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CLIMATE AND GOVERNMENT'S GUARANTEED PRICE POLICY EFFECTS ON THE MAJOR OILSEEDS CULTIVATION AREA AND LAND RENTAL IN IRAN

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Abstarct

One of the important targets of government policy in agriculture sector is to increase the cultivation area and production level of strategic goods such as oilseeds due to the wide dependence on imports in the supply chain of vegetable oil. This study aimed to assess the impacts of climatic factors and government policies (both uncontrollable and controllable factors) on soybean and canola cultivation area and land rental in some provinces of Iran using data collected over 2001-2016. For this purpose, Ricardian model and panel data approach were applied. The results revealed the great influence of rainfall and temperature changes on soybean and canola cultivation area in Iran. Guaranteed prices for soybean and canola had a positive significant effect on the crops cultivation area. On the other, adoption of the self-sufficiency policy for wheat production through increasing the guaranteed price impeded development of oilseed cultivation area. Unlike for canola, increased wheat cultivation area had, however, no statistically significant influence on soybean cultivation area. Overall, decreased precipitation and air temperature warming are anticipated to negatively impact oilseeds cultivation area and land rent.

Keywords: *Climate change, Guarantee price, Land rental, Oilseeds cultivation area, Panel data approach, Ricardian model*
Jel Codes: *Q15, Q18, Q51, Q58*

1. Introduction

Different factors affect the cultivation area, some of which can be controlled and some are uncontrollable. Controllable ones are part of agricultural policy tools and divided into two categories: price and non-price factors (Nassiri et al., 2006). The Prices of agricultural products and their inputs are the price factors playing a crucial role in cultivating or expanding the cultivation area. In other words, the price of agricultural products is both economically and politically important (Ashktorab et al., 2015). In addition to controllable factors, the effect of uncontrollable factors on increasing the cultivation area and even the cultivation of agricultural products is introduced. Climatic conditions are the most important uncontrollable factor.

Since 1850, some factors such as growing population, increase of fossil fuel consumption, deforestation and environmental degradation have led to an increase in greenhouse gas (GHG) emissions on the globe (Zarakani et al., 2014). In recent decades, climate change and global warming have threatened global sustainability through its role in addressing environmental challenges (Hope, 2005; Kemfert, 2009). Although climate change affects all sectors, the vulnerability of the agricultural sector due to its nature is relatively more than others.

Today, oilseeds are considered as the strategic agricultural products of the world, and after cereals, constitute the second largest food store worldwide (Heydari et al., 2010). The results of the Iranian Nutrition Institute's research show that 21% of total energy consumed in Iran comes from the oilseeds and vegetable oil.

The production and cultivation area of soybean and canola (the main oilseeds used in the oil industry) as can be seen in fig 1 and fig 2 reveal that the canola cultivation area and production estimated in 2015-2016 was about 40.2 thousand hectares and 58.6 thousand tuna, respectively, and 84.87% and 15.13% of the lands are irrigated and rainfed, respectively. Khuzestan province with 17.53% has the highest cultivation area of canola followed by Ardebil (13.51%), Golestan (12.38%), Mazandaran (10.33%), Kermanshah (5.56%) and Ilam (5.16%) (Ministry of Agriculture-JAHAD, 1997). For soybeans, the cultivated area and the amount of production in the country, respectively, is estimated at 61.53 thousand hectares and 140 thousand tons, 91.54% of the cultivated area was under irrigation. Around 96% of total soybeans are harvested from the farms located in Golestan, Ardebil and Mazandaran provinces.

