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ADOPTION OF PRESSURIZED IRRIGATION SYSTEMS AMONG MAIZE PRODUCING FARMERS IN ÇARŞAMBA DISTRICT-SAMSUN

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Abstract

Adoption of pressurized irrigation systems such as drip irrigation and sprinkler irrigation influences productivity and sustainable use of water resources. Since Turkey isn't counted among water-rich countries, farmers need to use these irrigation systems. However, there are many factors associated with the adoption of agricultural innovations. This study investigates the factors influencing the adoption of pressurized irrigation technologies in Çarşamba District of Samsun Province.

Participants of this study were a stratified sample of 350 farmers operated in different villages of Carşamba district. A well-structured questionnaire was administered and sought information about socioeconomic characteristicsand different farming practices applied by the participants. Data collection was completed in the May-September period of 2015. Descriptive statistics including frequencies, percentages, means and standard deviations were used to describe socioeconomic characteristics of respondents. Then farmers weredivided into two broad categories as adopters and non-adopters of pressurized irrigation systems. The independent sample t-test procedure was used to compare these two groups regarding their socioeconomic characteristics and farming practices.

Results of this study showed that adopters of the pressurized irrigation system in the region use more credit for inputs, obtain a higher yield of maize per decare, and have higher level of off-farm income; however, they have smaller family size, fewer persons involved in agricultural activities, and lower number of parcels of agricultural land.

Research results are expected to provide useful information in identifying the issues related to the adoption of innovations in agriculture, and in developing innovation adoption programs for rural communities.

Keywords: Pressurized Irrigation, Drip Irrigation, Sprinkler Irrigation, Adoption of Innovations.

1. Introduction

Although the population of the world and water being used for irrigation are continuously increasing, water potential in the earth remains constant. This means per capita water consumption will diminish in the future and people will have to find out new strategies for sustainable use of water resources (Ağır and Boz, 2013).Irrigation is one of the most important agricultural techniques of providing an adequate amount of water to plants which cannot be met by natural means, in a controlled system (Tekinel, 1995). Irrigation makes significant contributions to increasing productivity in agriculture and providing an adequate and balanced diet for the growing world population. Besides yield increases in irrigated areas, the production patterns can also be changed. It is always possible to grow a second and even a third product in the same year with proper irrigation (Güvercin and Boz, 2003).

Because water resources in the world do not allow all agricultural areas to be irrigated, more economical use of existing resources for future generations is inevitable. In many developing countries including Turkey, the available water sources aren't being used

economically. The furrow irrigation method practiced in many regions both cause significant reduction in water sources and damage the land and environment due to lack of proper drainage systems. Therefore, it is necessary for farmers to adopt pressurized irrigation systems which make contributions to agricultural sustainability regarding economic use of available water sources, and yield increases in many farm commodities.

The most commonly used pressurized irrigation systems in Turkey are drip irrigation and sprinkler irrigation. The advantages of the drip irrigation system include the following (Tekinel, 1996):

1. Provides high efficiency in water use.
2. Provides constant watering to the plant root in the field capacity, increases the effectiveness of fertilizers applied and therefore results in productivity.
3. Allows growing vegetables and fruits in greenhouses.
4. It is a secure irrigation method and does not require too much work.
5. It prevents the development of plant diseases and pests.
6. It isn't affected by slopping lands and wind conditions.
7. Due to the low dripper flow rate, the infiltration of water into the soil is rapid. Thus, it does not cause erosion on flat or sloping lands.
8. Savings from labor and other expenses increased productivity, and lower costs provide a significant increase in net income.

Researchers proved the benefits of drip irrigation system. For example, in a study conducted in Kahramanmaraş, it was concluded that drip irrigation increased the yield in pepper production, and irrigation water was used more economically with this method. In the same study, it was stated that Phytophthora Capcici L fungus, which negatively affects pepper yield and quality, decreased with drip irrigation (Gençoğlan et al. 2002).

In the sprinkler irrigation system, water is given to the air under pressure from the sprinkler heads which are placed on the land at specified intervals and fall into the land surface and enter into the soil by infiltration and stored in the plant root zone.The sprinkler irrigation system resembles an artificial rain in terms of application (KHGM, 2010).This method can be used efficiently in sloping and uneven lands; and in soils with low depth, high permeability and little water holding capacity.

