



An exploration on factors influencing certified and farm-saved seed use: a case study in Turkish wheat farming

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Seeds are an important input for wheat-growing, as is the case for all crop production. The type and quality of seed in crop production are the first condition for productivity and accordingly certified wheat seed use is being encouraged by the government since 2005 in Turkey. This study examined the factors affecting the certified seed and farmer (farm)-saved seed use in wheat farming in Turkey. The result of the analyses showed that there is a significant difference between farmers using certified seed and farm-saved seed, considering farmer experience, the purpose of wheat growing, the status of a farmer concerning system registration, agricultural credit use, size of total farmland and size of wheat cultivation area. As a result, it can be inferred that high-quality wheat production is associated with the use of certified seeds. In this context, maintaining the certified seed support is important for increasing of certified seed use.

1. Introduction

The Turkish agriculture sector constitutes 7.8% of gross domestic product, employs 21.2% of its total labour, and creates 11.4% of total export value (TURKSTAT, 2018). Wheat, one of the most important crops for the Turkish economy, is an essential basic food consumed mostly in the form of bread in Turkey. Wheat is also used as animal feed and as an input to make various foods in the industry. Therefore, wheat is a strategic crop for food security in Turkey, especially for smallholder farmers (Yilmaz et al., 2016).

Wheat is grown on about 7.6 million ha, and approximately 20.6 million tons of wheat is produced in Turkey annually. Wheat occupies the primary position among the cereal crops in Turkey both in terms of area and production amount (TURKSTAT, 2018). While wheat production amounts had risen steadily between 1961 and 2016, the wheat production area has been decreasing. Most of the rise in wheat production was

due to higher yields per hectare. In 1961, the yield was 909 kg/ha. It reached 2,292 kg/ha by the early 2000s and climbed to 2,707 kg/ha in 2016 (FAOSTAT, 2018). It is reported that both the genetically improved cultivars for yield and better cultural methods contributed to the yield improvement, but it is difficult to quantify the effects of each. The actual yield that is obtained on the farm depends on several factors such as the crop's genetic potential, seed variety, seed quality, the amount of sunlight, water and nutrients absorbed by the crop, the presence of weeds and pests (FAO, 2018). In crop production, the use of superior, high-quality and certified seed leads to rising crop yields by around 20-30 %, depending on other conditions of production (Koksal & Cevher, 2015; Aksoy et al., 2017).

It is important to point out that the seed industry uses several mechanisms to reduce competition from traditional farmers' seeds. One of these mechanisms is

the seed laws that constitute the most critical factor in many countries. By making seed certification mandatory and announcing the trade of uncertified seeds (farm-saved seed) illegal, governments indirectly support commercial seeds against traditional seed-exchange systems (GRAIN, 2007). Certified wheat seed provides significant yield gains. However, while prices are volatile over time, production costs rise continuously. Whenever costs rise, or wheat prices decline, producers search for ways to reduce costs without incurring a considerable reduction in yields.

It is paramount to understand factors such as management of crop and seed to achieve high wheat yields (Freiberg et al., 2017). The seed represents the main intensification factor for the achievement of high yields and production quality. Therefore, the production of high-quality wheat is associated with the use of certified seeds. Accordingly, the Turkish Ministry of Agriculture and Forestry (MAF) has been providing area-based supports to farmers to promote the domestic production of certified seed since 2005. Within this subsidy system, a farmer who plants wheat with domestically produced and certified wheat seed is allowed to receive 85 TRY per hectare using the 2017 exchange rate 3,65 Turkish Lira (TRY) to the US\$1. MAF has also been providing subsidies to seed producers for certified seed production in Turkey (TOJ, 2017). Turkish farmers have been using fewer and fewer saved seeds, but the practice still represents the majority of seed sources for wheat production. However, about 35% of the total wheat seed used each year is certified. The seed sector in Turkey has grown rapidly since the new seed law entered into force in 2006. Both the government and private sectors' production capacity has increased with the help of government supporting policies for certified seed use and domestic seed production (USDA, 2017).

