Chapter 10
Socioeconomic Evaluation of Einkorn Wheat Production

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10.1 Introduction

Wheat is a cultivated plant that is the most produced in the world and indispensable in the nutrition, trade, and crop rotation systems of many countries. The cultivation area and production of wheat, which is an important plant in human nutrition, increase in parallel with population growth (Serpi et al., 2011). Today, it is accepted as a constant food by the people living in the geography from the west of Europe to the north of India, from Scandinavian and Russia to Egypt. It is one of the products with a strategic feature along with products such as corn and soy in the world food markets.

It is reported that there are historical remains in the vicinity of the Red Sea that wheat was used by hunter-gatherer human societies approximately 19,000 years ago (Tanno & Willcox, 2006; Feldman & Kislev, 2007). However, the first wheat cultivation, that is, the beginning of the cultivation of wheat, is dated 10–12 thousand years ago. The first wheat farming in the world started in the Mesopotamian region, which is located in the Fertile Crescent region, 10–12 thousand years ago in the Neolithic period, and has enabled the transition of human societies from a foraging and a sedentary lifestyle to a settled lifestyle. It is reported that the first cultivated wheat forms were diploid, einkorn ($2n$ = 14, AA genome), and tetraploid, emmer ($2n$ = 28, AABB genome) wheats (Shewry, 2009; Peng et al., 2011a). It has been reported that einkorn and emmer wheats are instrumental in the development and spread of wheat agriculture in the world and are an important food source for the nutrition of the people of the world in the few thousand years until the emergence of more productive polyploidy wheats (Shewry, 2009).

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N. Zencirci et al. (eds.), *Ancient Wheats*,
https://doi.org/10.1007/978-3-031-07285-7_10

Wheat and its products can be examined in two sections: hulled wheat and its products, which are known as the ancestor of another word called einkorn (*Triticum monococcum* L. ssp. *monococcum*), and other wheat and its products. The first of these, einkorn wheat, also known as "Siyez" or "Iza," is the cultivated form of the wild wheat species *Triticum boeoticum* that grows in France, Morocco, Yugoslavia, and Turkiye. It is one of the wheat species cultivated in the early period, together with *Triticum dicoccum* Schrank wheat. It is thought to have been domesticated for the first time in Karacadağ, located in the Southeastern Anatolia region (Heun et al., 1997). Today, this wheat is still cultivated in Northern Anatolia, the Balkan countries, Germany, Switzerland, Spain, and Italy. As a result of examining the genetic relationships of einkorn and emmer wheats, it has been revealed that the gene center of these wheat species is the Southeastern Anatolia Region of Turkiye (Diyarbakır-Karacadağ region) (Heun et al., 1997; Dubcovsky & Dvorak, 2007; Shewry, 2009; Özkan et al., 2010). These wheat species are among the first domesticated plants among thousands of plant species in the Fertile Crescent (Zohary & Hopf, 2000) and grow naturally in the region (Özkan et al., 2010; Peng et al., 2011b).

Wheat farming, which started in the "Fertile Crescent" region, reached Greece and Europe (8000 BC) through Anatolia, the Balkans along the Danube, Italy, France, and Spain (7000 BC), and finally England (5000 BC), in different time periods. Likewise, it reached Central Asia and China (3000 BC) via Iran and Africa (3000 BC) via Egypt. It was brought to Mexico by the Spanish in 1529 and to Australia in 1788 (Shewry, 2009; Peng et al., 2011a). It is reported that the first wheat cultivation in the United States was made in the 1830s, but the variety known as Turkish red wheat, which was brought to the state of Kansas in the United States by the Mennons who migrated from the Crimea, began to be grown intensively in 1874 (Quisenberry & Reitz, 1974). Until the 1940s, this variety was largely grown in the United States. Wheat was a wild character plant that was only grown/cultivated in the Middle East geography 10–12 thousand years ago, but it has spread all over the world in this time period and has become an important cultivated plant. Today, wheat farming, which has spread throughout the world, is carried out in more than 120 countries according to FAO data (FAO, 2021). It is reported that wheat cultivation is carried out between 67° north latitudes in Scandinavian countries and Russia, and 45° south latitudes in Argentina (Shewry, 2009).

According to USDA, as of 2020, a total of 775.9 million tons of wheat is produced in an area of 220.9 million hectares in the world (USDA, 2021). 44.12% of production is in Asia and 34.75% is in Europe (FAOSTAT, 2021). Roughly 95% of the production is common wheat and the remaining 5% is durum wheat (Dubcovsky & Dvorak, 2007). However, einkorn wheats (such as einkorn and Iza), emmer wheats (gernik), and spelt wheats, which are the oldest forms of wheat, are not produced in a statistically significant manner today (Nesbitt & Samuel, 1995; Zohary & Hopf, 2000; Kan et al., 2016a).

Wheat is one of the important building blocks of food security. Shocks such as the food crisis in the 2000s and the COVID-19 process we are in, as well as the negativities caused by climate change and modern technology, have shown the strategic importance of wheat in food security. Although the effects of the crises are

different in every country, when it comes to food, the fact that humanity is faced with the danger of not being able to feed itself is important for all countries of the world to understand the importance of basic food sources. For this reason, genetic resources are important in ensuring sustainable production and building resistance against shocks.

