The effects of participating environmentally friendly agricultural land protection program on the farm level production efficiency in Samsun province of Turkey

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Abstract

In recent years, eco-friendly practices have gained importance in agricultural production. Therefore, the aims of the study were to estimate the efficiency measures of participant and non-participant to the Environmentally Friendly Agricultural Land Protection Program (EFALP) in Samsun province of Turkey, to determine the effects of participating the program on the farm level production efficiency and to calculate the opportunity cost of conversion to eco-friendly farming system in Samsun provinces of Turkey. The bulk of the data were collected from randomly selected 133 farms and cluster analysis was performed to select similar farms. Data Envelopment Analysis (DEA) was used to estimate efficiency scores. Opportunity cost of conversion was calculated by comparing the net revenue of eco-friendly farming system and conventional one. Research results showed that the mean technical, allocative and cost efficiencies of participant farms were lower than non-participant ones. The opportunity cost of conversion eco-friendly farming and environmental subsidies paid by government were €468,98 and €500,87 per hectare, respectively, indicated that subsidies met the loss sourced from conversion in the research area. It was clear based on research findings that farmers would increase their technical competence, if they improved their skills via participating training and extension programs. Since the opportunity cost of the conversion was the main drivers of farmers' satisfaction from eco-friendly farming system, increasing the number of participants and continuing this support policy for environmental protection considering the balance between loss and subsidy may increase the succeed to protect of human health, soil and water resource protection.

Keywords: Opportunity cost. Environmental protection. Eco-friendly farming. Production efficiency. Samsun.

1.Introduction

As world population is increasing day by day, increasing the food supply has been compulsory. The demand pressure make farms use excessive input use to reach higher yields, resulting in environmental degradation and human health problems. For these reasons, there has been much debate on the issue of agricultural sustainability all over the world for last decades. Organic agriculture and good farming practices as an eco-friendly farming system have the priority and they were supported by the governments throughout the world in order to minimize the residuals left in products by unconscious inputs used in agricultural activities and to provide a sustainable environment. There have been several national programs to protect environment and human health via eco-friendly farming systems worldwide. In

Finland, government served the subsidies to the farms in order to reduce water pollution caused by agriculture during the time period of 2007 and 2013. Similarly, eco-friendly farming has been encouraging by national level environmental services and farms have been supported to protect the environment via Agricultural Environmental Schemes in German, France, Netherland, Sweden and Switzerland and inn OECD Country since 2010. Correspondingly, there have been many efforts and variety practices for environmental protection are implemented in Turkey. EFALP is one of the important and comprehensive program, which is continued since 2006 to protect quality of soil and water resources, to ensure the sustainability of natural resources, to prevent erosion and to reduce negative effect of intensive agricultural practices. Samsun is one of the province where program was implemented due to existing intensive farming practices and both soil and water pollution.

Up to now, some researchers have focused on the evaluation of the environmental scheme worldwide. Uchida et al. (2009), have examined the impact of support program to create green land on Agricultural employment in China. Jayasinghe-Mudalige and Weersink (2004), have determined the factors of farms to adoption of environmentally management system. In Turkey, Boz (2016), Comparing the between adoption and non-adoption farmers' socio-economics characteristics. Hasdemir and Hasdemir (2012), have examined the environmental sensitivities of EFALP personnel. Türkten et al. (2014), have carried out an assessment of the sustainability of the program.

There have been lots of effort to estimate the efficiency measures in agricultural production (Wang et al., 1996; Engindeniz and Öztürk, 2013; Gündüz et al. 2016; Ceyhan et al., 2017; Haq and Boz, 2017; Ul Haq et al., 2017; Ceyhan, 2017). However, there has been information gap regarding the effects of subsidies on production efficiency. Similarly, there has been limited information related to opportunity cost of eco-friendly farming and the sufficiency level of environmental subsidies to eliminate the farmers' loss sourced considering environment. In addition, the link between the participation to the environmental program and production efficiency has been still unclear. Therefore, the study intended to test the hypotheses of whether subsidies meet the farmers' loss sourced from opportunity cost of conversion and conversion affected the production efficiency negatively. To reduce the information gap, the aims of the study were to estimate the efficiency measures of participant and non-participant to EFALP in Samsun province of Turkey, to determine the effects of participating the program on the farm level production efficiency and to calculate the opportunity cost of conversion to eco-friendly farming system in Samsun provinces of Turkey.

2. Production Efficiency

The term of production efficiency reflects the potential for increasing output and decreasing input that the farm has failed to exploit. The production efficiency of the farm is a product of input-output relations and facilitating strategic planning for production.

Parametrically or non-parametrically elicited production frontier is mostly used to measure the production efficiency. The point on the production frontier means that no more production is possible with the given resources and technology without additional costs. When applying the best technical practices and adjusting best possible resource allocation incorporated into the production system, decision making unit is a productive efficient.

