Journal of Balkan Science and Technology
journal homepage: www.jbst.nku.edu.tr/

Determining the Knowledge Level of Farmers in Thrace Region about the Use of Digital Applications and Their Demands for Digital Applications in Agriculture

Ebru IRMAK [1*], Hayati BAŞARAN [2], Muaffak SARIOĞLU [3]

[1] *District Directorate of Agriculture and Forestry, Tekirdağ, TÜRKİYE*
[2] *Turkish Rebuplic Ministry of Commerce, Ankara, TÜRKİYE*
[3] *Giresun University, Technical Sciences Vocational School, Giresun, TÜRKİYE*

Research Article

Keywords:
Digital agriculture
Agricultural technologies
Thrace Region
Level of awareness
Demand determination

Received: 23.02.2024
Accepted: 13.12.2024
Published: 30.12.2024

DOI: 10.55848/jbst.2024.48

ABSTRACT

The development of agricultural technologies and the gradual decrease of scarce resources such as water and soil on the other hand, reasons such as the rapid increase in the human population, the obligation to leave a clean soil and a clean future to future generations, and the desire of countries to act with sustainable agriculture awareness make digitalization in agriculture mandatory. Thrace is a region with a high level of knowledge and awareness. Despite this, the research topic was examined based on the hypothesis "The level of knowledge about digital agricultural technologies is high." A survey was conducted with 153 people about digital technologies in agriculture. These 153 people were selected according to the simple stratified random sampling method. The analysis of the data was made based on numerical size, charts were created and evaluations were made. As a result of these evaluations; the level of awareness in soil analysis, soil cultivation time determination, drone application and others was quite high. The most needed issues from digital technologies are planting time determination, soil analysis, drug dosage adjustment, etc. it was determined as.

1. Introduction

It is predicted that the world population, which is currently 7.7 billion, will reach 9.7 billion people by 2050 [1]. The increasing population will also trigger an increase in food demand. Since it is not possible to increase a scarce resource such as soil, meeting this demand is only possible by increasing the food supply, that is, by working on productivity. According to the results of a research; it is reported that current agricultural production must be increased by 70% in order to feed the people who are expected to reach 9.7 billion people in 2050. Another problem of population growth is urbanization and the rapid disappearance of agricultural areas. Due to this situation, both agricultural lands and agricultural labor are decreasing. The agricultural sector has entered into a major transformation in order to find a solution to all these negative predictions. This transformation is called 'digital agriculture' [2].

The history of agriculture, which started with human and animal power, was introduced to water and steam power in the 1900s, benefited from tractor and engine power in the 1650s, started to automate irrigation applications in greenhouses in the 1990s, especially with the use of automation in greenhouses, and in the 2010s. smart agricultural applications have started. The use of information technologies in agriculture first occurred in Germany in 2011. With the application of Industry 4.0, information technologies and industry will come together; It was announced that production will be done online with the use of integrated computer systems and artificial intelligence. The increase in productivity and efficiency in agriculture as a result of the use of information and communication technologies in the agricultural sector is considered as the contribution of industry 4.0 application to the agricultural sector. Another result of digitalization in agriculture can be listed as access to safe and healthy food, information sharing, and acceleration of the decision-making process [2].

According to information released by the European Agricultural Machinery Association (CEMA), smart agricultural applications will affect the agricultural sector by 60% by 2030. These factors are 44% automation, 40% consolidation, 36% professionalization and 28% labor shortage, respectively [3].

The contribution of agricultural development to the economic development of lower income groups is greater than any other industry. According to the results of comparative country analyses, growth in the agricultural sector; it is two to four times more effective at raising incomes among the poorest than other sectors. World Bank reports also state that agriculture-based growth is two to four times more effective than other sectors in increasing incomes in the poorest parts of the world [4].

Precision agriculture technologies are very important for determining the current state of the soil, reducing chemical

[*] *Lalapaşa Tarım ve Orman İlçe Müdürlüğü Lalapaşa-Edirne, TÜRKİYE*
E-mail address: ebruirmak22@hotmail.com

costs, reducing environmental pollution, providing high quality products and optimum water use. For example, by using drip irrigation method in potato fields in India, the productivity increased by an average of 31% in 3 years; water consumption decreased by 50% and potato cracks decreased from 10% to 1% [5].

The Thrace region is a region where 74% of its people earn their living from agricultural activities. Additionally, the use of mechanization in agriculture and the level of awareness are high in this region. The aim of this study is to determine the awareness level of Thrace producers in addition to changing agricultural technologies and to determine which technologies in agriculture they can adopt more easily.