The advantages of the system are listed as follows (Tarım Kütüphanesi, 2019):

1. It provideshigh irrigation efficiency in light textured soils with a high water absorption rate.
2. Controlled irrigation is done in shallow soils (without raising the groundwater).
3. Due to the water distribution uniformity, irrigation efficiency is high, and therefore it enables irrigation of larger areas with existing water.
4. Erosion problem is eliminated with good project and operation.
5. Irrigation labor costs are less.
6. Commercial fertilizers and agrochemicals can be supplied with the system.
7. Fruit trees are protected from frost with short periodic applications of the system.
8. During the germination period, it facilitates the plant to rise above the soil.
9. As the field trenches are no longer needed, the cultivated area increases and the field operations are made easier.

Although the system has many advantages, the initial investment costs are quite high, water distribution is affected by wind, and operating the system requires energy consumption.

Different researchers in Turkey have studied the adoption of agricultural innovations. Kaynak and Boz (2012) investigated the adoption of new cotton varieties by Kahramanmaraş farmers and found significant differences between the adopters and non-adopters regarding the socioeconomic variables of education, and information seeking behavior variables of using the Internet and visiting extension agents of agricultural ministry, and faculty members of the college of agriculture. Öz and Boz (2014) conducted a study around the Lake Eğirdir area of Isparta Province to determine factors that influenced the adoption of the Environmentally Friendly Agricultural Land Protection program (ÇATAK-in Turkish). Results of the study showed that the program was useful in the region to protect soil and provide sustainability. Participation in village administration, credit use for investments, the income level of farmers, and contacts with extension personnel were the main factors that

influenced the adoption of the program. The study conducted in the Eastern Mediterranean Region of Turkey (Budak et al., 2011) showed that socioeconomic factors of farmers' experience and income; and meeting frequency with private veterinarians had a positive effect on adoption of innovation among sheep farmers. Another study conducted in the same region (Boz, 2014) showed that adoption of innovation among beef cattle farmers was quite low, and it was influenced by socioeconomic variables of cooperative membership, investments, farm size, owning improved breeds, and income level; and by information-seeking variables of reading newspapers, using the Internet, contacts with extension personnel, and contacts with private veterinarians.

The overall purpose of this study was to determine irrigation methods used by maize farmers and to compare the adopters and nonadopters of pressurized irrigation system regarding different selected socioeconomic variables and farming practices. The study concludes with a list of recommendations to increase the adoption of these irrigation systems in the region.

2. Materials and Methods

In determining the sample size, firstly villages with high agricultural potential were identified consulting with the technical personnel of the district directory of the Ministry of Agriculture and Forestry. Then lists of farmers in these villages and their land size were obtained, and this made the accessible population of the study. Considering the frequency distribution of the land size farmers operated, the accessible population was divided into three strata. Primary purposes in stratified sampling increase the accuracy and the degree of adequate representation of different groups of the main population in the research. Besides, the principle in this method is to reduce the variance. In this way, with fewer respondents, a good and detailed study is possible (Güneş and Arıkan, 1985). According to the stratified sampling method, the number of farmers entering the sample of the research was found by the following formula (Yamane, 2001):

$$x = \frac{N\Sigma N_h S_h^2}{N^2 D^2 + \Sigma N_h S_h^2},\ D^2 = \frac{e^2}{t^2}$$

n = Sample size,
N = Number of farmers in the stratisfied sample,
N_h = Number of farmers in each stratum,
S_h = Standard deviation within a stratum,
D_2 = Desired variance
e = Error accepted from the mean of the accessible population,
t = t-table value of the accepted confidence interval.

Accepting 5% error from the mean and 95% confidence interval (t=1.645), the sample size was calculated as 350. This sample size was proportionally distributed to the three strata, and the farmers who were surveyed from each stratum were determined by using the random numbers table. The reserve subjects were also determined considering the possibility of the farmer not being able to be found or refused to answer the questionnaire.

