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Analysis of Stabilizer Structures of Canola Fields in Qazvin Province

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ABSTRACT

Objective: Today, addressing the issue of sustainability especially in agriculture has received more attention. Sustainability in the systems of Canola cultivation depends on many factors like ecological, social and economic dimensions and understanding these factors can result in formulation of policies and strategies for sustainable agricultural development. **Methods:** 8961 Canola farmers of Qazvin Province composed the statistical society of this research out of which 322 persons were chosen as sample using Cochran formula and they have been studied using a stratified sampling technique. The research collection tool was a questionnaire validity of which was approved by professors and experts in rural development and reliability of which was approved by preliminary study and calculation of Cronbach's alpha. Total sustainability indicator was calculated according to the three separate dimensions after leveling the indicators scale with the method of dividing by the average through analysis of main factors. **Results:** The findings suggest that in terms of sustainability of the whole system of Canola cultivation, 50.90 % of the farmers act in unstable and relatively unstable manner. From economic aspect, 44.10 % of the farmers act in unstable and relatively unstable manner. 25.8% of the farmers act in stable manner in terms of ecological aspect. Results of regression analysis showed that 32% of the changes in the ecological sustainability are explained by variables of technical knowledge, knowledge of sustainability, job satisfaction, benefit from promotional programs and mechanization.

1.INTRODUCTION

Benefiting from 1.38 million hectares of arable lands and 265 thousand farmers with more than seven million tons of different products, Qazvin Province is considered as one of agricultural poles of Iran (anonymous, 2005). Canola cultivation area in this province was over 20 thousand hectares during crop year of 2009-2010. Total amount of Canola production in the same crop year totaled 850 thousand tons which led to its first place in

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the country (Statistics of Agricultural Jihad, 2009). In recent years, Canola production increased in this province and therefore, farmers have been encouraged to use various technologies and chemical fertilizers and pesticides in the production of this crop. Studies conducted by researchers and organizations related to rural and agricultural development show that more emphasis on the use of technology in agricultural development has led to adverse and concerning consequences for environment and natural resources. In addition investigation shows that the past functions all of which have been based on technology promotion are not in harmony with current needs of human society. Soil erosion, destruction of forests and pastures, destruction of beneficial soil microorganisms, threat of aquatic life due to indiscriminate use of pesticides and chemical fertilizers are adverse and concerning effects of the approach of technology transfer. This concern has led to a new attitude titled " Unsustainable Exploitation of Natural Resources"; however it should not be forgotten that sustainability is not a new concept, but a concept that today has received more attention (Praneetvatakul & et al, 2001) and due to its long-term and unique nature it requires attention to issues beyond the everyday problems and it is rapidly expanding (Lozano, 2008). In relation to interpretation of the concept of sustainable agriculture, there are different schools of thought all of which have a common vision: what exists today is not sustainable agriculture. Some researchers classified present schools of thought into three categories: economic, ecological and social categories (Karami, 1995); others believe that sustainable agriculture is a system widely focused on both environmental and social aspects (Lyson & et al, 1998). Others define sustainable agriculture with regard to economic dimension (Young & Burton, 1999); others consider sustainable agriculture as a system that is technically appropriate, economically viable and socially acceptable (Ogaji, 2005).