2. Material and Method

The main material of the study consists of primary data obtained from the survey conducted between 01.08.2023 and 01.10.2023 in Edirne, Tekirdağ and Kırklareli provinces. In order for the survey to cover the Thrace Region, face-to-face interviews were held in three provinces and the district centers and villages of these provinces. In addition to the field study, Turkish Statistical Institute (TUIK) data was also used [6]. In addition, many written sources such as articles, books and magazines on the subject were scanned. One of the researchers has been working as a technical services staff within the Provincial Organization of the Ministry of Agriculture and Forestry for more than ten years, which gives him the chance to make observations and judgments in the field about the research subject. This can have a positive effect on increasing the reliability and validity of the study.

Within the scope of the study, a survey was conducted with a total of 153 agricultural producers, 50 from each of Tekirdağ, 36 from each of Kırklareli and 67 from each of Edirne provinces (Table 1). W In stratified random sampling, if the variable examined varies according to any characteristic in the region, individuals in the population are first stratified according to this characteristic. Then, sufficient samples from each stratum are selected by simple random sampling method. The individuals to be sampled are selected in proportion to the number of individuals in the strata. In this study, calculations were made according to the formula below, based on the number of agricultural enterprises for each province.

$$n = \frac{N.t^2.pq}{(N-1)D^2 + t^2pq}$$

It was calculated as N=85.497, p=0,3, q=0,7, t=2,576, D=0,1, n=153.

A coding was made for each question in order to measure the awareness level of producers for digital agriculture in the Thrace region and to determine which digital technology they can accept more easily in the future. The data obtained from each producer interviewed was entered into the computer separately and separate codes were created according to the knowledge level and demand of the producers. These data were analyzed according to numerical values and the findings were tabulated. Analysis and evaluations were made based on these data. In addition, correlation, Mann Whitney and chi square tests were tested to see if there was a significant relationship between the findings.

Table 1. Sample Size.

Provinces	Number of Agricultural Enterprises	Percentage (%)	Number of Surveys
Edirne	37.390	0,44	67
Tekirdağ	20.081	0,23	36
Kırklareli	28.026	0,33	50
Total	85.497	1,00	153

Source: TUIK (2018)

In this type of research, the data source is human and one of the methods of obtaining direct information is the survey method. Data is collected from primary sources through the survey method [7]. In order for the research to fully represent the Thrace Region, face-to-face interviews were held with 153 producers living in the centers, districts and villages of Edirne, Kırklareli and Tekirdağ provinces. The places where the interviews were held (center/village/district) are the places where randomly selected producers are registered in the farmer registration system. In addition, data obtained from the Turkish Statistical Institute was also used within the scope of the research.

3. Results and Discussion

Technological developments determine the direction of the sector in agricultural activities, as in almost every field. The European Agricultural Machinery Association stated that the decisive impact of smart applications on the agricultural sector will increase to 60% by 2030 [3]. Although digital applications are related to the technological development level of the country, their application in the agricultural field is related to government policies. Digital agriculture applications are carried out in cooperation with universities, industrialists and the state in England. British governments spent 450 million Euros on agricultural research and development activities in 2011-2012. The Netherlands, one of the most advanced countries in the field of agriculture 4.0 technologies, follows long-term and technology-based agricultural policies. In order to increase agricultural productivity, the Netherlands purchases satellite data on soil and climate on behalf of the state and makes it available to farmers. In Japan, where the availability of land suitable for agriculture corresponds to only 11% of the total country; university, private sector and technology centers work together on agricultural technologies. At Osaka Prefecture University, vegetables are grown in sterile and much shorter times than normal conditions by using artificial lights [2]. This change in the world also manifests itself in Turkey in terms of economic conditions and climate. During this change process, the agricultural sector is also in search of new ones [8]. Since it is the direct implementing agency in Turkey, the Ministry of Agriculture and Forestry undertakes the task of creating and supporting policies regarding digital agriculture. In addition to providing financial support to the Ministry's R&D activities, it has also made regulations with secondary legislation referencing the Agricultural Law No. 5488 [9].

Table 2. Thrace Region Agricultural Areas, 2022.

Provinces	Area of cereals and other crop products (decare)			Area of vegetable gardens (decare)	Area of fruits, beverage and spices (decare)	Ornamental plants area (decare)
	Total land	Sown area	Fallow land			
Tekirdağ	4.152.437	4.006.268	0	29.444	116.616	109
Edirne	3.409.302	3.304.070	6.754	40.795	56.083	1.600
Kırklareli	2.482.285	2.432.572	3.067	14.481	32.165	0
TR2 West Marmara	16.957.960	14.392.449	242.269	489.267	1.831.778	2.197
Turkiye	238.450.494	164.866.554	29.595.607	7.176.802	36.754.808	56.723

Source: TUIK, 2023[10].

Table 3. Education level of the research participants (%).