Another issue as important as food security is food safety. Developing welfare levels pushes people to question food safety more. At this point, people turn to organic products, local products and tastes where traditional methods are used, where less technology and input are used, and they describe this production and products as reliable in terms of food safety. Local varieties and populations considered as genetic resources are also considered in this segment. Reliability also creates a willingness to pay, and these products are sold at higher prices in the market. Contrary to mass production, limited production creates a supply gap, and excessive demand increases prices. In fact, this can be called localization in the face of globalization, or in other words, activating local dynamics. For example, consumers regard organic products as reliable food. It is reported that the farm gate price of organically produced wheat is 50–200% higher in many European countries (Offermann & Nieberg, 2000). For this reason, genetic resources such as local wheat have an economic dimension as well as food and nutrition.

While wheat is seen only as food in many countries, it is among the sociocultural values of many countries such as Turkiye (Karabak & Kan, 2021). Both beliefs and traditions add a different value to wheat and its products and create a bond between the area where it is grown and the people. Sociologically, seeing wheat as a representative of the nutrients necessary for the continuity of human life and that bread made from wheat is attributed as sacred for this reason is a phenomenon that is not foreign at all in Turkish and Middle Eastern cultures (Bjørnstad, 2016). For this reason, wheat and its products are included in many traditions and are used symbolically, with the effect of the historical process in geographies that are the gene center of wheat.

In the historical process of wheat development, it is seen that many wheat species gain importance during certain periods. Ancient wheats such as einkorn, emmer, and spelt are used in human nutrition in many regions, primarily in Anatolia, but with the help of later developments and modern agricultural techniques, it is seen that hexaploid wheats that we use today are more widely produced and traded. Especially the fact that these newly improved wheat varieties have great advantages such as yield compared to the varieties and populations in other wheat species is one of the main reasons for the disappearance of these spelts (Kan et al., 2016a). However, studies conducted in recent years show that the nutritional content of einkorn, emmer, and spelt wheat is very rich compared to other wheats, and they are more beneficial for human health (Shewry & Hey, 2015; Arzani & Ashraf, 2017). This situation shows that local wheats, which are considered as genetic resources, are exposed to genetic erosion. In order to both limit genetic erosion and ensure the sustainability of these wheat species, it is necessary to determine the potential for commercialization of these wheats by revealing the factors that affect the producer

decisions about the production of local wheat populations in order to provide economic gain for the producers growing these types.

10.2 Economics of Einkorn Wheats

It is important to evaluate genetic resources from an economic point of view both in terms of protection and sustainability. There is an increasing interest in local products and local varieties/populations in the world (Kan et al., 2016a; Petropoulos et al., 2019; Blare et al., 2020; Lodhi et al., 2020). There are many international initiatives that try to activate local dynamics based on wheat and its products. It is important to add added value to these products, especially in studies aimed at protecting genetic resources in situ (in situ conservation). In this context, the most used applications are organic production of these products (Varia et al., 2021), protection within the geographical indication system (Raggi et al., 2021), and marketing them as finished goods in niche markets by creating a healthy food perception (Kan et al., 2021).

When einkorn wheats are evaluated, which constitute the scope of this study, Turkiye, the homeland of wheat, is one of the countries with the widest examples in this regard. There are important studies in Turkiye on Siyez and Iza wheats, which are einkorn wheats. Siyez wheat is grown in Turkiye, especially in the Kastamonu region, and is consumed by processing bulgur, as it is not suitable for making bread (it is very hard and mills cannot convert it into flour). Einkorn bulgur is a product obtained by drying Siyez wheat, which has single-grain spikelets and a husked structure, after being soaked in water and grinded in stone mills with traditional methods and sieved (Wikipedia, 2021). There are three geographical indications (PDO) belonging to Siyez wheat, which gained added value within the geographical indication system, especially in Turkiye after 2017. These are (TURKPATENT, 2021)

- Kastamonu Siyez bulgur (C2017/201)
- Kastamonu Siyez wheat (C2019/001)
- Kastamonu Siyez flour (C2018/154)

There are many local development approaches especially for Siyez bulgur in Turkiye. Siyez bulgur produced around Kastamonu is also on the agenda of many NGOs and is a wheat product supported by the Slow Food organization as a local product (Slow Food, 2021). This product is produced not only in the Kastamonu region but also in many regions of Turkiye and has been converted into economic activity in a few known places. It is used as animal feed in other areas (Karabak et al., 2019). In their study on Siyez wheat in İhsangazi district of Kastamonu province, it was determined that the producers of Siyez wheat used 68% of the Siyez wheat they produced for animal feeding and 32% for making bulgur. They stated that 11% of the produced Siyez bulgur is consumed at home and 85% is marketed.