Figure 1 Major Cultivation Provinces of Canola

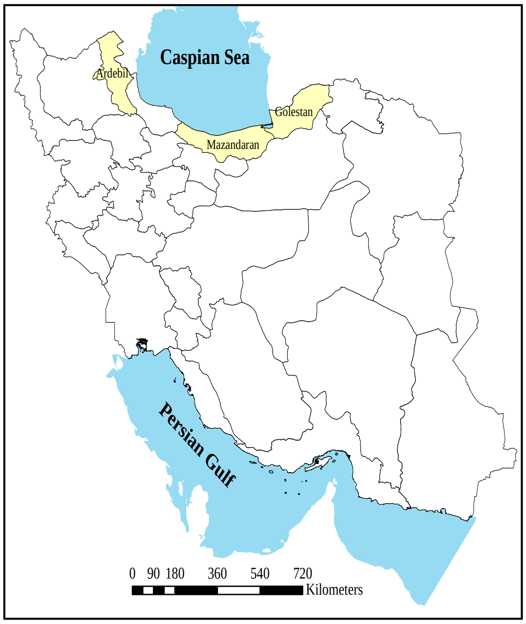
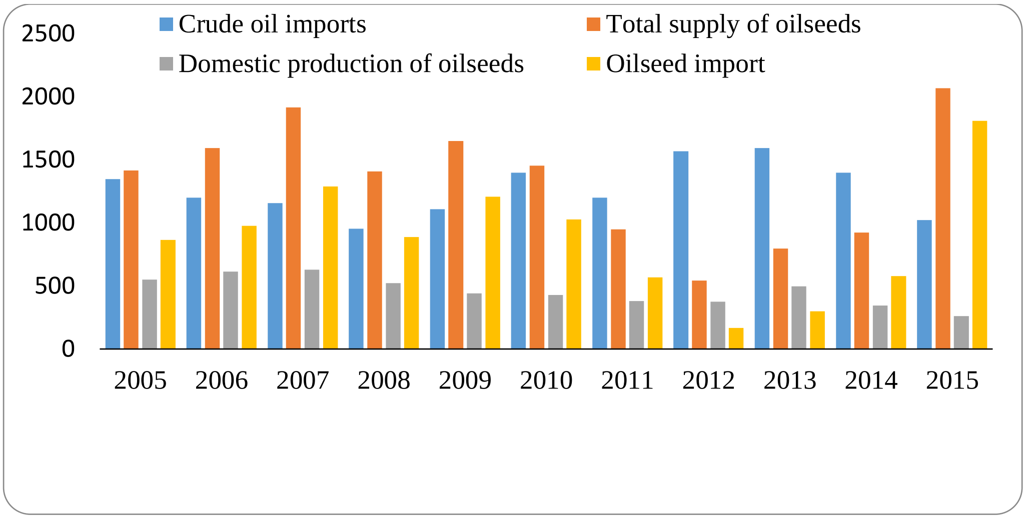


Figure 2 Major Cultivation Provinces of Soybean

The sources of vegetable oil supply in Iran highly rely on importing oilseeds (mainly soybeans and canola) and crude oil and extraction from domestic oilseed production. Today, Iran is considered as one of the largest importers of vegetable oilseeds and crude oil, and the import trend was also steadily increasing. To understand the dependence of imports on the supply chain of vegetable oil, the amount of domestic and imported oilseeds and crude oil is shown in Fig-3. Except for 2012 and 2013, the amount of imported oilseeds was more than 60% of the domestic demand, and in aforementioned years, the import trend has shifted from oilseeds to crude oil. The crude oil import trend during the surveyed period was accompanied by increasing fluctuations, from 840 to 1397 thousand tons in 2014, indicating a rise in dependency on importing crude oil as the raw material of the oil extraction industry. Therefore, the supply of vegetable oil in the country has a significant foreign currency drain. As an instance, the amount of currency allocated to this basic commodity was 2,548 million dollars, with the share of oilseeds, crude oil and meal 970, 872 and 706 million dollars, respectively.



