run elasticities of the factors influencing irrigated wheat land area in Iran.

Geographical Position	Provinces	P^w_{it-1}			P^b_{it-1}			YC^w_{it-1}		
		2015	2016	Average	2015	2016	Average	2015	2016	Average
North	Ardabil	-0.47	-0.64	-0.55	-0.03	-0.04	-0.04	4.26	4.28	4.27
	Golestan	-0.19	-0.29	-0.24	-0.08	-0.09	-0.09	0.99	0.96	0.98
East	Khorasan Razavi Razavi	-0.16	-0.32	-0.24	-0.07	-0.05	-0.06	0.44	0.73	0.58
	Sistan and Baluchistan	-1.14	-1.16	-1.15	1.56	2.43	1.99	6.19	6.89	6.54
Central	Esfahan	-0.88	-0.97	-0.92	0.92	0.94	0.93	-4.24	-5.02	-4.63
	Tehran	2.10	2.25	2.18	-2.80	-2.93	-2.86	5.06	5.43	5.24
	Semnan	-0.96	-1.03	-1.00	0.44	0.58	0.51	-0.73	-0.74	-0.73
	Fars	-0.21	-0.33	-0.27	-0.08	-0.10	-0.09	-0.77	-0.81	-0.79
	Qazvin	0.05	0.09	0.07	0.38	0.37	0.37	-0.25	-0.29	-0.27
	Kerman	-1.14	-1.22	-1.18	0.70	0.83	0.76	-0.38	-0.39	-0.38
	Markazi	-0.75	-0.88	-0.81	0.09	0.09	0.09	-3.12	-3.74	-3.43
	Hamadan	-0.40	-0.54	-0.47	3.13	3.10	3.12	-2.36	-2.31	-2.34
	Yazd	-0.74	-0.85	-0.80	0.06	0.05	0.05	-0.33	-0.35	-0.34
West	East Azerbaijan	0.17	0.15	0.16	0.22	0.21	0.21	8.59	6.59	7.59
	West Azerbaijan	-3.03	-3.67	-3.35	4.68	4.85	4.77	9.82	11.51	10.66
	Kurdistan	-1.03	-1.13	-1.08	0.97	0.97	0.97	5.69	4.36	5.02
	Kermanshah	-1.08	-1.15	-1.12	1.84	1.80	1.82	-1.02	-0.90	-0.96
	Kohgiluyeh and Boyerahmad	-0.20	-0.23	-0.21	0.98	1.06	1.02	0.17	0.15	0.16
	Ilam	-0.18	-0.24	-0.21	0.10	0.12	0.11	-0.59	-0.59	-0.59
	Lorestan	-1.98	-2.25	-2.11	0.89	0.97	0.93	3.63	3.48	3.56
	Chaharmahal and Bakhtiyari	-0.63	-0.74	-0.69	0.33	0.40	0.37	13.19	16.37	14.78
	Khuzestan	-1.10	-1.28	-1.19	0.45	0.52	0.49	7.87	9.59	8.73
	Zanjan	0.09	0.11	0.10	-0.95	-0.99	-0.97	-0.05	-1.06	-0.56
South	Bushehr	-0.82	-1.08	-0.95	0.52	0.81	0.66	2.76	2.64	2.70
	Hormozgan	-0.11	-0.11	-0.11	0.05	0.06	0.06	-2.82	-3.15	-2.99
	Countrywide	-0.74	-0.86	-0.80	0.72	0.80	0.76	0.28	0.34	0.31

[DOR: 20.1001.1.16807073.2020.22.1.11.7]

issue lead to farmers' reluctance to allocate land for planting wheat. Hence, the timely announcement of the guaranteed purchase price of wheat prior to the planting season will make the price expectations of the farmers properly formed. As a result, the provision of equipments and inputs for wheat planting is also timely and improves the effectiveness of price policy. The results of Table 8 indicate that, in the short run, the increase in irrigated wheat land area in the country has been due to the changes in the price of barley and the yield per unit area of irrigated wheat. In this regard, it should be noted that the available statistics indicate that the purchase price of wheat, during the various periods, was at average about 20 percent higher than the purchase price of barley. Therefore, the final barley prices would be less than the final wheat prices in the short run. Thus, the parameter that matters most to the farmers for determining the allocation of agricultural lands for planting wheat or barley, is the ratio of the purchase prices of these two products.