Productive efficiency concept covers the resource allocation efficiency (AE) and technical efficiency (TE). TE is a product of the components of pure technical efficiency and scale efficiency. Then both TE and AE constitute the measure of overall economic efficiency (EE) (Coelli et al., 2005). Based on the suggestion of Farrell (1957), TE refers to the ability of a farm to use minimal input to reach given the level of output, while AE refers to the ability of a farm to use the inputs in optimal proportions, given their respective prices and the production technology. Scale efficiency is a measure for determining how closely an observed farm is to the most productive scale size and equals to the ratio of the minimum cost of the farm under constant returns-to-scale (CRS) technology to minimum cost under variable returns-to- scale (VRS) technology (Banker et al., 1984).

3. Materials and Methods

3.1. Research area

Samsun is a province of Turkey, which extends along with the coast of the Black Sea. To Samsun's west, lies the Kızılırmak (Red River), one of the longest rivers in Anatolia and its fertile delta. To the east, lie the Yeşilırmak. Samsun has a humid subtropical climate like most of the eastern Black Sea coast of Turkey (Figure 1).

Figure 1: Map of research area

Approximately 62.213 farms conducted their activity in Samsun (FALM, 2015). Farmers tend to raise field crops such as maize, wheat and paddy, fruits such as hazelnut, peach and apple and vegetables such as pepper, cabbage and tomato on their 3,20 hectares of farmland, on average.

Table 1: Distribution of agricultural areas

	Farmland (ha)
Field crops	228.684
Fruits	94.259
Vegetables	32.933

3.2. Research data

The main sources of research data were farmers and Ministry of Food, Agriculture and Livestock. The research data were collected from randomly selected 121 participant farms to EFALP and 12 non-participant farms in Samsun by using structured questionnaire during the production year of 2015. Precision level and confidence level were 5% and 95%, respectively when determining the optimum sample size.

The variables measured in the study were age of farmers, experience of farmers, schooling of farmers, family size, farmland, working hours of labor, working capital, labor use, machinery use, fertilizer use, chemical use, yield, price, profit, revenue etc.

3.3. Methodology

Economic and efficiency analyses were performed for participant and non-participant farms separately in the study. In order to set ceteris paribus condition between two group of farms, cluster analysis was used. Cluster analysis included the farmers' profile score and land size. The farmers' profile score was calculated by using the variables of age, education, agricultural experience of farmers, etc. Cluster analysis produced similar 43 participant farms and 4 non-participants' farms.

Data envelopment analysis (DEA), which was based on the efficiency concept suggested by Farrell (1957) was used to calculate efficiency scores. Based on the suggestions Charnes et al. (1978) and Banker et al. (1984), we assumed that each farm produced hazelnut and/or peach (Yi) using the most important inputs of labour cost, manure and pesticide cost (xi*). Since the farmers had the more control power over their inputs comparing to their outputs, the input-orientated efficiency model was constructed to estimate the efficiency scores. Input oriented efficiency scores under variable return to scale (VRS) were estimated by running the linear programming depicted below: he variables measured in the study were age of farmers, experience of farmers, schooling of farmers, family size, farmland, working hours of labor, working capital, labor use, machinery use, fertilizer use, chemical use, yield, price, profit, revenue etc.

$$\begin{aligned} &\textit{Minimum}_{\lambda,.xi*} \quad w_i^T (x_i^*) \\ &\text{Subject to} \quad -y_i + Y\lambda \geq 0 \\ &x_i^* - X\lambda \geq 0 \\ &\lambda \geq 0 \end{aligned}$$

In equation, wi, input price of each farm; T, transpose of function and xi*, input price, wi, with output level, Yi, minimum cost of input level was calculated via linear programming for each farm. This equation revealed the minimum cost under variable return to scale (VRS). Cost efficiency for each farm was estimated by using the formula of (CE) = wiT xi* / wiT xi. Allocative efficiency was calculated by using the formula of AE= CE / TE (Coelli et al., 1998). The software of DEAP 2.1 was used to estimate efficiency scores.

When calculating the opportunity cost of conversion to eco-friendly farming system, the difference between the net revenue of participants and non-participant farms. The revenue of the sample farms was calculated by using classical economic analysis procedure. Then, the sufficiency of subsidies paid by governments were evaluated by comparing the opportunity cost of conversion and quantity of subsidy, considering the subsidies level of €175 per hectare for conversion organic farming, €125 per hectare for conversion to good farming practices and €337,50 per hectare for participating to EFALP (FALM, 2016).

4. Results and Discussion

Socio-economic analysis showed that the farm operator in participant farm was 54,56 years old, while that of non-participant farm was 52,42 years. Sampled farmers had over 32 years of agricultural experience in the both groups (table 2).