Source: Ministry of Agriculture and Customs Organization (2016)

Figure 3 The Statues of Import and Production of Oilseeds and Crude Oil in Iran (Thousand Tons)

Self-sufficiency coefficient is one of the important indicators that shows the quantity of securement the basic needs of the country from domestic sources and is one of the indicators for measuring food security and the actual share of domestic production of the total supply. Table 1 shows the self-sufficiency coefficient of Iran's vegetable oil supply chain based on the imported oilseed and crude oil, conversion factors of oilseed to crude oil and the percentage of waste in conversion of crude oil to refined oil. These findings indicate that the self-sufficiency rate of oil supply from domestic sources fluctuated to less than 10% in the studied period implying an increased dependency on imports for this essential and strategic commodity.

$$\text{Self Sufficiency} = {(\text{Domestic production})}\Big/{(\text{Import} - \text{Export} - \text{Domestic Production})}$$

Table1. Self-Sufficiency Coefficient in Vegetable Oil (Percentage)

year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Self-sufficiency coefficient	3	16	17	36	23	6	10	6	8	8	17

Source: Research findings

Considering the levels of self-sufficiency in the supply chain of vegetable oil, recently one of the government's policies is to enhance the domestic production of oilseeds and the self-sufficiency over 70% in line with the country's vegetable oil supply plan resources during the period of 2005-2014. Therefore, in the past few years, the government has been attempting to increase the prices and adopt a guaranteed purchasing policy to increase the cultivation area and consequently the production of soybeans and canola oilseeds in the country. Further, the government is pursuing a wheat guaranteed price policy which has an indirect impact on the cultivation and production of oilseeds. Putting it differently, due to the high yield per hectare of wheat, this product is in competition with the cultivation of oilseeds. Due to recent wheat self-sufficiency policy, the failure in the country's oil supply plan can thus be attributed to the implementation of this policy and the willingness of farmers to plant wheat. Therefore, besides environmental and climatic factors, government policies can also influence the crop cultivation area (Garshasbi et al., 2012).

Some studies have been carried out to study the climate change impacts on agriculture over the globe Wang et al. (2009) Liu et al. (2004) Gbetibouo and Hassan (2005) Finger and Schmid (2007) Hussain and Mudasser (2007) and Iran Ashktorab et al. (2015) Parhizkari et al. (2013) Moameni and Zibae (2013) (Nouri et al., 2017). Overall, their results indicated that climate change seems to be a threat to agricultural production particularly in water-limited regions such as Iran.

This study aimed to assess the impacts of climatic changes and government policies on soybean and canola cultivation area and land rental in Iran.

2. Materials and Methods

A regression model in the form of panel data is defined as follows:

$$Y_{it} = \alpha_{it} + \beta_1 X_{1it} + \beta_2 X_{2it} + \cdots + U_{it} \quad (1)$$
$$U_{it} = \mu_i + v_{it}$$
$$v_{it} \approx iid(0, \sigma_i^2)$$

where U_{it} has a mean of zero and a constant variance, μ_i consists of constant effects and indicates the differences in specific characteristics of the individual, firm or countries and v_{it} denotes the error term.

v_{it} is independent of X_{it} for all i and t.

In the case of heterogeneous confirmation, the model is estimated by the panel method with fixed or random effects, otherwise it is estimated by OLS method, as data are accumulated and the difference between the sections is ignored (Baltagi, 2008).

According to this test, with the null hypothesis for μ_i that expresses the individual effects or heterogeneities, they are defined as:

$H_0 = \mu_1 = \mu_2 = \cdots = \mu_n = 0$

H_1: At least one of μ_i is non − zero

The F-Leamer statistics can be defined as follows:

$$F = \frac{(R_{fe}^2 - R_{pool}^2)/(n-1)}{(1 - R_{fe}^2)/(nt - n - k)} \sim F_{[(n-1),(nt-n-k)]} \quad (2)$$

Where R_{fe}^2 statistics is the coefficient of determination of the regression with fixed effects and R_{pool}^2 is the coefficient of determination of restricted regression related to the null hypothesis.