Thus, we can say that sustainable agriculture includes different aspects like economic profitability for farmers (Karami, 1995, Ingels & et al, 1997, Herzog & Gotsch, 1998, Lyson, 1998, Comer & et al, 1999, Pannell & Glenn, 2000, Andreoli & Tellarini, 2001, Koeijer & et al, 2002, Rasul & Thapa , 2003, Gafsi & et al, 2006 and Passel & et al, 2006), maintenance of environmental quality and facilitation of local communities. Hence, despite public concern about sustainable agriculture, there are disputes among researchers and agricultural scientists in the field of sustainable agriculture. A group of researchers emphasis on low use of external inputs as a key tool for agricultural sustainability (Saltiel & et al, 1994, Hayati, 1995, Rezaie Moghaddam, 1997, Ingels & et al, 1997, Norman & et al, 1998, Comer & et al, 1999, Boshard, 2000). Others heavily focus on increasing production and use of more external inputs in some cases – albeit taking soil quality and crop yield into account. However, concern of most researchers in ecological sustainability is maintaining the ecological health (Rasul & Thapa, 2003), diversity (Saltiel & et al, 1994; Ingels & et al, 1997; Pannell & Glenn, 2000; Gafsi & et al, 2006; Cawenbergh & et al, 2007) and maintaining the quality of resources (Sands & Podmore, 2000; Bosshard, 2000; Gafsi & et al, 2006) as necessary conditions for sustainable agriculture. However, understanding different approaches of sustainability enables us to evaluate potentials and related constraints. Sustainable agriculture depends on different ecological, economic and social factors that recognizing these factors and their interactions can be of great importance to the issue of sustainability (Brower, 2004, Filho, 2004, Ikerd, 1990). Ecological dimension of sustainable agriculture is its most visible and important aspect. This dimension is based on conservation of natural resources and less emphasis on hazardous inputs and chemicals contaminating the environment. Climate change or new plant pests and diseases can have similar effects. Efficient use of water resources (Karami and Hayati, 1998), minimum tillage (Manyong & Degand, 1995), multi-cultivation (Kouchaki and Khiabani, 1994), crop management for sustainable soil fertility, crop rotation, use of crop residue, use of green and animal manures, use of compost, efficient use of fertilizers and chemical pesticides are variables that are considered in terms of ecology (Arnon, 1998; Nazemosadat et al, 2006). Exclusive emphasis on ecological sustainability, regardless of its economic dimension, will not result to sustainable agricultural development because farmers usually make their decisions about the use or non-use of different methods in agriculture based on personal guarantee of profitability of these methods.

In assessment of the economic dimension of sustainable development we can mention several criteria and measures like productivity (in terms of yield or net income), stability of yield or net income, yield sustainability or net income and income distribution (Yousefi, 2005, Tisdell, 1992).

The social dimension may be reflected in the capacity of agricultural systems to adequately protect agricultural communities (Herzog & Gotsch, 1998). The welfare of family and farmer, job satisfaction, appropriate working conditions, health and nutrition, life and living standards of farmers, all affect production process and its continuation (Filho, 2004). In general, there are problems in the way of analysis of sustainability that prevent a thorough assessment and providing a comprehensive model of sustainable agriculture. However, several studies have been done in assessment of the three dimensions of sustainability in agriculture. In a study, ecological sustainability was measured according to five indicators of land use pattern, cropping pattern, soil fertility management, pest and disease control management (Rasul & Thapa, 2003). Also intercropping, soil fertility, use of fertilizers and pesticides were discussed as measures in the ecological dimension (Ibid). Whereas some researchers consider soil structure, food chain, residue management and crop diversification as indicators of ecological sustainability (Anderson, 2005). In consideration of economic dimension, income is considered as one of the indicators. As well the economic sustainability has been measured by three indicators of land use efficiency or performance, stability of yield, and profitability (Rasul & Thapa, 2003). In assessment of social impacts, some people consider it as existence and operation of infrastructure, services (health, education and culture) and governmental rules for the public (Karami, 1993). From another perspective, social sustainability includes issues that affect people's quality of life (Guy & Rogers, 1999). Some of them have spoken about combinational approaches for analysis of sustainability (Bebbington & et al, 2006; Dietz & Neumayer, 2006). However, as sustainability simultaneously emphasizes on economic, social and ecological dimensions, the process of evaluation of sustainability and analysis of related models makes we face this challenge that how we can create interaction between the different dimensions of sustainability (Munda, 2004).

Several studies have been done by domestic and foreign researchers in the field of measurement of agriculture sustainability and its effective factors that some of the most important ones are mentioned.