Moreover, it seems that due to the characteristics of free and competitive markets, the volatility and uncertainty of the prices in the barley market is important as well. Therefore, in general, it is evident that the increase in the price of barley in the country does not have enough power to change farmers' decision to reduce the irrigated wheat land area in the short run. According to the results of Table 8, an increase in the yield of irrigated wheat per unit area has a positive effect toward increasing the land area of this product, since the yield of irrigated wheat along with its purchase price constitute the expected income of farmers. Thus, by comparing the results, it can be said that, in both short and long run, the wheat land area is derived from the increase in yield of this product. Therefore, adopting other agricultural policies that increase wheat yield in Iran will indirectly increase the land area of wheat. Supporting coupled to input factors and promotion of agricultural research policies are among the most important policies available in the field of wheat production in the country.

In the short run, the results also indicate that area under irrigated wheat in Tehran, Qazvin, Zanjan, and East Azerbaijan Provinces has had a positive reaction to the price increase of this product. Regarding the Province of Tehran, it should be noted that this observation is relatively reasonable since the wheat silos in this province are the country's largest and the there is a relative ease of supply of wheat to these silos for the farmers. In addition, it seems that the proximity of the other mentioned provinces with each other and their presence near the province of Tehran has been important in this regard. According to the results of Table 8, it is observed that the increase in yield in the major western provinces significantly increased the area of irrigated wheat in the short run. Therefore, it is evident that the presence of water reserves and occurrence of significant annual rainfall in western regions of the country is one of the most important reasons for this observation. In the short run, this causes farmers of these provinces to allocate their lands to irrigated wheat production more readily as compared to the other provinces. Therefore, in order to increase the efficiency of the guaranteed purchasing policy, policies related to higher yield should be prioritized in other provinces of the country.

In relation to the Provinces of Kermanshah and Ilam, it should be noted that among all the provinces, these two were the main exporters of wheat over several years, besides providing the provincial demand for wheat. For example, the statistics of the cereals and commercial services companies of the Kermanshah Province indicate that, in 2015, about 58 percent of the wheat produced in this province was exported to either other provinces or abroad (Dizgah, *et al*., 2019). In addition, similar statistics regarding the Ilam Province indicate that about 50 percent of the annual wheat produced in this province was exported in the same year. Hence, it can be implied that wheat trade in these two provinces is significant along with the production of this product. This is due to the fact that these two provinces span the main western borders of Iran, where trade relations with the neighbouring countries are much higher than the rest of the country.

In addition, the positive effect of enhanced yield observed on the increase in irrigated wheat land area in Tehran, Sistan, Baluchestan, Golestan, and Khorasan Razavi Provinces can be attributed to the relative advantages of producing this product in these provinces. Regarding the results of Table 8, it was also observed that the increase in area of irrigated wheat in many of the central provinces of Iran was more dependent on the amount of increase in the price of barley than many other provinces, such as Isfahan, Kerman, Yazd, Markazi, Hamadan, and Semnan. It can be suggested that this is due to the industry-oriented demand for wheat in the central provinces as compared to the other provinces. Finally, the results of Table 8 indicate that among all the Iranian provinces, Fars is the only province that did not indicate any positive and significant correlation of irrigated wheat land area with any of the three factors mentioned in this study. In this regard, a survey of the existing statistics indicates that, during the period under review in this study, the area of irrigated wheat in this province declined with an average annual growth rate of -2 percent from about 351,000 hectares to 262,000 hectares. Therefore, it can be inferred that the sensitivity of the irrigated wheat land area in the Fars province in the short run is related mostly to the significant reduction of water resources and droughts in this province.