If the calculated F is greater than the tabulated F-value with degrees of freedom (n-1) and (nt-n-k) from the region of α, then the hypothesis $H_0$is rejected, so the regression model is estimated by panel data method.

The most common test for determining the type of panel data model is the Hausman test. After performing the F-Leamer test, if the H_0 hypothesis is rejected against the H_1 hypothesis, then this test can be used to choose between a fixed and random method (Yaffee, 2003). To decide on choosing a fixed or a random effect model, Hausman proposed the following test:

$$H_0: \quad E(\varepsilon_{it}/X_{it}) = 0$$
$$H_1: \quad E(\varepsilon_{it}/X_{it}) \neq 0$$

In panel models, the Levin, Lin, Chu test, Breitung test, Im, Pesaran, Shin test, Fisher test and Hardi test methods, which are the most important unit root tests with panel data, are used to determine the stationarity or non-stationarity of variables.

In the analysis of co-integration, the existence of long-run relationships between variables is tested. The main reason for this analysis comes from the fact that many economic time series may not be stationary, but it is likely that their linear combination in the long run is stationary without random process. Generally, the co-integration test in panel data is done using Pedroni and Kau methods.

Most farmers respond to the price changes by changing the cultivating area. Therefore, to measure farmers' response to the price changes, cultivation area is preferably used (Ashktorab et al., 2015), because the planned production or optimal production is not visible and the farmer does not control it. Therefore, since the cultivation area shows an appropriate response to the changes in price, it is used instead of production in the supply response model (Saylor, 1974).

Several price and non-price factors have been considered for determining the factors affecting the cultivation area of oilseeds. In the present study, soybean and canola cultivation area were considered as a function of the following factors:

$$S_{it} = f(W_{it}, R_{it}, T_{it}, PS_{it-1}, PW_{it-1}, S_{it-1}) \tag{3}$$

Where,S_{it}, W_{it}, R_{it} and T_{it} are the oilseeds cultivation area, wheat cultivation area, rainfall and temperature in the province i at time t, respectively. There are many alternative crops for oilseeds. Given the government's policy of self-sufficiency in the production of wheat, as well as the similarity of cultivation conditions of these two crops, wheat guaranteed prices and cultivation area were presented in the model. The comparative expectations model was used in the formation of the oilseed farmer’s expectations for price and non-price factors, as farmers take their decisions based on expectations rooted in this pricing model. In other words, the actual prices of the previous year would be considered to form price expectations of the next year (Hayat Gheibi et al., 2009). Since oilseed and wheat crops are supported by the government at guaranteed prices, the criterion for farmers' decision is to guarantee prices for wheat and oilseeds with a lag. Thus, PS_{it-1} and PW_{it-1} were included in the model. Finally, the lag of oilseeds cultivation area was considered in the model due to its importance in determining the farmer's decision to plant the desired product. The final mathematical expression of model is:

$$S_{it} = a_0 + a_1 W_{it} + a_2 R_{it} + a_3 T_{it} + a_4 PW_{it-1} + a_5 PS_{it-1} + a_6 S_{it-1} \tag{4}$$

The Ricardin method was employed to study the climate change impacts on agricultural land rents. Theoretically, agricultural land rent reflects the net productivity of the farm, and the net income per hectare for the cultivation of selected products is considered as the yardstick for rent or land value(Vaseghi & Esmaeili, 2008) (Ricardo, 1817, 1822). In fact, this model tests the effects of climate change and other variables on land value or net income (Kurukulasuriya and et al, 2006). In the Ricardian model, the production and cost functions are as follows (Eid et al., 2007):

$$\begin{aligned} Q_i &= Q_i(K_i, E) \\ C_i &= C_i(Q_i, W, E) \end{aligned} \tag{5}$$

where Q_i represents the amount of i-th produced product, K_i denotes the vector of production inputs for the i-th product, E is the factor vector of exogenous climates factors such as temperature and rainfall, C_i denotes the cost of production and W is the price vector of the production factors.