In the study of Roosta (2000) analysis of sustainability of farming system of corn farmers is considered and the findings suggest that there is significant positive relationship between technical knowledge, performance of the product, the service provided by the Agricultural Service Centers and type of farming system and sustainability of farming systems of corn farmers. Iravani and Darban Astaneh (2004) in a study entitled "Measurement, analysis and explaining sustainability of operation units of wheat farmers in Tehran" concluded that 46.70% of the operations were unstable and amount of yield and productivity of production factors and technical knowledge have had the greatest impact on sustainability. Findings of Omani and Chizari (2006) about analysis of sustainability of farming system of wheat farmers show that educational level, technology, knowledge of sustainable agriculture, the amount of land under cultivation, crop income, social status, and social norms, social participation and use of information channels have positive and significant correlation with the sustainability of farming systems. In the research of Maghsoudi et al (2007) sustainability of the farming system of potatoes was studied. The findings show that 66.78% of the cultivation systems are relatively stable. Also there is positive and significant correlation between sustainability of potato and variables like history of farming, history of potato cultivation, and membership in cooperative company, the area of land under potato cultivation and use of fallow. However consumption of fertilizer has a significant relationship with sustainability. Solomon et al (1997) examined the influence of family factors affecting the adoption of sustainable farming systems and concluded that the adoption of sustainable systems has a positive and significant relationship with ethnicity, and religious activities and cooperative promotional services. In the research of Stokle et al (1994) 9 major factors of profitability of farm, product quality, water quality, soil quality, air quality, energy efficiency, protection of the environment, and acceptance by the society were considered to assess the sustainability.

Overall in this study 38 indicators were used to measure sustainability in three social, economic and environmental dimensions and the effects of technology, mechanization status, benefit from support services, educational and promotional services, social participation and satisfaction with the job of farming on sustainability of Canola cultivation were studied.