Another example of einkorn wheat in Turkiye is Iza wheat. It is produced in Bolu and Bilecik provinces in Turkiye. It can be said that Iza wheat, which is consumed

as bulgur, is tried to be evaluated within the geographical indication system, especially with the aim of gaining added value. This wheat has two applications for geographical indication registration in Turkiye, one in 2018 (Bolu Seben Iza Wheat) and the other in 2020 (Seben Iza Bulgur) (TURKPATENT, 2021). In studies on this subject, Yaman et al. (2020) tried to make a socioeconomic analysis of production in the Black Sea region (Bolu, Karabük, Kastamonu, Sinop, and Samsun provinces) where emmer and einkorn wheats are grown intensively. As a result, they determined that 86% of the producers growing these wheats use the products for their own consumption, not for commercial purposes. It has been stated that while einkorn wheats are primarily used to meet household needs such as bread making by obtaining bulgur and flour, emmer wheat is mostly used for animal feed. In their studies, it is stated that this type of wheat should be transformed into value-added products to protect and ensure its sustainability.

In addition, there are other examples in the world where einkorn wheat is produced and sold as a local product and an economic value is created. For example, emmer, einkorn, and spelt wheats, known as spelt in Italy, are called "farro." It is stated that new markets based on the products obtained from these wheats have developed in Italy, although it is subject to a large amount of genetic erosion (D'Antuono & Bravi, 1996). For example, it is stated that an Italian company uses spelled by-product (i.e., husks) to produce high-quality baby products (pillows, mattresses) that do not cause allergies. In addition, it is emphasized that these products are preferred with the healthy and nutritious aspects of these wheats (Laghetti et al., 2009).

Another example of einkorn wheat is in Greece known as "Kaploutzas." This wheat is grown organically in Aridaia, Kilkis, and Thessaloniki (Region of Central Macedonia, Greece) mostly on flat and sloping lands. Papadakis (1929) reports that "Kaploutza-Einkorn Landrace" was brought to Thrace and from there to Central Macedonia with Greek refugees from Anatolia in the early 1920s. This wheat has a local niche market with its special flavor and rich nutritional content. Most farmers sell produce directly at organic public or farmer's markets or using local distributors. Its producers are supported by the Greek Ministry of Rural Development and Food, and AEGILOPS NGO (Network for Biodiversity and Ecology in Agriculture) provides support for the protection and sustainability of this wheat species. (ECP/GR, 2021a). In this structure, it is seen that this wheat is sustainable and creates added value, especially with organic product certification, government, and NGO support.

Another einkorn wheat sample is from Romania known as "Bözödi." This einkorn wheat was first grown in Hungary and then in Romania in Tata, Héreg, Ócsa, and Badacsony regions. "Bözödi einkorn" is traditionally cultivated in "Bözödújfalu" valley (Central Romania) on several hectares. "Bözöd" landrace on separated several hectare fields are marketing the dehulled seeds or the products (flour, pasta). The farmers and researchers working on Bözöd landrace established the "Bözöd Einkorn Society," but now there is no activity within the Society. There is the increasing demand for the products of Bözöd landrace by the pasta and bread business, and this ensures to conserve the diversity over the long period (ECP/GR,

2021b). In this example, it is seen that Bözöd einkorn wheat is not supported by any competent authority, and the element that ensures sustainability is the demand from the private sector.

In a study conducted in Croatia, an alternative production system consisting of emmer, einkorn, and spelt wheats was compared with the wheat produced in the conventional and organic farming system by making an economic analysis. As a result of the research, it is stated that these grains are more profitable than the conventional and organic farming system. In this context, it is recommended to expand the production of these grains in the country, especially within the organic farming system (Čop et al., 2019).

Konvalina et al. (2010) evaluated the performance of einkorn, emmer, and spelt wheats in an organic farming system in the Czech Republic. The local varieties evaluated as a result of the research findings show that they can be grown under the organic farming system, especially in marginal areas for agricultural production. It is stated that producers can increase their product variety and expand their market opportunities by producing these local varieties in these areas. Thus, it has been reported that they can contribute to both sustainable development and the conservation and sustainable use of plant genetic resources.

Longin et al. (2016), in their study with the aim of agronomic comparison of emmer, einkorn, and spelt wheats with bread and durum wheats in Germany, determined that spelt, emmer, and einkorn wheats yielded 37, 55, and 62% less yield than conventional bread wheats, respectively. Despite this, they state that these wheats will be preferred to produce high-quality bread, breakfast cereals, and special breads.

10.3 Case Study from Turkiye: Einkorn Wheat (Iza Buğdayı-Iza Wheat)

Turkiye is in a very special position in terms of plant genetic resources. Among the centers of diversity and origin explained by Vavilov (1994), the Mediterranean and Near East Centers overlap in Turkiye. In terms of plant gene resources, Turkiye is one of the richest countries in the world. According to J. Harlan, there are five micro-gene centers in our country where more than 100 species show wide variation (Demir, 1990). Turkiye's rich biodiversity stems from being an important gene center and home to many plant and animal species. The most important of these plant species is "wheat."