According to the production and cost functions, the profit function for a farmer in the condition of the fixed price is computed by (Eid and et al, 2007):

$$Max \quad \pi = [P_i Q_i - C_i(Q_i, W, E) - P_{Li} L_i \tag{6}$$

Where P_{Li} and L_i are the annual land cost of i-th product and its cultivation area, respectively. Given the fact that the land rent per hectare of cultivation is equivalent to net income per hectare P_{Li} can be calculated by:

$$P_{Li} = (P_i Q_i - C_i(Q_i, W, E))/L_i \tag{7}$$

In this equation, net income per hectare for the cultivation of the target product is considered as a measure of land rent. In order to obtain the net income, all production costs (e.g. planting and harvest costs) except the land cost must be subtracted(Vaseghi & Esmaeili, 2008). In general, the Ricardian model considering land rent as a function of climate variables is defined by:

$$P_{Li} = \beta_1 E + \beta_2 E^2 + \beta_3 Z + u \tag{8}$$

Where Z is a vector of other exogenous variables that varying according to the type of product and area studied.

Considering the importance of studying climate change impacts on net revenue of oilseeds, oilseed net revenue, instead of land rent, was used as a dependent variable to investigate the effects of independent variables such as temperature, rainfall, elevation of sea level, labor, seeds, fertilizers and interactions of temperature and precipitation on oilseed net revenue. Therefore, the applied model in this study was:

$$NR = F(T_{it}, T_{it}^2, R_{it}, R_{it}^2, TR_{it}, H_{it}, L_{it}, F_{it}, S_{it}) \tag{9}$$

Where NR is the net revenue, T_{it} is the temperature in i-th province, TR_{it} represents the interactions of temperature and precipitation and $H_{it}, L_{it}, F_{it}, S_{it}$ denote the elevation of sea level, labor, fertilizers and seeds, respectively.

The data used in this study were soybean and canola cultivation area obtained from the Iran Ministry of Agriculture (Ministry of Agriculture-JAHAD, 1997), the guaranteed prices gathered from Parliament Research Center as well as temperature and rainfall data collected from the Iran Meteorological Organization (Iran's Meteorological Organization-IRIMO) over 2001-2016 for major provinces producing oilseeds.

3. Results and Discussion

According to the results given in Table 2, all the variables used in the model were stationary at level or in first difference.

Table 2. Results of Stationary Test of Variables

	index	Levin, Lin & chu	Im, Pesaran and Shin stat.	Stationary level
Soybean	S	-3.53^{***}	-1.56^{**}	I(0)
	W	-2.54^{***}	-1.83^{**}	I(0)
	R	-2.49^{***}	-3.21^{**}	I(0)
	PS(-1)	-1.75^{**}	0.45^{ns}	I(1)
	PW(-1)	-2.01^{**}	0.12^{ns}	I(1)
	T	-0.61^{ns}	-3.77^{***}	I(1)
Canola	Ca	-9.57^{***}	-5.48^{***}	I(0)
	W	-3.45^{***}	-2.61^{***}	I(0)
	R	-1.22^{*}	-2.87^{***}	I(0)
	PS(-1)	4.50^{ns}	6.06^{ns}	I(1)
	PW(-1)	2.18^{ns}	4.59^{ns}	I(1)
	T	-8.69^{***}	-7.37^{***}	I(0)

Note: *** indicated significant level at 1%, ** indicated significant level at 5% and * indicated significant level at 10%

For soybean, Group Panel PP and Group Panel ADF test statistics were significant at 1% confidence level and Group Panel rho test at 10% level and Kau statistics at 1% confidence level (Table 3) implying that the co-integration test was significant. In other words, there was a strong and long-run equilibrium relationship between the dependent variable of soybean and the explanatory variables of the model in Iran. Analysis of the results of the co-integration test for canola based on the three group panel PP, group panel ADF and kau statistics showed a statistically significant level of 1% which indicates the co-integration or long-run equilibrium relationship between the dependent variable and the explanatory variables of the model. But based on Group Panel statistics, the assumption of co-integration was rejected.