Many studies have been conducted on seed use of farmers and the evolution of the seed sector in Turkey and other relevant countries (Grain, 2007; Tanrivermis & Akdogan, 2007; Clayton et al., 2009; Sichali et al., 2013; Curtis & Halford, 2014; Koksal & Cevher, 2015; Gul et al., 2015; Nardi, 2016; Spielman & Kennedy, 2016; Joshi et al., 2016; Adalioglu et al., 2017; Aksoy et al., 2017; Kart et al., 2017; USDA, 2017; Furtas, 2018; Gungor et al., 2018; Cevher & Altunkaynak, 2020). This study examined the factors affecting farmers' use of government-supported certified seed and

farm-saved seed in wheat farming in Burdur and Isparta provinces located in the Lakes Region of Turkey. This study examined factors affecting farm-saved seed use of wheat farmers for the first time. It also aimed to fill the information gap on farm-saved seed use. Therefore, the study was conducted to contribute to the literature by adding original values.

2. Material and methods

2.1. Data collection

Isparta and Burdur provinces were chosen as representatives for the Lakes Region of Turkey's wheat production area since wheat farming is one of the most common economic activities. Karaaliler and Kızılkaya villages in Bucak district of Burdur; Hüyükü and Eğirler villages in Yalvac district of Isparta provinces which are dominant in wheat production were chosen (Figure 1). A list of farmers growing wheat was obtained from the Agriculture and Forestry Directorates of Isparta and Burdur to be used for sample size calculation. The sample size was determined as 88 for the simple random sampling method (Yamane, 2001) using Eq. 1.

$$n = \frac{N * s^2 * t^2}{(N - 1) * d^2 + s^2 * t^2} \quad (\text{Eq. 1})$$

Where: n=sample size; s=standard deviation; t=t value with a 95% confidence interval (1.96), N=total farm number in the sample population (489 farm), d=acceptable error (5% deviation).

Following sample size determination, data were collected in January 2017 using structured interviews with 88 randomly selected wheat producers. The collected data were divided into two groups before analyses. This divide allowed for a comparative analysis of both certified seed and farm-saved seed use by farmers.

2.2. Data analysis

This research was carried out with 88 farmers; collected data were divided into two groups before analyses. Group 1 farmers were using certified seed (64 farmers), and group 2 farmers were using farm-

saved seed (24 farmers). In the scope of this study, descriptive statistics were used to understand the nature of the sample. Chi-square test was used to analyse differences between groups depending on the normality of the data. SPSS 20 was used for data analysis. The chi-square (χ^2) test statistic is given below (Eq.2) (Koseoglu and Yamak, 2008).

$$\chi^2 = \sum_{ij} \frac{(O_{ij} - E_{ij})^2}{E_{ij}} \quad (\text{Eq. 2})$$

Where: χ^2 =calculated chi-square value, E_{ij} =expected frequency value, O_{ij} =observed frequency value,

3. Results and discussion

3.1. General characteristics of the farms

The socioeconomic characteristics of farmers using certified seed or farm-saved seed were compared to understand the nature of the sample. Some basic characteristics of the sample farms are presented in Table 1.

Farmer's average age was 53.33 years for the certified seed users, and that of farm-saved seed users was 54.79.

The educational level of farmers using certified seed was higher compared to farmers using farm-saved seed. Their experience in wheat farming was vast in both groups. The average experience of farmers using certified seed was 36.66 years, lower than (40.54 years) of farmers using farm-saved seed. The farm size area and wheat production area of farmers using certified seed was 9.79 ha and 5.11 ha, respectively. Their farm income per farm was TRY 53.125 on average. In contrast, the farm size area and wheat production area of farmers using farm-saved seed were 4.16 ha and 2.10 ha, respectively, and they received less farm income (TRY 26 041.67). The agricultural credit usage rate of farmers using certified seed was 67.19%, higher than the rate (20.83%) of farmers using farm-saved seed. The wheat yield of farms using certified seed (3.64 t ha⁻¹) was higher compared to the yield of farms using farm-saved seed (3.33 t ha⁻¹).