Wheat, which has a history of 10,000 years in Anatolia (Harlan, 1995), is a cultural heritage as well as being a strategic product. Turkiye is one of the important regions where wheat is cultivated (Zohary & Hopf, 2000). In Turkiye, wheat has an economic, social, cultural, historical, and even archaeological value and importance. The history of wheat in Turkiye goes back before all civilizations. Wheat is the value at the center of the revolutionary changes that determine the way of life that man has reached today, and moreover, the changes that have taken place in the

geography we live in today. There are historical remains showing that wheat is the homeland of the Fertile Crescent, especially in the Southeastern Anatolia Region of Turkiye (Nesbitt & Samuel, 1995; Tanno & Willcox, 2006).

Wheat is the most important agricultural product in Turkiye, and when products such as bread, phyllo, and bulgur are considered, it can be said that Turkish cuisine is one of the indispensable foodstuffs. When the statistical data of institutions such as TURKSTAT and FAO are examined, it is seen that Turkiye's annual wheat production is approximately 20 million tons, which corresponds to an agricultural production value of 7 billion dollars. In terms of added value, it can be said that the agricultural industry based on wheat and wheat products is one of the main sectors in the food industry and economy.

10.3.1 Research Area

In this case study, the socioeconomic evaluation of Iza wheat production in *Triticum monococcum* subspecies, which is one of the einkorn wheats belonging to *Triticum monococcum* L. ssp. *monococcum* wheat species, and effective management strategies on the decisions of the operator in wheat production in the enterprise are emphasized.

The main material of the research consists of the data obtained through the survey conducted with the agricultural enterprises producing Iza wheat (einkorn wheat) in Gölpazarı and Pazaryeri districts of Bilecik province and Göynük, Merkez, Mudurnu, and Seben districts of Bolu province. The research area is shown in Fig. 10.1. Bolu and Bilecik provinces, which are defined as research areas, are the places where Iza wheat is widely cultivated in Turkiye. Especially in Bolu province, there are two geographical indication registration applications under the names of "Bolu Seben Iza Wheat" and "Seben Iza Bulgur" (TURKPATENT, 2021). For this reason, this wheat is one of the hulled wheats known in both regions and has been produced for a long time.

10.3.2 Sampling Method

Since it is not possible to reach the records and quantitative data of the producers using local wheat varieties, the "Snowball Sampling Method," which is one of the non-probabilistic sampling varieties, and the chain transportation principle were used in this study. In the selection of this method, due to the difficulty of determining the producers using unregistered local wheat varieties, attention was paid to reaching the other one through the first producer. Snowball sampling has been particularly effective in identifying individuals or situations that can be a rich source of information. In snowball sampling, it is aimed to establish a relationship with the sample event that can be included in the universe and suitable for the purpose of the

research, and then with the help of the person contacted, with the help of another case, and then with another case study in the same way, and in this way, it is aimed to enlarge the sampling like the snowball effect (Coşkun et al., 2017; Kuş, 2012). This approach is particularly effective in identifying individuals or situations that can be a rich source of information regarding the researcher's problem (Fig. 10.2).

In the study, the opinions of experts (Provincial Directorates of Agriculture and Forestry, District Directorates of Agriculture and Forestry, Chambers of Agriculture and University) were taken to determine the number of producers in the provinces

Fig. 10.1 The map of research area

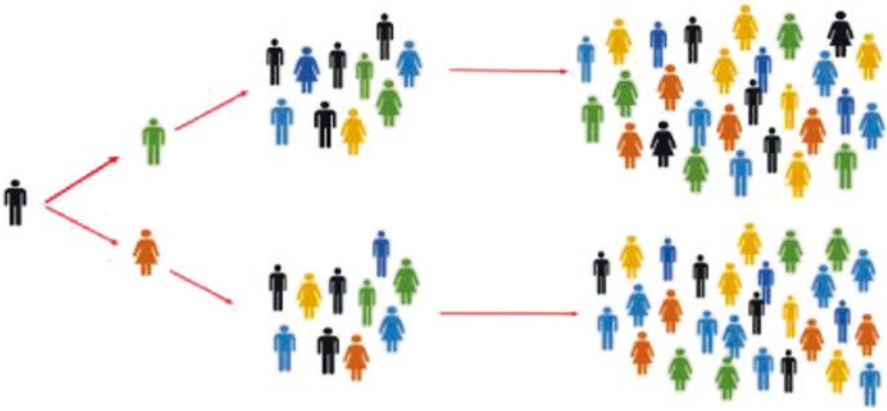

Fig. 10.2 Schematic of the snowball sampling model

in the research area. As a result of the study, a total of 51 Iza wheat producers were reached and the questionnaires were filled in face to face.

10.3.3 Research Aims

Structured questionnaire questions were used in the study, and the following information was tried to be reached with the study:

- Socioeconomic and demographic characteristics of Iza wheat growers
- Agricultural structure of Iza wheat growers and determination of the place of Iza wheat in production
- Iza wheat production strategies and reasons for preference
- Determination of production cost of Iza wheat
- Evaluation of Iza wheat

10.3.4 Analyze Methods

In the study, producers were divided into two groups. These are "only einkorn (Iza) wheat producers – EWP" and "both einkorn (Iza) wheat and improved wheats producers – BWP." Statistical analyses were done on these two groups. In the study, *t*-test statistics, which is one of the parametric tests, was used when the assumptions of the normal distribution were met in the comparison of the means of two independent groups. In cases where the assumptions of the normal distribution were not met, the Mann–Whitney *U*-test, which is one of the nonparametric tests, was used. The chi-square test of independence was used to test the interdependence of two discrete variables (Kesici & Kocabaş, 2007).