Table 3- Results of Kao and Pedroni Co-Integration Tests of Variables

	Test method	Test statistics	Null hypothesis	Test result
Soybean	Kao test	-6.73^{***}	Not cointegration	Null hypothesis rejected
	Group Panel rho-statistics	-1.27*	Not cointegratio	Null hypothesis rejected
	Group Panel PP-statistics	-5.23***	Not cointegratio	Null hypothesis rejected
	Group Panel ADF-statistics	-4.57***	Not cointegratio	Null hypothesis rejected
Canola	Kao test	-8.43***	Not cointegratio	Null hypothesis rejected
	Group Panel rho-statistics	1.33^{ns}	Not cointegratio	Null hypothesis rejected
	Group Panel PP-statistics	-5.19***	Not cointegratio	Null hypothesis rejected
	Group Panel ADF-statistics	-2.53***	Not cointegratio	Null hypothesis rejected

The calculated F-Limear value for both the soybean and canola regression models was more than the critical value of the tabulated F (Table 4). The performance of both models was thus better in the form of a panel. Therefore, the null hypotheses were rejected in favor of the alternative hypothesis.

Table 4. Results of F-Leamer (Redundant Fixed Effects Tests)

	Effects Test	statistics	df	Prob.
soybean	Cross-Section F	17.45	(3,60)	0.000
	Cross-Section Chi-square	41.92	3	0.000
canola	Cross-Section F	3.72	(7,106)	0.001
	Cross-Section Chi-square	26.36	7	0.0004

Since three provinces of Golestan, Mazandaran and Ardebil contain about 97% of the soybean cultivation area, and our cross-sections are less, applying Hausman test and the random effects to estimate the soybean oilseed regression appears to be unreliable. In this regard, the soybean model was developed as a fixed effect form.

The value of R^2 showed that 92% of the changes in soybean cultivation area were explained by the variables of the model. The F statistics indicates the meaning of the whole model. Finally, based on the Durbin-Watson statistics, it can be stated that there was no correlation in the model. There was a negative and significant lagged relationship between the guaranteed price of wheat and soybean cultivation area (Table 5). This implies that 1% increment in wheat guaranteed price announced by the government decreases soybean cultivation area by 2.95%. Considering the policy of self-sufficiency for wheat and increasing prices of wheat guarantee by the government, an increase and a reduction in wheat and soybean cultivation area is expected, respectively. Since self-sufficiency of wheat production is one of the most important economic goals of the government to maintain food security, farmers cultivates wheat due to the high yield per hectare of wheat declining the soybean cultivation. In addition to the lag effect of guarantee price of wheat, the soybean guarantee price with a lag was also surveyed. The results show that soybean guarantee price has a positive and significant effect on the soybean cultivation and a 1% increase in soybean's guaranteed price causes a 2% rise in the soybean cultivation. The variable of wheat cultivated area had a negative insignificant impact upon soybean cultivation.

Based on the estimated coefficients, the variable of soybean cultivation with a lag was considered as one of the factors influencing the cultivation area of this product. This indicates that production change is risky for farmers owing to the cropping experiences they previously earned and adequate access to necessary inputs, so the farmers react less to change production.

Finally, if other factors are fixed, annual rainfall and temperature statistically significantly affected the soybean cultivation area with coefficients of 0.91 and -0.8, so 1% increment of rainfall and temperature changed the soybean cultivation by 0.91% and -0.8%, respectively. Increase in precipitation can cause increased soybean cultivation area. Considering that 92% of soybean cultivation is under irrigation, increase of precipitation can provoke soybean cultivation in drought-prone provinces, and a 1% increase in the average temperature during the soybean growth season reduces the soybean cultivation area by 0.8%.