CONCLUSIONS

Considering the significant importance of wheat toward providing food security in Iran, supporting the self-sufficiency of this product in the country has always been one of the top priorities for developing the infrastructure policies of the Islamic Republic of Iran. The self-sufficiency policy for wheat production in the country has generated external costs for the country and has caused the destruction of water and land resources. In this regard, reports from the Ministry of Economic Affairs and Finance of Iran (2013) show that groundwater levels have dropped by more than 2 meters in 70 plains of the country. In most of these plains, wheat is the main agricultural product that has a major share of agricultural lands. Nevertheless, self-sufficiency regarding wheat production in Iran, due to various political, economic, and socio-economic reasons, is a binding policy. Therefore, given the fact that an average of about 67 percent of the wheat production across the country is irrigated wheat, in this study, the effect of the guaranteed price policy on the distribution of the area of irrigated wheat was evaluated with an emphasis on the differences among the various regions and using the pooled mean group approach. The results indicate that, in the long run, the increase in irrigated wheat area is sensitive to the increase in the guaranteed price of wheat. At the same time, with the rise in the price of barley, this area would decrease in the long run. Therefore, in Iran, the increase in the guaranteed prices of wheat are commonly associated with the rise in the price of barley. Besides, according to the elasticities calculated in this study, it is evident that, in the long run, the impact of the guaranteed price policy on the increase in the area of irrigated wheat will have a significant dependence on the changes in barley price. However, the results of this study indicate that increasing the yield per unit area of irrigated wheat in the long run can help to increase the efficiency and effectiveness of the guaranteed price policy.

Therefore, it is suggested that the policy of improving the wheat yield per unit area in the country should be pursued more vigorously by using different methods. In addition, the results indicate that in spite of the long run period, in the short run, the increase in area of the irrigated wheat in most of the provinces is not elastic to the increase in the guaranteed price of this product. This could also undermine the terms of trade relation of the prices of wheat and barley in the long run. Therefore, it seems that in the short run, due to the lack of the farmers' complete understanding regarding their expectations of the prices, and thereby their judgment toward the allocation of land use, the positive effects of enforcing the guaranteed price policy for increasing the area of irrigated wheat, are at the stake of being realized completely. Thus, to answer the question raised in the introduction section, it can be said that the lack of complete satisfaction of farmers' price expectations is one of the negative factors affecting wheat production in Iran. For the short run, it is suggested that farmers' expectations of wheat production should be provided through a full and proper implementation of the upstream policies, such as the announcement of the guaranteed wheat purchase price prior to the start of the planting season. Moreover, the results indicate that, in the short run, the increase observed with respect to the area of irrigated wheat in most of the western provinces has a significant correlation with the increase in yield per unit area of this product.

Therefore, it is evident that the stock of water resources and significant rainfall in the western regions are very important in this regard. Hence, it is suggested that in order to meet the area required for irrigated wheat in the short run, the policy of improving the yield per unit area in the other provinces should be pursued more seriously. In addition, the results indicate that in the short run, the increase in the prices of barley in most of the central provinces of the country will encourage the farmers of these provinces to plant more irrigated wheat than those in the other provinces. Thus, considering the characteristics related to the industrial demand for wheat in most of the central provinces of the country, it is suggested that the derived demand for wheat and the development of industrial applications of this product play an important role in the development of planting and production of this crop. In the end, the results of this study showed that the use of pooled mean group approach offers far better results than traditional methods of econometric analysis in relation to the analysis of the factors affecting wheat land area. The reason is that, in this method, the coefficients for the short and long run are calculated individually and provide the possibility to compare results between different provinces.