10.3.5 Research Findings

Iza wheat, one of the important einkorn wheats grown in Turkiye, is produced especially in the provinces of Bolu and Bilecik. These provinces are in TR4 East Marmara Region according to the Turkiye Statistical Regional Units Classification. In addition, Iza wheat, which is produced in other provinces, is called by different names according to the regions (Kan et al., 2016a; Zencirci et al., 2020; Yaman et al., 2020). For example, it is known as Siyez wheat in and around Kastamonu province. IZA wheat, which set out from Karacadağ, reached the province of Bolu and its districts thanks to migrations and trade routes, and gained a unique genetic structure compatible with this environment by being cultivated here for many years. Siyez and Iza wheats are often confused with each other. According to Zencirci

et al. (2020), the name Siyez is the species name (*Triticum monococcum* ssp. *monococcum*), and Iza wheat is a village variety (wheat landraces) under this species.

In this study, there are two types of production strategies of the producers. While 41.18% of the producers produce only Iza wheat, the remaining 58.82% produce Iza wheat (einkorn wheat) and other improved wheats (*Triticum aestivum* and *Triticum durum*) together (Fig. 10.3). These behaviors of producers developed for both wheat species, which have advantages and disadvantages relative to each other, can also be called risk management strategy.

The demographic characteristics of the Iza (einkorn) wheat producers interviewed in the research region according to their production strategies are given in Table 10.1. When the table is examined, it is seen that the age of the producers dealing with the production of Iza is over 50. In particular, it was determined that the producers that implement the BWP strategy are younger than those that implement the EWP strategy and this difference is statistically significant at the 99% confidence level. Kan et al. (2016a) stated in their study with wheat landrace producers in Turkiye that the average age of wheat landrace producers was over 50 years old. They reported that the average age of producers producing only wheat landraces was even higher. When both research findings and other studies are examined, it can be said that age is an important variable in both decision-making and production behaviors in wheat landrace production. Especially the older population has a higher tendency to produce only wheat landrace, and as a result of the research, similar results were obtained in the production of Iza wheat. In recent studies on the age of producers engaged in agriculture in Turkiye, it is stated that the average age varies between 46 and 51 years (KKB, 2020). This situation shows that the population dealing with Iza wheat production is above the average farmer age of Turkiye.

Another demographic factor is the education level of the producers. It has been determined that more than 85% of Iza wheat producers in the research area have education between primary–secondary and high school. The average education year is 6.80 years. The academic year was higher especially in producers who implemented the BWP strategy, and the difference was statistically significant at the 95% confidence level. As the education level rises, producers tend toward more

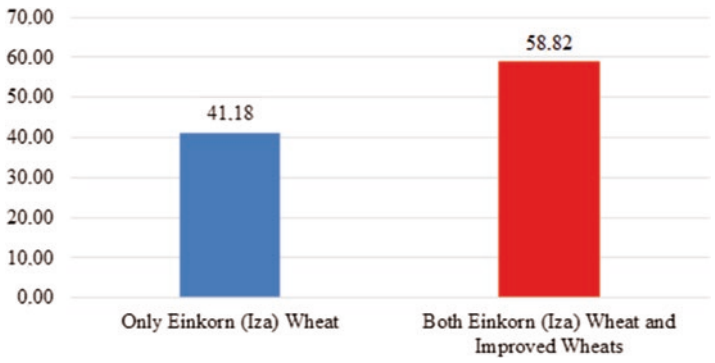

Fig. 10.3 Production strategies of the Iza wheat producers

Table 10.1 Demographic statistics of the farmers by their production strategies

Variables		Production strategy						*t*-test/ chi-square test
		Only einkorn wheat (Iza wheat) – EWP		Both einkorn (Iza) and improved wheat varieties – BWP		Farm average		
		Mean	%	Mean	%	Mean	%	
Household heading age		58.90		50.07		53.71		2.87***
Education	Illiterate		0.00		0.00		0.00	3.80
	Literate		9.52		3.33		5.88	
	Primary–secondary school		71.43		53.33		60.78	
	High school		14.29		36.67		27.45	
	Vocational school		0.00		0.00		0.00	
	Higher education		4.76		6.67		5.88	
Education (year)		5.48		7.73		6.80		−2.24**
Household number (total)		3.00		3.77		3.45		−2.30**
Household number (male)		1.48		1.90		1.73		−2.05**
Household number (female)		1.52		1.87		1.73		−1.59
Man power unit (total)		2.07		2.79		2.50		−2.63**
Man power unit (male)		1.19		1.58		1.42		−2.09**
Man power unit (female)		.88		1.22		1.08		−2.28**

Statistically significant at *90%, **95%, and *** 99% confidence levels

commercial wheats. Kan et al. (2016a) stated in their study that as the education level increases the producers tend to produce more improved wheat.