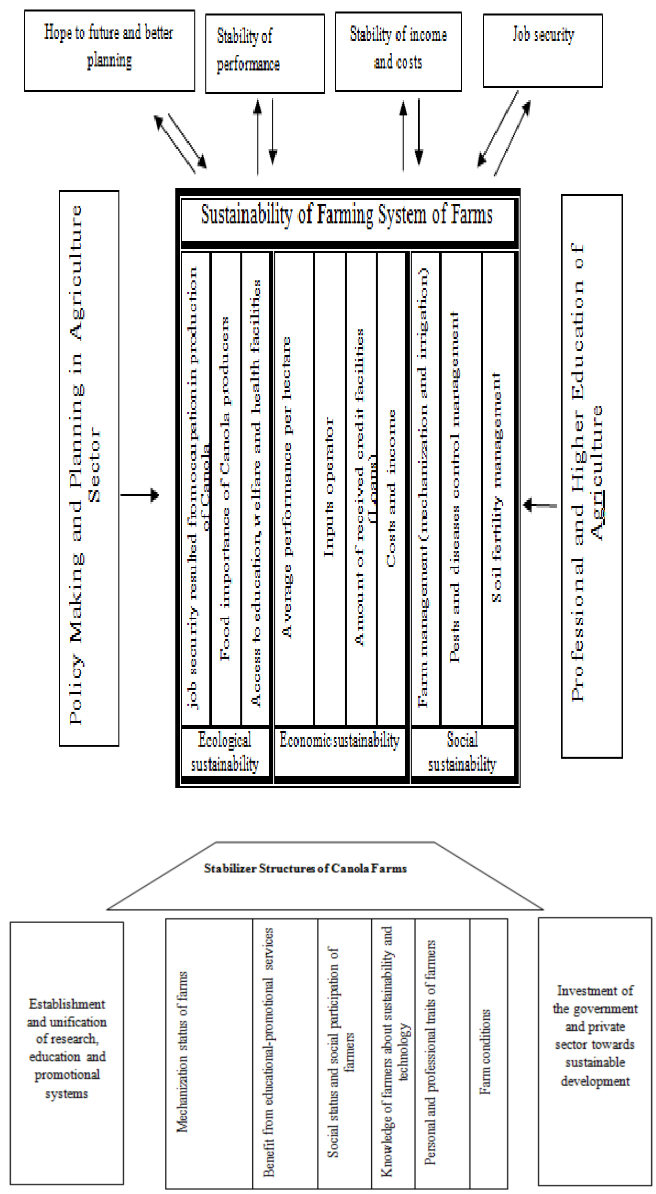

Figure 1: The Research Framework

2. METHODOLOGY OF RESEARCH

In terms of nature and quantity and considering the extensive range of research, survey techniques were used in the present study. This study is considered as applied research in terms of orientation and target. In terms of time as well, given that it was performed at a certain point of time, it is considered as a cross-sectional study. The population of this study consisted of 8961 Canola farmers who cultivated Canola in crop year 2009-2010 in Qazvin province. Sampling was based on a stratified multi-stage random sampling. For that purpose, with respect to the method of sampling, Scheffer et al Formula (1996) was used to more accurately estimate the number of samples and 245 persons were included in the study. In order to better generalize the results, according to the classes of the total population, 77 persons were added to the obtained ratios. Finally, the sample size was determined as n=322. Data collection was conducted using a questionnaire. First the validity of the questionnaire was approved by the relevant professors and experts and a pilot study was performed with 30 selected farmers outside the scope of the investigation, in order to check reliability of the measurement tool. The Alpha coefficients obtained for measures were between 0.75 and 0.88. Necessary adjustment was performed on variables that had a small amount of alpha and finally 322 questionnaires were completed.

In the present study, in order to assess the sustainability, basic variables of three ecological, economic and social dimensions were extracted and indicators of sustainability were developed based on them. Ecological dimension was composed of 19 indicators, economic dimension was composed of 12 indicators and social dimension was composed of 12 indicators (Table 1). Validity of the indicators was approved by consensus of the pundits. Then the desired indicators were leveled through the method of division by the mean (Karami and Rezaei Moghadam, 1998). The scaled leveled indicators were multiplied by corresponding weight obtained by the method of principal components analysis. The combined indicator, according to the three dimensions, was obtained by the sum of all related indicators. Then total combined sustainability indicator was measured by the sum of combined indicators of the three dimensions. The equation of sustainability indicator of farming system of Canola is as follows:

$$CI = \sum_{i=1}^{n} \frac{xij}{X} * Wij$$

Where CI is combined indicator of sustainability, Xij is indicator I of Canola farmer j, X is the mean of Xi, wij is the weight of indicator I, which was obtained through principal components analysis.

Table 1: Indicators used in the Measurement of Sustainability in the Research

Measures of Ecological Sustainability	Measures of Economic Sustainability
Ratio of fallow lands to total cultivated lands	The average yield per hectare
Ratio of rotation lands to total land area	The average income of farmer per hectare
Ratio of continuously cultivated lands to total area (negative)	Ratio of debt to total farm income
Ratio of Leveled lands to total lands	Ratio of insured to total land area
Ratio of sloped lands to total land area (negative)	Proportion of the family workforce employed in agriculture
Ratio of composted lands to total land under cultivation	Expenditure per hectare (negative)
Ratio of Protective tillage to total land under cultivation	Seed productivity (total value of production to the costs of seeding)
Ratio of lands with modern irrigation systems to total land area	Fertilizer efficiency (total value of production to the costs of fertilizer)
Consumption of bred seeds per kilogram of consumed seed	
Consumption of sterilized seeds per kilogram of consumed seed	
Removal of crop residue per hectare (negative)	Productivity of toxins (total value of production to the costs of toxins)
The use of agricultural machinery (negative)	Water productivity (total value of production to the

Consumption of phosphate fertilizer per hectare (negative) Consumption of potassium fertilizer per hectare (negative) Consumption of nitrogen fertilizer per hectare (negative) Consumption of micronutrient fertilizer per hectare (negative) Consumption of herbicide per hectare (negative)	costs of water) Labor productivity (total value of production to the costs of labor) Machine productivity (total value of production to the costs of machinery)
Consumption of toxin per hectare (negative) Consumption of water per hectare (negative)	Measures of Social Sustainability
	Satisfaction with the career future Position and social status Participation in promotional classes Job security Food Security Access to training facilities Access to health and welfare