3.2. The result of the chi-square test analysis according to selected personal characteristics of the farmers and their information-seeking behaviour

Turkish farmers face many of the decisions every growing season. Seed selection is one of the principal farm management decisions. Wheat farmers need to allocate their budget properly for certified seed



Figure 1. Location of Burdur and Isparta Provinces

use. Alternatively, they can allocate time, labour, and resources to clean their production and to use farm-saved seed. The factors that influence this decision are not always straightforward (Furtas, 2018). In this study, it was found that the rate of certified seed use among farmers was 72.73 % while the rate of farm-saved seed use was 27.27 % in wheat farming. In another study, the rates of certified seed use farmers in wheat farming were found as 34.70% in Burdur province and 69.3% in Isparta province (Gul et al., 2015). In another study, the rate of certified seed use farmers in wheat farming was 58.70% in Ankara province in Turkey (Cevher & Altunkaynak, 2020).

The use of certified or farm-saved wheat seed in farms can be associated with many factors, such as the personal characteristics of the farmers, their information-seeking behaviour, and farming characteristics. Table 2 shows the chi-square (χ^2) test

of differences between groups of selected personal characteristics of the farmers and their information-seeking behaviour in wheat farming. The result of the analyses showed that there is a significant difference between the farmers using certified seed and farmers using farm-saved seed, considering farmer's wheat farming experience ($p \leq 0.05$), the status of the farmer registration system, and agricultural credit use ($p \leq 0.01$). These findings suggest that registered farmers are provided more farming experience, and more agricultural credit use and raise the possibility of using certified seed.

In another study that investigated the socioeconomic characteristics of wheat producers on certified seed use in Turkey, it was found that the income levels of farmers had a significant ($p < 0.05$) effect on seed selection (Cevher & Altunkaynak, 2020).

Table 1. Main characteristics of surveyed farms

Characteristics	Farmers using certified seed (N=64)		Farmers using farm-saved seed (N=24)	
	Average	S.D	Average	S.D
Age (year)	53.33	13.34	54.79	9.90
Education (year)	7.11	2.96	6.96	3.29
Family size (person)	3.72	1.82	3.50	1.84
Farm income (TRY/farm)*	53 125.00	79 948.89	26 041.67	23 510.37
Experience (year)	36.66	12.63	40.54	11.31
The rate of the farmer membership in agricultural cooperative (%)	89.06		79.17	
The proportion of farmers using agricultural credit (%)	67.19		20.83	
Average farm size (hectare)	9.79	10.47	4.16	2.87
Owned land (ha)	8.51	10.59	3.26	2.55
Rented land (ha)	1.04	1.91	0.66	1.36
Common land (ha)	0.24	1.17	0.24	1.02
Wheat production area (hectare)	5.11	4.75	2.10	1.20
Wheat yield (tons/hectare)	3.64	7.78	3.33	5.67
Wheat Production (tons/farm)	18.77	18.35	6.99	4.39
Reserved for farm animals' consumption (tons/farm)	5.54	9.15	3.20	3.52
Reserved for household consumption (tons/farm)	1.58	5.14	0.57	0.74
Amount of wheat sold (tons/farm)	11.65	15.42	3.22	4.32

* using 2017 exchange rate 3.65 Turkish Lira (TRY) to US\$1.