Of the 350 sampled farmers in Çarşamba district, 67 were maize growers, and data collection and analyses procedures were carried out for these farmers. Maize growing rate among the sampled farmers was calculated as 19.14%, meaning approximately one-fifth of the farmers grew maize in the region. The researchers developed a well-structured questionnaire seeking information about farmers' socioeconomic characteristics and farming practices. Rogers (2010)' study was explicitly utilized in preparing the questionnaire. Data were collected in the May-September period of 2016. Descriptive statistics including frequencies, percentages, means, and standard deviations were used to describe respondents' socioeconomic characteristics. The independent sampled t-test was used to compare the adopters and nonadopters of respondents.

4. Research Findings

Socioeconomic characteristics of the respondents are presented in Table 1. It can be seen from the table that more than half of the respondents (56.7%) were above than 50 years of age, and 59.7% hold a primary school degree. A vast majority (86.6%) had farming experience for more than 20 years. More than half of the respondents (53.7%) belonged to a family consisting of 1-2 persons. While a vast majority (81.2%) had off-farm income, those who had tractors made almost half of the respondents (49.3%). Those who used credit for farm inputs made 49.3%, and a vast majority (83.6%) kept farm records for their farming practices.

Regarding income level more than half of the respondents (58.2%) reported that they fell in the medium income level category if the farmers of their village were divided into three income categories as low, medium, and high-income levels. More than half of the respondents (56.7%) had farm size larger than 50 decares, and 44.8% grew maize in 16-30 decares of agricultural land. Slightly higher than half of the respondents (50.7%) used no irrigation for maize production while 47.8% used sprinkler irrigation and 1.5% used drip irrigation.

Table 1. Socioeconomic Characteristics of Maize Farmers

Yaş	N	%	Credit use for farm inputs	n	%
≤35	4	6	Yes	33	49.3
36-50	25	37.3	No	34	50.7
51≤	38	56.7	TOTAL	67	100.0
TOTAL	67	100.0	Keeping farm records		
Education level			Yes	56	83.6
Primary school	40	59.7	No	11	16.4
Secondary school	20	29.7	TOTAL	67	100.0
High school	7	10.5	Level of income		
TOTAL	67	100.0	Low	19	28.4
Farming experience			Medium	39	58.2
≤10 years	2	3.0	High	9	13.4
11-20	7	10.4	TOTAL	67	100.0
21years ≤	58	86.6	Farm size		
TOLAR	67	100.0	≤30 decares	7	10.4
Family size			31-50	22	32.8
1-2 persons	36	53.7	51≤	38	56.7
3-4 persons	19	28.4	TOTAL	67	100.0
5 and more	12	17.9	Maize production area		
TOTAL	67	100.0	≤15 decares	21	31.3
Off farm income			16-30 decares	30	44.8
Yes	55	82.1	31 decares	16	23.9
No	12	17.9	TOTAL	76	100.0
TOTAL	67	100.0	Irrigation methods		
Tractor ownership			No irrigation	34	50.7
Yes	33	49.3	Drip irrigation	1	1.5
No	34	50.7	Sprinkler irrigation	32	47.8
TOTAL	67	100.0	TOTAL	67	100.0

Table 2 presents the comparisons between the adopters and non-adopters of pressurized irrigation systems among maize farmers in the research area. Of the 67 maize farmers participated in this study 33 (50.3%) adopted pressurized irrigation system (32 farmers adopted sprinkler irrigation and 1 farmer drip irrigation), and 34 (50.7%) used no irrigation for maize production.

Of the sixteen variables selected to compare the adopters and non-adopters of the pressurized irrigation system, six were significant at an Alpha level of 0.05. The first significant variable

was credit use for inputs for which the rate of adopters was 73%, and nonadopters 27%. The independent sample t-test conducted between these two categories yield significance indicating that adopters of pressurized irrigation used more credit for input as compared with non-adopters.

The second significant variable was the number of persons in the family engaged in agricultural activities, and it was found as 1.52 persons for adopters and 2.21 persons for non-adopters. The independent t-test conducted between these two categories yield significance indicating that the adopters had fewer individuals engaged in farming activities.

Average maize yield per decare was 577 Kg/da in adopters, and 453 Kg/da in non-adopters. The independent sample t-test between these two groups was significant meaning that the average maize yield in adopters was significantly higher than non-adopters.