3. RESULTS AND DISCUSSION

Findings listed in Table 2 show individual and occupational characteristics of the responding farmers. The results indicate that average age of respondents is 46.09 years, and average household size is 6 persons. Average agricultural work experience of the farmers is 18.33 years indicating the importance of agriculture in the study area. The research findings suggest that the area of personally-owned land is 2.91 hectares 2.39 hectares of which, whether personally or by rent, are devoted to the cultivation of Canola on average. The average number of plots, which is one of the basic measures of dispersion, is 3.5 plots and the average size of the plots is 2.47 hectares.

The findings suggest that average yield of Canola is 55.33 tones and average annual income of the farmers is 50 million Rials per year.

Table 2: Individual and occupational characteristics of the respondents

Max.	Min.	SD	Mean	Variables
85	20	16/16	46/09	Age (Year)
12	0	2/89	6	Household Size (person)
45	2	11/66	18/33	Agricultural work experience (year)
6	0/5	1/13	2/39	Area under cultivation of Canola (hectare)
45	1	7/06	2/91	Land area (hectare)
6	0	1/33	3/5	Number of plots (plot)
15	0/5	2/55	2/47	Average size of plots(hectare)
92/5	20	17/45	55/33	Average yield (tone)

130000	750	738/43	5000	Income (1000 Tomans)

The findings contained in Table 3 indicate that 9.31% of the farmers have low level of technical knowledge and 25.15 of the farmers are located on the upper level. In addition, 46.61% of the farmers had medium level of knowledge about sustainability. In terms of mechanization, 15.62% of them benefited from low level of mechanization and about 51% were at high levels. The results showed that 73.90% of the farmers benefited from low level of support services and only 3.41% of them enjoyed high level of support services. Information related to benefit from educational – promotional services also shows that 69.87% of the respondents enjoyed low level of benefit from these services. 31.36% of the Canola farmers had low participation in social activities of the village and 15.83% of them showed high level of participation in social activities of the village. In terms of satisfaction with the career, 49.06% of the farmers had low satisfaction with the job of farming and only 11.8% of them were satisfied with the career.

Table 3: Distribution of Respondents Regarding Some Selected Structures

High		**Medium**		**Low**		**Quantity**
%	**Frequency**	**%**	**Frequency**	**%**	**Frequency**	**Structures**
25/15	81	65/52	211	9/31	30	Technical Knowledge
45/03	145	41/61	134	13/36	43	Knowledge of Sustainability
51/24	165	33/23	107	15/62	50	Status of Mechanization
3/41	11	22/67	73	73/9	238	Benefit from Support Services
8/69	28	21/42	69	69/87	225	Benefit from educational – promotional services
15/83	51	52/79	170	31/36	101	participation in social activities
11/8	38	39/12	126	49/06	158	satisfaction with agriculture

Sustainability of Canola Fields

Table 4 shows frequency distribution of Canola farmers in terms of the three dimensions of sustainability of Canola fields. In terms of ecological sustainability of Canola farming system, 15.2 percent of the farmers act in unstable manner, 33.2% of them act relatively unstable, 25.80% of them act relatively stable and 25.80% of them have stable action. Findings in terms of social sustainability showed that 10.2% of the farmers act in unstable manner, 39.10% of them act relatively unstable, 36.10% of them act relatively stable and 14.60% of them have stable action.

The data indicate that in terms of economical dimension, 15.2 percent of the farms act in unstable manner, 28.90% of them act relatively unstable, 39.40% of them act relatively stable and 16.50% of them have stable action.

In terms of combined indicator of sustainability, 18.90% of the farmers act in unstable manner, 32% of them act relatively unstable, 32.60% of them act relatively stable and 16.50% of them have stable action.