REFERENCES

1. Akbari, M., Najafi Alamdarlo, H., Mosavi, S.H. 2020. The Effects of Climate Change and Groundwater Salinity on Farmers' Income Risk. *Ecol. Indic*., **110:**105893.
2. Al Mamun, M. D., Sohag, K., Hannan Mia, M. A. and Ozturk, I. 2014. Regional Differences in the Dynamic Linkage between CO2 Emissions, Sectoral Output and Economic Growth. *Renew. Sust. Ener. Rev*., **38:** 1–11.
3. Alipour, A., Mosavi, S. H., Khalilian, S. and Mortazavi, S. A. 2018. Climate Change and Prospect of Wheat Self-Sufficiency in Iran; (Effectiveness of Guaranteed Purchasing Policy). *11th Biennial Conference on Agricultural Economics in Iran,* Tehran University, Karaj, Iran.
4. Asafu-Adjaye, J. Byrne, D. and Alvarez, M. 2016. Economic Growth, Fossil Fuel and Non-Fossil Consumption: A Pooled Mean Group Analysis Using Proxies for Capital. *Ener. Econ.,*. **60:** 345-356.
5. Bai, J. and Ng. S. 2004. A Panic Attack on Unit Roots and Co-Integration. *Econometrica,* **72(4):** 1127-1177.
6. Baltagi, B. H. 2005. *Econometric Analysis of Panel Data.* Third Edition, Wiley Publisher, New York, pp. 314.
7. Bangake, C. and Eggoh, J. C. 2012. Pooled Mean Group Estimation on International Capital Mobility in African Countries. *Res. Econ*., **66(1):** 7-17.
8. Bassanini, A. and Scarpetta, S. 2001. *Does Human Capital Matter for Growth in OECD Countries? Evidence from Pooled Mean-Group Estimates.* OECD Economics Working Paper No. 282.
9. Chepng'eno, W. 2018. Effect of Price and Exchange Rate Volatility on Kenya's Black Tea Export Demand: A Pooled Mean Group Estimation. *J. Dev. Agric. Econ***., 10(3):** 71-78.
10. Choi, I. 2006. Combination Unit Root Tests for Cross-Sectionally Correlated Panels. In: "*Econometrics Theory and Practice: Frontiers of Analysis and Applied Research*", (Eds.): Corbae, D., Durlauf, S. N. and Hansen, B. E., Cambridge University Press, Cambridge: PP. 331-333.
11. Davies, A. and Lahiri, K. 1995. A New Framework for Analyzing Survey Forecasts Using Three-Dimensional Panel Data. *J. Economet.*, **68(1):** 205-227.
12. De Hoyos, R. E. and Sarafidis, V. 2006. Testing for Cross-Sectional Dependence in Panel-Data Models. *Stata J.*, **6(4):** 482-496.
13. Debertin, D. 2012. Agricultural Production Economics. University of Kentucky. Second Edition, Amazon Create space 2012.
14. Dizgah, M. R., Mortazavi, S. A., Mosavi, S. H. 2019. The Ability of Iranian Exporters to Price Discriminate in Agricultural Sector Trade: Case Comparison of Fig and Grape. *J. Agr. Sci. Tech.* **21(6)**:1411-1422.
15. Esam A, B. 2017. Economic Modelling and Forecasting of Sugar Production and Consumption in Egypt. *Int. J. Agric. Econ.,* **2(4):** 96-109.
16. Gagniuc, P. A. 2017. Markov Chains: From Theory to Implementation and Experimentation. ISBN 978-1-119-38755-8. John Wiley & Sons, NJ, USA, PP. 1–256.

[DOR: 20.1001.1.16807073.2020.22.1.11.7]