Household size and man power unit (MPU) size are the other factors in demographic factors examined in the research. It makes sense when both factors are evaluated together. It has been determined that the size of the household and, accordingly, the MPU size is higher, especially in the producers who carry out the BWP strategy. This is since producers tend to meet their labor needs from the family. The increase in MPU leads producers to different products, not to a single product. As can be seen in the table, there is a statistically significant difference between the producers producing both production strategies in terms of these two factors.

The land assets and land patterns of the producers in the research area are shown in Table 10.2. When the table is examined, it has been determined that the average land size in the average of agricultural holdings is 13.09 ha and 14.52% of this land is allocated for Iza wheat production. Iza wheat is produced in the rainfed farming system. It has been determined that the producers following the EWP production strategy are engaged in agricultural activities on a smaller scale than the producers applying the BWP production strategy. The difference between the two different

Table 10.2 Land assets of the Iza wheat producers

	Production strategy			
	EWP	BWP	Farm average	
Variables	Mean	Mean	Mean	*t*-test/Mann–Whitney *U*
Total cultivated area (ha)	6.01	18.05	13.09	−4.80***
Own area (ha)	2.92	7.66	5.71	−3.91***
Rented area (ha)	3.09	9.31	6.75	−2.84***
Sharecropping area (ha)	0.00	1.08	0.64	−0.83
Own irrigated area (ha)	0.39	0.96	0.72	−0.63
Rented irrigated area (ha)	0.63	0.51	0.56	0.22
Sharecropping irrigated area (ha)	0.00	0.00	0.00	–
Einkorn (Iza) wheat production area (ha)	1.38	2.26	1.90	1.63*
				188.00** (M-W-U)

Statistically significant at *90%, **95%, and *** 99% confidence levels

types of farms in terms of both the size of the cultivated land and the size of the land allocated to the production of Iza wheat was found to be statistically significant. It has been determined that the producers following the EWP production strategy allocate 22.96% of the total cultivated land to Iza wheat production, while the producers following the BWP production strategy allocate 12.52% of the total cultivated land to Iza wheat production. The latest data on the scale of agricultural holdings in Turkiye show that they have an average size of 7–8 ha (TURKSTAT, 2018). Considering the size of the owned land in the research region, it is seen that the size of the agricultural holdings is below the Turkiye average. It has been determined that the producers following the BWP production strategy rented a significant amount of land for agricultural production. According to Kan et al. (2021), they determined the average land size of wheat landrace producers in Turkiye as 7.16 ha and as 6.11 ha in Eastern Marmara Region in their study. Yaman et al. (2020), in their study on emmer and Einkorn wheats, reported that the average farm size was 7.97 ha. As can be seen from the studies on wheat landraces producing agricultural holdings, as the size of the agricultural holdings increases, the agricultural holdings tend to combine the wheat landrace production with the commercial (improved) wheat production. In other words, the production strategies of the producers change with the size of the agricultural holdings. There is a positive relationship between agricultural holding size and the adoption of modern varieties (Perrin & Winkelmann, 1976; Feder et al., 1985; Kan et al., 2016b). These research findings also support this result.

One of the most important aspects of Iza wheat production is the economic return of production. In this context, expense items were calculated according to the inputs and practices used by the producers in the production of Iza wheat and are presented in Table 10.3. Cost items are determined only on variable costs and fixed costs were not considered. As a result of the analysis, the average variable cost per hectare of agricultural holdings was calculated as $641.96, and the gross agricultural production value was $156.56. There was no statistically significant difference between the

Table 10.3 Cost items of Iza wheat production

	Production strategy						*t*-test value
	EWP		BWP		Farm average		
	TL	$[a]	TL	$	TL	$	
Soil preparation cost (TL/ha)	511.43	72.85	440.00	62.68	469.41	66.87	1.50
Planting cost (TL/Da) (including bottom fertilizer)	1899.05	270.52	1920.00	273.50	1911.37	272.28	−0.27
Fertilizer and fertilization cost (TL/ha)	1044.76	148.83	1159.67	165.19	1112.35	158.45	−0.72
Plant protection cost (TL/ha)	138.10	19.67	92.00	13.11	110.98	15.81	1.89*
Harvest cost (TL/ha)	307.14	43.75	326.67	46.53	318.63	45.39	−3.22***
Threshing cost (TL/ha)	365.71	52.10	371.67	52.94	369.22	52.59	−0.84
Revolving fund interest (5%)	213.31	30.39	215.50	30.70	214.60	30.57	
Total variable cost	4479.50	638.11	4525.50	644.66	4506.56	641.96	0.18
Straw yield (kg/ha)	2438.10		2477.78		2461.44		−0.84
Grain yield (kg/ha)	2467.62		2633.33		2565.10		−0.79
Gross agricultural production value (TL/ha)	1082.53	154.21	1110.57	158.20	1099.02	156.56	−1.08
Gross profit (TL/ha)	634.58	90.40	658.02	93.73	648.37	92.36	−0.71