Table 2. Comparisons between Adopters and non-adopters on Selected Farming Variables

Variables		Mean		t	p
		Adopters	**Nonadopters**		
1	Credit use (1=yes, 0=no)	0.73	0.27	4.26	0.001
2	Number of persons working on the farm	1.52	2.21	-3.29	0.002
3	Yield Kg/da	577	453	2.91	0.005
4	Family size	2.42	3.41	-2.87	0.005
5	Number of parcels	5.58	9.47	-2.33	0.023
6	Off-farm income TL/Month	3168	2020	2.27	0.026
7	Knowledge about water consumption of irrigated plant (1=yes, 0=no)	0.55	0.38	1.336	0.186
8	Maize growing area (Da)	21.82	25.16	0.935	0.353
9	Farming experience (Year)	31.79	33.53	-0.643	0.523
10	Tractor ownership 1=yes, 0=no)	0.45	0.53	-0.605	0.547
11	Average proximity of the land to the water source (Meters)	152	173	-0.591	0.557
12	Age of farmer	52.82	54.18	-0.513	0.610
13	Owned land (Da)	81.88	78.01	0.456	0.650
14	Do you think there will be water shortages in the future? 1=yes, 0=no	0.42	0.47	-0.376	0.708
15	The education level of farmers (Years)	6.73	6.50	0.355	0.723
16	Total operating land (Da)	87.52	88.95	-0.111	0.912

Similarto family members engaged in agricultural activities, the family size was also significantly different between the two groups, as it was 2.42 persons in adopters, and 3.41 persons in non-adopters. The difference between these two groups was statistically significant indicating that adopters had fewer persons in their families than non-adopters.

The fifth significant variable was the number of parcels of land operated by each adoption categories. Results showed that the number of parcels was 5.58 decares for adopters, and 9.47 decares for non-adopters. The independent sample t-test between these two categories was significant indicating that the adopters had fewer parcels than non-adopters.

Finally, the last significant variable was off-farm income for which monthly off-farm income was 3166 Tl for adopters, and 2020 Tl for non-adopters. The independent sample t-test between these two groups showed that there was a significant difference between these two categories meaning that the adopters had higher off-farm income as compared with non-adopters.

4. Conclusions and Recommendations

This study was conducted in Çarşamba District-Samsun to determine socioeconomic characteristics and farming practices of maize growers, and to compare adopters and non-adopters of pressurized irrigation systems regarding these characteristics and practices. Results showed that half of the farmers in the region applied no irrigation and average maize yield among the farmers who applied irrigation was quite higher than those who didn't use any irrigation. This finding indicates that farmers need to be encouraged and even supported to adopt irrigation, particularly pressured irrigation systems.

An average profile of the farmers in the district is a male,aged over 50 years, holds a primary school education degree, has farming experience more than 20 years, belongs to a family with less than four persons, keeps farming records, earns off-farm income, operates approximately 88 decares of land, and grows maize in about 23 decares.

Results of this study showed that the farming population in rural areas is decreasing and people engaged in agricultural activities are getting older. Although an average farm in the locality can provide sufficient income for a family, they still search occupations other than farming. In order to convince farmers to stay in rurality and continue with agrarian activities, agriculture needs to be made more attractive. Promoting agricultural innovations to rural areas may easier the work done by farmers, and higher their income. If farmers generate more stable income from agriculture and don't spend most of their time working in the fields, they may be willing to live in rural areas.

Although the Black Sea Region is the most-rainy area of Turkey, irrigation is necessary for summer, and it increases productivity. The government promotes the adoption of pressurized irrigation systems through different programs. For example, the government provides long term low-interest loans to farmers who agree to apply drip irrigation or sprinkler irrigation. Adoption of these systems not only increases the productivity and income of farmers but also provides economical use of water sources and contributes to sustainable agriculture.

Ministry of Agriculture and Forestry may play an essential role in promoting pressurized irrigation systems. Irrigation associations should also undertake many necessary tasks on irrigation. They should not only distribute the water to farmers but also employ irrigation experts and give training to farmers regarding water consumption of plants, water plant relationships, and irrigation practices. The ministry should also provide regular extension services on irrigation.

Further research should be conducted to determine factors influencing the adoption of pressurized irrigation systems in different crops. The constraints of adoption should be determined, and proper extension programs should be implemented accordingly.

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