Table 2. Results of chi-square test (χ^2) showing associations between groups by selected characteristics of surveyed farms

Characteristics	Farmers using certified seed (N=64)		Farmers using farm-saved seed (N=24)		Total (N=88)	
	N	%	N	%	N	%
Personal characteristics						
Age (year)						
< 60	42	65.63	16	66.67	58	65.91
60 and over	22	34.38	8	33.33	30	34.09
$\chi^2 = 0.008$						
Education						
primary or middle school	48	75.00	18	75.00	66	75.00
high school or university	16	25.00	6	25.00	22	25.00
$\chi^2 = 0.000$						
Experience (year)						
< 30	32	50.00	6	25.00	38	43.18
30 and over	32	50.00	18	75.00	50	56.82
$\chi^2 = 4.446^{**}$						
Family population (person)						
< 3	35	54.69	14	58.33	49	55.68
3 and over	29	45.31	10	41.67	39	44.32
$\chi^2 = 0.094$						
Cooperative membership of farmer						
Yes	57	89.06	19	79.17	76	86.36
No	7	10.94	5	20.83	12	13.64
$\chi^2 = 1.451$						
With livestock on the farm						
Yes	49	76.56	20	83.33	69	78.41
No	15	23.44	4	16.67	19	21.59
$\chi^2 = 0.473$						
Registration of the farmers in the farmer registration system						
Yes	59	92.19	17	70.83	76	86.36
No	5	7.81	7	29.17	12	13.64
$\chi^2 = 6.758^{***}$						
Agricultural credit use						
Yes	43	67.19	5	20.83	48	54.55
No	21	32.81	19	79.17	40	45.45
$\chi^2 = 15.127^{***}$						
Information-seeking behavior						
Participation in agricultural extension activities about wheat growing						
Yes	17	26.56	8	33.33	25	28.41
No	47	73.44	16	66.67	63	71.59
$\chi^2 = 0.393$						
Participation in the extension meeting about certified seed use						
Yes	32	50.00	12	50.00	44	50.00
No	32	50.00	12	50.00	44	50.00
$\chi^2 = 0.000$						
Information sources of farmers about seed use						
Directorate of agricultural extension services	31	48.44	12	50.00	43	48.86
Agricultural cooperative	11	17.19	4	16.67	15	17.05
Seed dealers	22	34.38	8	33.33	30	34.09

3.3. Results of the chi-square analysis showing associations between groups by selected farming characteristics of the wheat farms

Certificated seed use decreases unit cost following higher crop yield. Hence, using certificated seed provides significant gains both to agricultural management and the region's and country's economy

(Aksoy et al., 2017). Many variables influence farmers' use of certified or farm-saved seed in wheat production. These can be indicated by the purpose of wheat growing, size of total farmland and wheat cultivation area, wheat yield, agricultural combat method, and use of paid labour on the farm. Table 3 demonstrates the difference between groups of farmers by type of seed used, and these groups were formed by using selected farm characteristics. The empirical evidence revealed that there is a significant difference between the farmers using certified seed and farm-saved seed, considering the size of the wheat cultivation area ($p \leq 0.01$), the purpose of wheat growing, and the size of total farmland ($p \leq 0.10$). It implies that as the size of wheat cultivation area and farmland area rises and as more farmers produce wheat for commercial purposes, the possibility to use certified seed rises.

Farmers producing wheat for commercial purposes were more likely to prefer the use of certified seed than farmers producing wheat for domestic consumption purposes. Because it could be said that certified seeds are the only input for higher yields, more income and production can be achieved. One notable result of this study was that there was no significant difference between the seed types used in terms of seed yield. In some circumstances, soil structure, climate conditions, choosing the right wheat variety, and healthy wheat

seeds and cultural precautions can be more effective on yield than seed type in wheat farming.

3.4. Farmers' opinions on fluctuations in the amount of wheat produced in the research region

Certified seed usage is quickly replacing farm-saved seed in Turkey, mainly because of the higher yield realised by producers and the subsidy policies applied. Some wheat farmers prefer farm-saved seed use either due to financial constraints or lack of knowledge on certified seed (USDA, 2017). Depending on subsidy policies for certified seed usage and the developments in the certified seed sector in Turkey, certified seed production and use has increased over the years (Bagcı & Yilmaz, 2016). Table 4 shows the farmers' opinions on major reasons for fluctuations in the amount of wheat produced. It was determined that 'climatic conditions as, drought', 'high input prices', 'wheat diseases', and 'low wheat prices' are the most important reasons in the fluctuations of the wheat amount produced. Reasons such as 'using insufficient fertiliser', 'problems caused by seed', and 'wheat pests' were found to be unimportant. The share of farmers indicating 'problems caused by seed' as an important factor was lower for farmers using certified seed with 15.63% than for farmers using farm-saved seed (37.50%).