Statistically significant at *90%, **95%, and *** 99% confidence levels

[a]1$:7.02 TL (Central Bank of the Republic of Turkiye, 2021-year average Exchange rate data)

variable costs of Iza wheat and the gross agricultural production value of the producers following both EWP and BWP production strategies. One of the most important subjects is related to the yield of Iza wheat. According to TURKSTAT 2020 data, Turkiye's average wheat yield was 2920 kg/ha, Bolu province was 2970 kg/ha, and Bilecik province was 2600 kg/ha (TURKSTAT 2021). Considering these figures, the yield of Iza wheat is below the average wheat yield. The other subject in the region is that Iza wheat is supported by the Bolu Municipality, especially in the province of Bolu, and contracted agriculture with a purchase price above the market price. It was determined that Bolu Municipality made a purchase from contracted producers for 512.82 $/ton in 2020. According to TURKSTAT 2020 data, the average wheat price in Turkiye is 213.68 $/ton, Bolu is 186.61 $/ton, and Bilecik is 226.50 $/ton (TURKSTAT, 2021). Given these data, the producers consider wheat production economically sustainable and continue to produce.

Studies on wheat landraces show that the need for family consumption is an effective factor in the sustainability of the wheat landrace production (Frison et al., 2011; Kan et al., 2021; Jaradat, 2017; Karabak et al., 2019; Yaman et al., 2020). In the research, the evaluation methods of Iza wheat and improved wheat were examined. In the research area, 15.69% of the Iza wheat producers do not sell the Iza wheat anywhere, and they use it only for family needs. The ways of using Iza wheat of the remaining 84.31% are given in Fig. 10.4 in detail. When the figure is examined, it has been determined that 78.63% of the Iza wheat production was sold to the "Köroğlu Cooperative," which was established under the leadership of Bolu Municipality. The Cooperative, supporting Iza wheat producers in Bolu province,

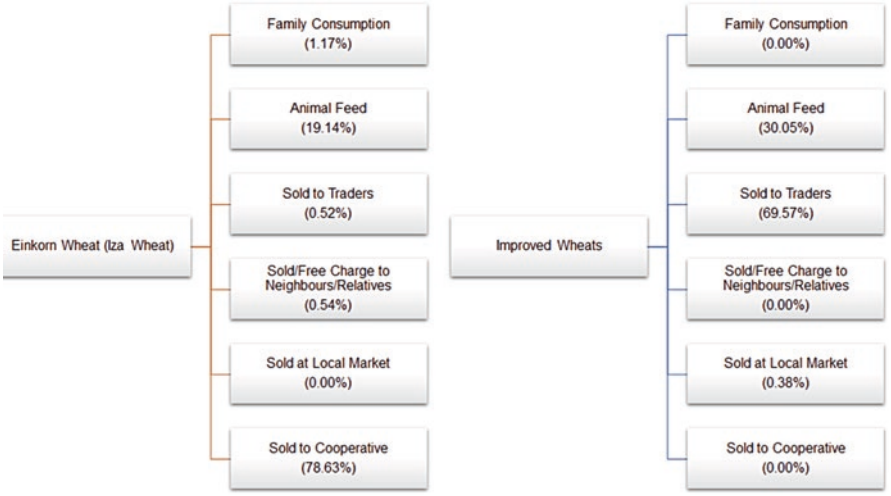

Fig. 10.4 Evaluation of einkorn (Iza) wheat and improved wheats

supports the farmers by contracted production method and purchases the product from the producer at a higher price than commercial wheats in the market. For this reason, commercialization potential in Iza wheat production in Bolu province is higher than Bilecik province. In Bilecik, 63.64% of the producers stated that they produce only for their own family needs. In addition, animal feeding is an important factor in the production of Iza wheat, and it has been determined that the producers use 19.14% of the production for animal feeding. Regarding improved wheat, traders have a significant share in product evaluation (69.57%). As can be seen from the figure, NGOs play an important role in turning wheat landraces into economic advantages. The sample in Bolu is an important initiative for both the expansion of the production of Iza wheat and the conservation and sustainable use of genetic resources. In addition, the Cooperative's attempts to create a brand by transforming Iza wheat into value-added products give hope that this initiative will contribute significantly to regional producers and local economic development in the future.

In Fig. 10.5, the variables that can be effective in the production decision of the Iza wheat and commercial wheat farmers are shown comparatively. The variables were evaluated with 5-point scoring (5 – very effective factor in decision-making in production). When the figure is examined, it has been determined that the factors "drought tolerance," "cold tolerance," "tolerance to diseases," "tolerance to pests" are effective in decision-making, especially in the production of Iza wheat. These factors show that Iza wheat has an advantage over commercial wheats under biotic and abiotic stress conditions. Studies on this subject report that wheat landraces are preferred by producers as they are more tolerant to biotic and abiotic conditions (Meng et al., 1998; Williams, 1989; Jarvis et al., 2000; Bardsley & Thomas, 2005; Kan et al., 2021; Jaradat, 2017) and has greater adaptability to a range of soil types (Bellon & Taylor, 1993).