Table 2: General characteristics of sample farms

	Participant		Non-Participant	
	Mean	St. Deviation	Mean	St. Deviation
Age of farm operator (year)	54,56	12,61	52,42	7,79
Agricultural experience of farm operator (year)	32,43	14,63	32,50	9,88
Education of farm operator (year)	5,89	2,55	6,25	2,38
Working time (day)	103,23	47,59	122,92	46,34
Family size (person)	5,00	2,29	5,00	1,64
Farmland (ha)	3,56	2,54	3,33	1,84

The mean schooling years of farmers were 5,89 and 6,25 year, respectively. Non-participating farmers spent more time their farming work than participants, on average. Both participant and non-participants, they also had equal number of farm household with 5 persons. Participants had 3,56 hectares of farmland whereas non-participants had 3,33 hectares of land, on average (table 2).

The results of the efficiency analysis were given in table 3. It was clear based on the results of the efficiency analysis that non-participant farms were technically and economically more efficient comparing to participant ones. Being economically efficient farms, participant and non-participant farms would reduce the inputs cost (labour, pesticide and manure cost) by %53,5 and 45,7%, respectively. Regarding the allocative efficiency, participants and non-participants could decrease their input cost by 13% and 5,5%, respectively by allocating them properly to market conditions. Pure technical inefficiency was the primary cause of technical inefficiency in both groups.

Table 3: The productive efficiency measures for participant and non-participant farms

	Participant		Non-Participant	
	Score	St.Deviation	Score	St.Deviation
Cost efficiency	0,465	0,234	0,543	0,175
Allocative efficiency	0,870	0,165	0,945	0,029
Technical efficiency	0,548	0,266	0,575	0,185
Pure technical efficiency	0,311	0,222	0,349	0,205

Scale efficiency	0,563	0,213	0,585	0,195

Based on the result of the scale efficiency analysis, 90,69% of participant farms had increasing returns to scale, while rest of participant farms had constant returns to scale and decreasing returns to scale. However, all the non- participant farms had increasing returns to scale (Table 4).

Table 4: Result of scale efficiency measures of farms

	Return to scale	Farms		Total revenue (€/year)	Labour cost (€/year)	Pesticide + manure cost (€/year)
		N	%			
Participant	IRS	39	90,69	26.868,25	4.665,00	353,00
	CRS	2	4,65	149.594,00	7.125,00	62,50
	DRS	2	4,65	185.079,00	13.325,00	1.175,00
Non- Participant	IRS	4	100	28.997,70	3.165,62	285,62
	CRS	0	0	-	-	-
	DRS	0	0	-	-	-

Opportunity cost of conversion and sufficiency level of subsidy were given table 5. Firstly, as expected, participants benefited more agricultural subsidies, almost two times that of non-participant. If we added the subsidies for environmental protection to the revenue, the net revenue per hectare of participant and non-participant farms were almost the same. However, net revenue of participant farms was lesser than non-participant farms when ignoring the subsidies to farmers for environmental protection. In this case, participant farms' net revenue of per hectare was € 6502,43, while non- participants' net revenue was € 6971,41 per hectare. According to the current situation, average loss of farms' net revenue would be € 468,98 comparing to the non-participant ones. The share of subsidies for environmental protection were 62,23% in total subsidies and 7,75% in net revenue. Regarding the sufficiency level of subsidies for environmental protection, it was clear that subsidies level was satisfactory level in the research area.

Table 5: Opportunity cost of environmental protection and the sufficiency level of subsidy

Reasons for decreasing cattle numbers	Order	Score
Feed prices high	1	249
Lack of family members dealing with animals	2	225
Low income	3	212
Lack of governmental support	4	186
Lack of capital to purchase live animals	5	179
Low meat prices	6	167
Illegal animal entries	7	133

Low milk prices	8	123
Lack of pasture and meadows	9	114

5.conclusıon

The study examined the opportunity cost of conversion eco-friendly farming in Samsun. It was also estimated efficiency scores of participating and non-participating farms in EFALP. The calculated efficiency scores revealed that non-participants were more efficient in all efficiency measures comparing to the participants. All farm groups were experienced high production cost, but participants were worse. There was same situation in net revenue of farms. But, subsidies for environmental protection have eliminated loss of net revenue. The opportunity cost of conversion eco-friendly farming was €468,98 per hectare. This cost lower than environmental subsidies (€500,87). Farmers also have satisfied to this subsidies for environmental production. It could be say that subsidies policy is successful in the research area.

Farmers should be pay attention to the monitoring the input markets. The severe investment is needed to increase education level for all farmers to judge the market price situation to reduce their expenditures. If farmers manage their farms by taking into account the price level and allocation of resources then they can increase their yield and reduce their input cost. Effective extension services may enhance the growers knowledgeable in managing their farms.

It was clear based on research results that opportunity cost of the conversion was the main drivers of farmers' satisfaction from eco-friendly farming system. Therefore, when designing support policy, opportunity cost of conversion must be calculated by regional and local basis. Adding more participants and continuing this support policy for environmental protection may increase the succeed to protect of human health, soil and water resource protection.

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