17. Garshasbi, A., Yavari, K., Najarzadeh, R. and Homayunifar, M. 2012. Price and Non-Price Factors Effects on Wheat Cultivation Acreage in Provinces by Using Panel Data. *Iran. J. Agric. Econ.,* **6(2):** 189-204. (in Persian).
18. Gerald, S. 1974. Supply Elasticities for Sao Paulo Coffee. *Am. J. Agric. Econ.,* **56(1):** 117-131.
19. Goswami, G. G. and Junayed, H. S. 2006. Pooled Mean Group Estimation of the Bilateral Trade Balance Equation: USA *vis-à-vis* Her Trading Partners. *Int. Rev. Appl. Econ.*, **20(4):** 515-526.
20. Greene, W. H. 2012. *Econometric Analysis.* 7th Edition. Stern School of Business, New York University, Pearson.
21. Hansen, H. O. 2016. *Agricultural Policy Schemes: Price and Support Systems in Agricultural Policy.* Book Chapter, Reference Module in Food Science, Elsevier.
22. Im, K., Pesaran, M., Shin, Y. (2003). Testing for unit roots in heterogeneous panels. *Journal of Econometrics.* **115(1):** 53-74.
23. Iranian Ministry of Agriculture. 2015. *Annual Year Book.* Available at http://www.maj.ir.
24. Iranian Ministry of Health. 2013. *Good Food Basket for Iranian Society.* Andisheh Mandegar Press, Qom.
25. Iran's Statistics Organization. 2014. Detailed Results of the General Agricultural Census of the Whole Country. Statistical Center of Iran. Available at: http://www.amar.org.ir.
26. Jennings, A. N., Young, R. J. 1980. Generalization of the Nerlove Supply Model Using Time Series Methodology: an Application to Potato Plantings in Great Britain. *J. Agric. Econ.,* **31(1):** 99-111.
27. Khan, M. and Khair, Z. 2010. Production and Acreage Response of Wheat in the Northwest Frontier Province (NWFP), Sarhad. *J. Agric*., **26:**1-7.
28. Khorramdel, S. Rezvani Moghaddam, P. Amin Ghafori, A. 2014. Evaluation of Environmental Impacts for Wheat Agroecosystems of Iran by Using Life Cycle Assessment methodology. *Cereal Res.,* **4(1):** 27-44. (in Persian)
29. Laajimi, A. Schroeder, K. Meyers, W. and Binfield, J. 2016. The Tunisia Wheat Market in the Context of World Price Volatility: A Stochastic Partial Equilibrium Approach. *J. Food Prod. Mark.,* **23(4):** 1540-4102.
30. Lin, W. 1977. Measuring Aggregate Supply Response under Instability. *Am. J. Agric. Econ.,* **59:** 903–904.
31. Mattison E. H. A. and Norris, K. 2005. Bridging the Gaps between Agricultural Policy, Land-Use and Biodiversity. *Trends Ecol. Evol*., **20(11):** 610-616.
32. Moon, R. and Perron, B. 2004. Testing for Unit Root in Panels with Dynamic Factors. *J. Economet.*, **122(1):** 81-126.
33. Mosavi, S. H. Alipour, A. and Shahvari, N. 2017. Liberalizing Energy Price and Abatement Cost of Emissions: Evidence from Iranian Agro-Environment. *J. Agri. Sci. Tech.,* **19(3):** 511-523.
34. Muchapondwa, E. 2009. Supply Response of Zimbabwean Agriculture: 1970-1999. *Afr. J. Agric. Resour. Econ*., **3(1):** 28-42.
35. Najafi Alamdarlo, H., Pourmozafar, H., Vakilpoor, M. H. 2018. Improving Demand Technology and Internalizing External Effects in Groundwater Market Framework, Case Study: Qazvin Plain in Iran. *Agric. Water Manag.,* **213**: 164-173.
36. Nerlove, M. 1956. Estimates of the Elastic Ties of Supply of Selected Agricultural Commodities. *J. Farm Econ*., **38:** 496-509.
37. Office of Research and Policy Departments of the Ministry of Economic Affairs and Finance. 2013. *A Glance at the Historical Course of the Destruction of the Country's Water Resources, Causes, Consequences and Solutions.* Available at: (http: // www.mefa.gov.ir).
38. Pesaran, M. H. 2007. A Simple Panel Unit Root Test in the Presence of Cross-Section Dependence. *J. Appl. Econ.,* **22(2):** 265–312.
39. Pesaran, M. H. 2004. *General Diagnostic Tests for Cross Section Dependence in Panels' IZA.* Discussion Paper No 1240.
40. Pesaran, M. H., Shin, Y. and Smith, R. 1999. Pooled Mean Group Estimator of Dynamic Heterogeneous Panels. *J. Am. Stat. Assoc*., **94:** 34-621.
41. Pesaran, M. H. and Smith, R. 1995. Estimating Long-Run Relationships from Dynamic Heterogenous Panels. *J Econ***. 68(1):** 79–113.
42. Shahvari, N., Khalilian, S., Mosavi, S. H., Mortazavi, S. A., 2019. Assessing Climate Change Impacts on Water Resources and

Crop Yield: A Case Study of Varamin plain Basin, Iran. *Environ. Monitor. Assess.* **191(3)**:134.