Table 4: Distribution of Canola farmers' frequency in terms of sustainability of Canola cultivation in different dimensions

Stable		Relatively Stable		Relatively Unstable		Unstable		Status
%	Frequency	%	Frequency	%	Frequency	%	Frequency	ابعاد
25/8	83	25/8	83	33/2	107	15/2	49	Ecological Sustainability
14/6	47	36/1	116	39/1	126	10/2	33	Social Sustainability
16/5	53	39/4	127	28/9	93	15/2	49	Economic Sustainability
16/5	53	32/6	105	32	103	18/9	61	Total Sustainability

According to the findings contained in Table 4 it can be seen that sustainability of Canola farm both in terms of total combined indicator and the three dimensions of sustainability has been in medium level. Based on total combined indicator, 18.9% of the farmers were in the group with unstable system and 16.5 percent of them were in a stable state.

Factors affecting the sustainability of Canola fields

In examining the effects of individual, social and economic variables on anticipation of the sustainability of Canola fields in three economic, social and ecological dimensions, as can be seen in Table 5, among individual variables age has had a significant negative correlation with ecological sustainability in the confidence level of 0.01 (r=- 0.685, P=0.0001) and social sustainability (r=0.641, P=0.0001), but positive and significant relationship with the variable of economic sustainability (r = 0.251, P = 0.0001). Agricultural work experience has had significant negative correlation with ecological sustainability (r = -0.713, P = 0.0001) and a significant positive correlation with economic sustainability (r = 0.223, P = 0.0001) and social sustainability (r = 0.442, P = 0.0001). Also, according to the findings, there is a significant negative correlation between Canola cultivation area and the three levels of sustainability of Canola fields in confidence level of 0.01 (Table 5). The variable of ownership has had a significant negative relationship with ecological sustainability (r = -0.123, P = 0.020) and social sustainability (r = -0.195, P = 0.0001) and it has had no statistically significant relationship with economic sustainability variable (r = 0.071, P = 0.191). According to the research findings, there is a significant positive correlation between job satisfaction and the three dimensions of sustainability of Canola fields (Table 5). However among social characteristics, participation in social activities has a positive and significant relationship (confidence level of 0.01) with the three dimensions of sustainability of Canola fields.

Table 5: Correlation between the Dimensions of Sustainability and Selected Variables

Social		Economic		Ecological		Sustainability Dimensions
p	r	p	r	p	r	Variable
0/001	-0/641	0/001	0/251	0/001	-0/685	Age
0/001	0/442	0/001	0/223	0/001	-0/713	Agricultural work experience
0/001	-0/271	0/671	-0/021	0/001	-0/222	Canola Cultivation Area
0/001	-0/195	0/191	0/071	0/020	-0/123	Ownership
0/001	0/434	0/000	0/321	0/000	0/160	Satisfaction with Agriculture Career
0/001	0/243	0/001	0/302	0/001	0/483	Participation in social activities
0/000	0/262	0/041	0/194	0/094	0/152	Social Status
0/040	0/145	0/000	0/632	0/030	-0/171	Technical Knowledge (Ordinary)
0/001	0/482	0/603	0/02	0/001	0/614	Knowledge of sustainability
0/040	0/145	0/025	0/144	0/044	-0/183	Mechanization
0/001	0/250	0/001	0/735	0/001	0/593	Benefit from Educational-Promotional Services

There was no statistically significant relationship between social status and ecological sustainability of Canola fields (r = 0/152, P = 0/094). However there was positive and significant relationship between social status and economic sustainability (r = 0/041, P = 0/194) and social sustainability (r = 0/262, P = 0/000), respectively, in the confidence level of 0.05 and 0.01. Technical knowledge of the farmers has negative and significant relationship with ecological sustainability (r = 0 / -171, P = 0/030) of their farms and positive and significant correlation with economic sustainability (r = 0/632, P = 0/000) and social sustainability (r = 0/145, P = 0/040) of their farms (at confidence level of 0.01). This finding is consistent with the research of Roosta (2000). Also knowledge of sustainable agriculture of the Canola farmers has had positive correlation with three dimensions of sustainability of their farms. This finding confirms results of Roosta (2000), Iravani and Darban Astaneh (2004). Mechanization status variable has low negative correlation with ecological sustainability (r = -0 / 183, P = 0/044) of Canola fields and significant positive correlation with economic sustainability (r = 0/144, P =