Table 5. Estimation Results of the Factors Affecting the Cultivation Area of Soybean Oilseed in Major Provinces

variables	Coefficients	t-statistics	Significant level
constant	3.46	1.62	0.12ns
Log of wheat guarantee price with a lag	-2.95	-1.8	0.07*
Log of soybean guarantee price with a lag	1.98	2.14	0.026**
Log of annuals rainfall	0.91	2.61	0.01*
Log of annuals temperature average	-0.8	-2.2	0.03**
Log of wheat cultivation area	-0.06	-0.47	0.63ns
Log of cultivation area of soybean with a lag	0.95	23.03	0.000*
Durbin-Watson F-statistics	2.28 90.75*	R-square Adjusted R-square	0.917 0.907

The model performed better in estimating the canola cultivation area in the form of a panel (Table 4). Table 6 also shows that the value of Hausman statistics for canola regression model was 13.56 with probability of 0.035, so estimating the model as random effects was unreliable as the probability value was less than 0.1. Therefore, the fixed effects model was used to estimate the effective factors on the canola cultivation area.

Table 6. Results of Hausman test (Random effects)

Test summary	Chi-Sq. statistics	Chi.Sq. d.f	Prob.
Cross-section random	13.56	6	0.035**

Table 7. Estimation Results of the Factors Affecting the Cultivation Area of Canola in Major Provinces

variables	**Coefficients**	**t-statistics**	**Significant level**
constant	4.09	2.12	0.03**
Log of wheat guarantee price with a lag	-2.09	-1.7	0.045**
Log of canola guarantee price with a lag	1. 84	1.92	0.034**
Log of annuals rainfall	0.37	1.67	0.05*
Log of annuals temperature average	-0.03	-0.16	0.87ns
Log of wheat cultivation area	-0.39	-1.85	0.038**
Log of cultivation area of canola with a lag	0.70	2.12	0.023**
Durbin-Watson F-statistics	2.48 49.61*	R-square Adjusted R-square	0.847 0.831

The logarithms of wheat guaranteed price with a lag, the guaranteed price of canola with a lag, annual rainfall, canola cultivation area with a lag, and constant coefficient were significant at 5% and had a significant effect on the canola cultivation area (Table 7). The temperature logarithm was not, however, statistically significant. For canola, the variables effects were similar to those of soybean, a 1% increment of wheat and canola guaranteed price leads to a 2.1% decrease and a 1.84% increase in canola cultivation area, respectively. Additionally, 1% increase of wheat cultivation reduces canola cultivation area by 0.4%. Precipitation positively significantly influences the cultivated area and a 1% increase in annual rainfall causes a 0.37% increase in the area under cultivation. Temperature had, however, a negative insignificant effect on the crop area.

Among the variables used in soybean Ricardian model, temperature, rainfall, height above the sea, square of rainfall, square of temperature, interaction of temperature and rainfall, fertilizers were significant at the acceptable level (Table 8). Temperature variables had a negative and significant effect on land rent. The estimated coefficient of rainfall variable was equal to 0.017 (significant at 1% level) implying that a 1% increment in annual rainfall increases the soybean net revenue by 0.017 An increment in soybean land rental under increased rainfall scenario can be attributed to the increase in water resources availability. In this study, height above the sea was considered as an indicator of solar radiation. The estimated coefficient was negative and significant. It can be, therefore, stated that increasing the height above the sea by 1%, soybean land rental is reduced by 0.3%. The air temperature decreases as the altitude increases leading to lengthened growth period and consequently a decrease in soybean land rental. The squares of temperature and rainfall represent the effects of U or inverse U on the net revenue, thereby; it is possible to obtain critical points of temperature and rainfall. Square of temperature and rainfall had a significant positive and negative effect on soybean land rental in the surveyed provinces, respectively. The interactions between these two variables were also significant at the level of 10% showing the significant simultaneous effects of these two variables on the rents. Furthermore, fertilizer input was significant at 5%. As a result, there was a positive significant impact on farmland rents resulting in an increase of rents. The variables of labor and seed were not significant on rents of soybean.