43. Siad, S. M., Gioia, A., Hoogenboom, G., Iacobellis V., Novelli A., Tarantino, E. and Zdruli, P. 2017. Durum Wheat Cover Analysis in the Scope of Policy and Market Price Changes: A Case Study in Southern Italy. *Agriculture*, **7(12):** 2-20.
44. Taheri, F., Yazdani, S. and Mohammdi, H. 2009. Impacts of Government Supporting Policies on Wheat Supply, Cropping Area and Yield in Iran: Application of Autoregressive Distributed Lag Model. *Iran. J. Agric. Econ. Res.*, **1(1):** 95-114. (in Persian)
45. Tan, K. Y. 2009. A Pooled Mean Group Analysis on Aid and Growth. *Appl. Econ. Lett.*, **(16):** 1597–1601.
46. Van Meijl, H., Van Rheenen, T., Tabeau, A. and Eickhout, B. 2006. The Impact of Different Policy Environments on Agricultural Land Use in Europe. *Agr. Ecosyst. Environ.*, **114(2006):** 21–38
47. World Bank Statistics. (2017). Historical climate information. Available at https://climateknowledgeportal.worldbank.org.

کاربری زمین و سیاست‌های حمایتی کشاورزی: شواهدی از کاشت گندم آبی در ایران

ع. علیپور، س. ح. موسوی، ص. خلیلیان، و س. ا. مرتضوی

چکیده

در بیشتر کشورهای در حال توسعه، افزایش زمین برای آبیاری و یا حداقل عدم کاهش زمین‌های در دسترس هنوز یکی از مهم‌ترین اهداف سیاست‌های مرتبط با رشد تولید محصولات کشاورزی است. سیاست خودکفایی تولید گندم در ایران باعث افزایش هزینه‌های جانبی نظیر تخریب منابع آبی و زمین شده است. با این وجود، خودکفایی در تولید گندم در ایران، به دلایل اقتصادی و اجتماعی مختلف یک سیاست الزام‌آور محسوب می‌شود. بر اساس آمارهای موجود، به طور متوسط در حدود ۶۷ درصد تولید گندم در مناطق مختلف ایران را تولید گندم آبی تشکیل می‌دهد. از این‌رو، در این مطالعه با تأکید بر نقش تمایزهای منطقه‌ای و با استفاده از رویکرد میانگین گروهی تلفیقی (PMG)، تأثیر سیاست خرید تضمینی بر توزیع سطح زیر کشت گندم آبی در ایران برای دوره زمانی ۱۳۸۰ تا ۱۳۹۵ ارزیابی شد. نتایج نشان داد که در بلندمدت افزایش سطح زیر کشت گندم آبی در کشور نسبت به افزایش قیمت تضمینی گندم و عملکرد در هکتار این محصول کشش‌پذیر است. با این وجود، با افزایش قیمت جو در بلندمدت، سطح زیر کشت گندم آبی کاهش می‌یابد. علاوه‌براین، در کوتاه مدت سطح زیر کشت گندم آبی در بسیاری از استان‌های غربی نسبت به افزایش عملکرد در هکتار و در اکثر استان های مرکزی به تغییرات قیمت جو کشش‌پذیر است. در نهایت، به‌منظور تأمین سطح زیر کشت گندم آبی در کشور در کوتاه‌مدت و بلندمدت تأمین انتظارات قیمتی کشاورزان در مورد سیاست خرید تضمینی و بهبود عملکرد در هکتار این محصول پیشنهاد شد.

[DOR: 20.1001.1.16807073.2020.22.1.11.7]