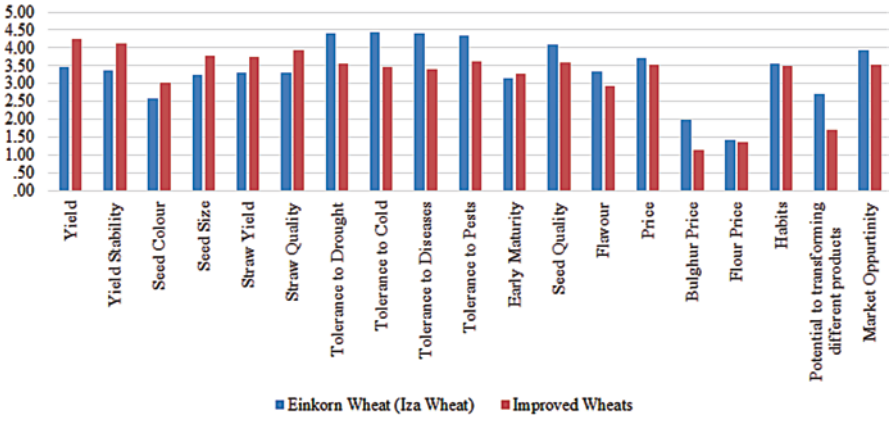

Fig. 10.5 The reasons for preference by the farmers for einkorn (Iza) wheat and improved wheats

10.4 Conclusion

Considering both its importance in human nutrition and its indispensability in animal production with its grains and stems, wheat is one of the strategic products. With the development of modern technology and science, we can say that today there is a quantitative increase in wheat, thanks to plant breeding methods. With this development, it is seen that modern wheat varieties have entered our lives more and the industry based on this also demands these varieties. However, the crises experienced lead people to become more conscious about healthy consumption and to produce higher quality products by using more environmentally friendly techniques. In this regard, the increasing perception turns into more attitudes and behaviors, that is, there is a shift in preference toward the products that create the quality perception of the consumers. In this context, concepts such as local product, niche product, geographically indicated product, traditional product, and organic product have become more audible in the market, and these concepts have begun to be brought together with the perception of healthy products. In this context, local seeds and local varieties/populations have become preferred in more production and consumption.

In this new market created, the concept of healthy products has gained an important place in an increasing trend today. The COVID-19 pandemic we are currently experiencing has an important contribution to the development of this new trend. This situation also provides a positive contribution to the conservation and sustainable use of local varieties (landraces) important in terms of genetic resources. Spelled wheat is one of these genetic resources (einkorn, emmer, spelt). The results of the research on these wheats showed that these wheat types have quantitative advantages when compared with the existing wheat varieties, and this new trend led to the inclusion of spelt. In addition to the studies carried out in Turkiye in the Fertile Crescent, which is known as the homeland of wheat, findings such as the

positive effects of these wheat species on human health in Europe, their resistance to climate change, and their resistance to biotic and abiotic stress conditions have made these wheats more popular.

Iza wheat, which is one of the einkorn wheats and grown around Bolu and Bilecik provinces in Turkiye, is one of the spelled wheats that has been mentioned frequently in recent years. Studies in the world focus on organic agriculture, geographical indication systems, government and NGO supports, as well as marketing them into value-added products in order to protect and sustainably use such genetic resources. In the case study examined within the scope of this study, the geographical indication system and the contribution of NGO were emphasized. In this way, a local development strategy based on this wheat has been tried to be created.

The involvement of the municipality, cooperatives, and the private sector in supporting Iza wheat is one of the best examples of how other sectors can achieve this without just creating a public policy. Especially in the province of Bolu, which is discussed within the scope of the study, purchasing the products of the producers at high prices and making them into finished products ensure that the difference created by the loss of efficiency is arranged and they remain in production. A shift from household consumption to commercial production is seen as a positive development in local economic development in the region. Local actions are important for the protection and sustainable use of wheat landraces, which is now in danger of disappearing in Turkiye. In this way,

- It contributes to regional recognition by allowing products with high added value to enter the market more, while providing more economic return.
- It develops social cooperation between producer, public, NGO, and private sector.
- It increases more tendency toward organization and improves organizational commitment.
- It strengthens social capital.
- By supporting environmentally friendly production systems (organic agriculture, geographical indication system, etc.), it contributes to combating climate change, reducing environmental damage from the use of inputs, and evaluating marginal areas.
- It ensures the preservation of cultural values and the continuity of ancestral information.

Considering the importance of wheat in the nutrition of the people of the country and in terms of farming, this strategic product is indispensable even if the geographical and climatic conditions are difficult, and it reveals the necessity of creating product-based development strategies. The fact that local wheat varieties find buyers, especially in niche markets, shows that the advantages of niche marketing will be effective for wheat. Local development strategies that can be created will allow in situ conservation of wheat landraces, as well as provide economic gain for the producers of the product.

Acknowledgments We thank Mr. Mustafa Anıl Kaya and Mr. Mehmet Uresin, students of Kırşehir Ahi Evran University, Faculty of Agriculture, Department of Agricultural Economics, who helped to collect the data in the preparation of the study.

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