0/025) and social sustainability (r = 0/145, P = 0/040) of Canola fields. Finally, there is a significant positive relationship between benefit of educational-promotional services and the three dimensions of sustainability of Canolaes fields in the confidence level of 0.01. These findings suggest that promotional trainings could lead people's knowledge towards sustainability that are consistent with the results of some studies on the social - economic dimensions ((Saltiel et al, 1994, Comer and et al 1999, Sydorovyh & Woossink,2008) and ecological (Hayati and Karami, 2000). The ability of concurrent effect of the research variables on anticipation of sustainability dimensions:

As shown in Table 6, among independent variables, technical knowledge, knowledge of sustainability, benefit from the promotional programs, job satisfaction and participation in social activities have entered the equation. Given the value of R^2, these variables are totally can predict 22% of the variation in economic sustainability. Meanwhile, technical knowledge, knowledge of sustainability, job satisfaction, benefit from the promotional programs, and state of mechanization are totally able to predict 32% of the variation in ecological sustainability. However according to the research findings outlined in Table 6 in relation to the social sustainability, among the independent variables, four variables of benefit from educational-promotional services, knowledge of sustainability, job satisfaction and participation in social activities can totally predict 43% of the variation in social sustainability.

Table 6: Multiple stage regression in order to predict the concurrent effects of independent variables on the sustainability prediction

P	t	β	B	Variable	Sustainability dimensions
0/000	12/572	------	2/465	*y*-intercept	
0/002	3/108	0/233	0/242	Technical Knowledge	
0/000	6/467	0/451	0/435	Knowledge of sustainability	
0020/	322/3	2810/	2390/	Benefit from promotional programs	**Economic**
0/049	1/99	0/125	0/178	Job Satisfaction	
0070/	7382/-	2390/	1820/	Participation in social activities	
0/117	1/570	----	0/529	*y*-intercept	
0/000	-4/244	-0/215	-0/222	Technical Knowledge	**Ecological**
0/000	6/451	0/330	0/345	Knowledge of sustainable agriculture	
0/000	6/103	0/291	0/338	Job Satisfaction	
0/001	5/77	0/282	0/328	Benefit from promotional programs	
0/060	-2/81	-0/152	-0/114	State of mechanization	
0/000	12/572	-	2/465	*y*-intercept	**Social Sustainability**
0/002	3/232	0/281	0/239	Benefit from promotional programs	
0/000	6/467	0/451	0/435	Knowledge of sustainability	
0/002	3/108	0/233	0/243	Job Satisfaction	
0/007	2/738	0/239	0/184	Participation in social activities	

Conclusion and Recommendations

Our results indicate that total sustainability status and the three dimensions of sustainability of Canola fields in the study area are in relatively good condition. Therefore, in order to improve the situation and prevent non-sustainability, officials and planners' attention to the priority of making policy and strategies in economic, ecological and social areas for sustainable agriculture can be beneficial.

The findings suggest that the level of farmers' knowledge of sustainability has had the greatest impact on the three dimensions of sustainability. It is therefore recommended to improve knowledge of sustainability in the region through agricultural training strategies focused on sustainability. Workshops, educational promotional classes, methodological and consequential presentations, scientific excursions, mass media and press can be used in this regard in proportion to the farmers' capability. According to the research, about 90% of the farmers have lower-middle to middle job satisfaction that needs more contemplation. So in this case by providing the necessary measures to improve attitudes towards agriculture (including financial incentives which are considered by most farmers) can improve their job satisfaction. Also it is recommended that inviting farmers to various stages of planning, design, and implementation of different phases makes them more attracted to the participation. In the economic dimension, similarly by taking the necessary measures including timely provision of funds and facilities needed by farmers, their job security and systematization of insurance policies and the like their job satisfaction can be improved. Participation in social activities can be a good predictor for social sustainability. Hence, according to cases predicted in the area of farmers' participation, it is strictly recommended that conditions of farmers' presence are provided in the appropriate context.

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