Table 3. Results of chi-square test (χ^2) showing associations between groups by selected farming characteristics of the farm

Characteristics	Farmers using certified seed (N=64)		Farmers using farm-saved seed (N=24)		Total (N=88)	
	N	%	N	%	N	%
Purpose of wheat growing						
Domestic consumption	24	37.50	14	58.33	38	43.18
Commercial	40	62.50	10	41.67	50	56.82
$\chi^2 = 3.088^*$						
Size of total farmland (hectare)						
< 5	30	46.88	16	66.67	46	52.27
5 and over	34	53.13	8	33.33	42	47.73
$\chi^2 = 2.741^*$						
Size of wheat cultivation area (hectare)						
< 3	25	39.06	16	66.67	41	46.59
3 and over	39	60.94	8	33.33	47	53.41
$\chi^2 = 5.345^{***}$						
Wheat yield (tons/hectare)						
1- 3.99	34	53.13	17	70.83	51	57.95
4 and over	30	46.88	7	29.17	37	42.05
$\chi^2 = 2.246$						
Method of plant protection						
Biological control	9	14.06	4	16.67	13	14.77
Chemical control	55	85.94	20	83.33	75	85.23
$\chi^2 = 0.094$						
Use of salaried labour force (non-family labour)						
Yes	35	54.69	10	41.67	45	51.14
No	29	45.31	14	58.33	43	48.86
$\chi^2 = 1.184$						

* $p \leq 0.10$, *** $p \leq 0.01$

Table 4. Farmers' opinions on the major reasons for changes in the amount of wheat produced

Opinions*	Farmers using certified seed (N=64)		Farmers using farm-saved seed (N=24)		Total (N=88)	
	N	%	N	%	N	%
Climate conditions, drought	59	92.19	23	95.83	82	93.18
Input prices are high	56	87.50	22	91.67	78	88.64
Wheat diseases	55	85.94	21	87.50	76	86.36
Wheat prices are low	46	71.88	8	33.33	54	61.36
Using insufficient fertilizer	16	25.00	7	29.17	23	26.14
Problems caused by seed	10	15.63	9	37.50	19	21.59
Wheat pests	10	15.63	3	12.50	13	14.77

*Note: farmers were allowed to give multiple responses.

4. Conclusion

Wheat is one of the most important crops for human nutrition in Turkey and the world. Product quality and having high yields are related to the use of the high-quality seed. Therefore, the rising use of certified seeds with higher genetic potential is expected to increase quality and yield in wheat production. Since 2005, area-based supports are provided to farmers' using certified seed by the Ministry of Agriculture and Forestry in Turkey. These supports have been necessary for the improvement of certified seed use.

In this study, the factors affecting the government-supported certified and farmer (farm)-saved seed use in wheat farming were examined in Burdur and Isparta province, which is located in the Lakes Region of Turkey. Based on qualitative and quantitative analyses presented in this study, the following conclusions and recommendations can be withdrawn. Empirical evidence revealed that a larger size of wheat cultivation and farmland area and the amount of wheat produced for commercial purposes was positively correlated to certified seed use. Also, rising registries to the system, more farming experience, and more agricultural credit use raised the possibility of certified seed usage. Based on these results, it can be said that government subsidy policies play important roles in promoting certified seed use among farmers. Therefore, the government should continue to subsidise certified wheat seed use and promote extension work to increase wheat yield. In this way, certified wheat seed use in wheat farming will have practical means to improve wheat productivity and enhance food security.

Conflict of Interest

The authors declare that there is no conflict of interest.

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