Table 8. Results of Climate Factors on Soybean Net Revenue in Major Provinces

Variables	Index	Coefficient	Standard deviation	T-statistics
Log of temperature	T	-0.38	0.156	-2.43**
Log of rainfall	R	0.017	0.004	4.25***
Log of height above the sea	H	-0.008	0.003	-2.28**
Log of square of temperature	T^2	5.713	2.33	2.45**
Log of square of rainfall	R^2	-2.89	1.64	1.76*
Log of interaction of temperature and rainfall	TR	1.64	0.85	1.92*
Log of labor	L	0.17	0.36	0.47^{ns}
Log of fertilizers	F	0.38	0.17	2.23**
Log of seed	S	0.435	0.583	0.82^{ns}
DW	2.43	R-square		0.853
F-statistics	53.06^{*}	Adjusted R-squared		0.836

Table 9. Results of Climate Factors on Canola Net Revenue in Major Provinces

Variables	Index	Coefficient	Standard deviation	T-statistics
Log of temperature	T	-0.08	0.32	-0.25^{ns}
Log of rainfall	R	0.009	0.004	2.22^{**}
Log of height above the sea	H	-0.07	0.02	-3.08^{***}
Log of square of temperature	T^2	0.003	0.016	0.18^{ns}
Log of square of rainfall	R^2	-2.71	1.51	1.79^{*}
Log of interaction of temperature and rainfall	TR	2.34	1.25	1.87^{*}
Log of labor	L	-0.28	0.47	0.59^{ns}
Log of fertilizers	F	-0.01	0.006	-1.98^{**}
Log of seed	S	0.34	0.165	2.06^{**}
DW	1.79	R-square		0.78
F-statistics	10.51^{*}	Adjusted R-squared		0.75

The Ricardin model was also used to study the effect of climate variables on land rental of canola oilseed (Table 9). Temperature, square of temperature and labor inputs had no significant effect on canola rent. The effects of rainfall, square of rainfall, interactions of temperature and rainfall, height above the sea, fertilizer and seed factors were, however, significant.

4. Conclusions

In recent decades, the issue of reducing the dependence on imports and increasing self-sufficiency over the 70% in the supply chain of vegetable oil was one of the most important policies that have been introduced. However, in the literature on international trade, self-sufficiency don't have particular position, due to the presence of Iran in Eventful Middle East region, self-sufficiency in the production of basic goods of the household basket can lead to maintaining independence and increasing bargaining power, as well as providing food security for the household. In order to achieve this, the government has sought to increase the level of oilseeds production as the first level of vegetable oil supply chain through various policies.

One of these policies is the guaranteed price determined annually by the Strategic Economic Council. Agricultural sector is highly prone to climate change and variability. The results of the current study revealed the great influence of rainfall and temperature changes on soybean and canola cultivation area over the provinces in Iran. Guaranteed prices for soybean and canola had a positive significant effect on the crops cultivation area. On the other, adoption of the self-sufficiency policy for wheat production through increasing the guaranteed price impeded development of oilseed cultivation area. Unlike for canola, increased wheat cultivation area had, however, no statistically significant influence on soybean cultivation area.

Overall, decreased precipitation and air temperature warming are anticipated to negatively impact oilseeds cultivation area and land rent. These results were in agreement with those of Vaseghi and Esmaeili (2008).

Hence, future climatic changes appear to pose a serious threat to oilseeds yields and farmers' income naturally leading to a reduction in production incentives. Further investigations are needed to examine the economic implications of climate change for strategic agricultural products and to obtain the best cultivation pattern for vulnerable areas. Land use evaluation to select the high yielding areas for oilseed is also required.

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