Education Level						
Provinces	Primary school	Secondry school	High school	college	University	Postgraduate
Edirne	40	13	7	2	3	2
Kırklareli	14	6	8	4	2	2
Tekirdağ	16	6	10	6	9	3
%	45,75	16,33	16,33	7,84	9,15	4,57

Although the provinces of Edirne, Tekirdağ and Kırklareli correspond to only 4.21% of Turkey's agricultural land, they are extremely important in terms of the productivity obtained per unit area (table 2) [11]. For example, the Thrace region accounts for 70% of Turkey's sunflower cultivation area and 75% of its production; It covers 50% of paddy cultivation area and production. The situation in wheat production is much more striking. While the average wheat yield in Turkey varies between 179-226 kg, the yield in the Thrace Region varies between 440-465 kg. It was determined that agriculture was carried out in dry conditions in the area corresponding to 73% of the agricultural land of Edirne province [12]. On the other hand, in another study, it was determined that productivity and production were at high levels in the Thrace Region for many herbal products of economic importance throughout Turkey. The average yield of winter cereals such as barley and wheat is more than twice the Turkey average [13].

In a study conducted by Başak in the Thrace Region (2014), the average land size was found to be 117.49 decares. In the survey conducted with 153 people, the average land size was found to be 294.320 decares in dry agriculture (211,118 decares of property land, 82,202 decares of rented land) and 34.88 decares in irrigated agriculture. This increase in the average business size over the years can be explained by land consolidation and the change in the inheritance law. Land consolidation of a total of 898,000 hectares of land, including 795,000 hectares by 2009 and 103,000 hectares in 2009, was completed by the General Directorate of Agricultural Reform. As of 2012, 2,953,602 hectares of land consolidation has been completed. 14,000,000 hectares by the end of 2023. It is aimed to consolidate the field throughout Turkey [14]. In the Official Gazette dated 01 May 2023, it was reported that land consolidation and in-field development works would be carried out in various provinces and districts of the Thrace Region by the General Directorate of State Hydraulic Works. The Soil Conservation and Land Use Law No. 5403 was amended by Law No. 6537 published in the Official Gazette No. 29001 dated 15.05.2014. The same law was previously amended by law no. 5578. Concepts such as economic integrity and sufficient amount of agricultural land with sufficient income were added to Law No. 5403. New regulations have been introduced for transfers through transfer and inheritance [15].

Education is all social processes that are effective in helping individuals acquire society's standards, beliefs and ways of life [16]. Education level is accepted as an indicator of social development [17]. In a research conducted on a producer basis, it was found that for the province of Edirne, 0.37% were literate, 51.57% were primary school graduates, 19.06% were secondary school graduates, 21.93% were high school graduates and 7.06% were university graduates [18].

45,75% of the participants in our research were in primary school, 16.33% in secondary school, 16,33% in high school, 7,84% in college, 9,15% in university, and 4,57% in postgraduate studies. While the number of primary school graduates is higher in Edirne and Kırklareli, the number of high school graduates is higher in Tekirdağ (table 3). According to TÜİK 2023 population distribution, the median age value of Edirne is 41,1 years, the median age value of Kırklareli is 40,8 years and the median age value of Tekirdağ is 35,2 years (Table 3).

Table 4. Ages of the research participants (%).

Provinces	Ages Group		
	18-40	41-60	61-+
Edirne	7	48	12
Kırklareli	3	25	8
Tekirdağ	22	18	10
Average	24,0	54,41	69,82

The average age of the participants in our research was 54,82 years old, the rate of those between the ages of 18-40 was 24,0%, the rate of those between the ages of 41-60 was 54,41% and the rate of those the ages more than 61 was 69,32%. While Tekirdağ has higher rates in the 18-40 age range, the highest rate for those over 61 is in Kırklareli (Table 4).

In the survey study, producers were asked whether they had received any training on agricultural extension. 30 of the producers did not receve any trainig on agricultural extension (Table 5). 123 producers stated that; they attended training organized by agricultural provincial/district directorates (65.27%), private companies (19.38%), associations (7.38%), universities (7.0%) or other companies (4.97%). 70.54% of the participants in the research did not receive digital training, and 79.37% received digital training (Table 6). The relationship between the educational status of the producers included in the research and their digital training was examined with chi-square analysis. According to the results of chi-square analysis it was observed that there was a statistically significant relationship between educational status and digital education of the pruducers (Table 7).

3.1 Findings About Digital Agriculture

The main purpose of the research is digital agriculture. Data obtained by applying the survey; they were grouped under the headings of soil preparation, planting, irrigation, fertilization, spraying, harvesting, marketing and business management, and analysis was made separately for each application under the mentioned headings. In converting the survey questions into data, a statistical evaluation was made based on purely numerical quantities in table 8.

Soil preparation is one of the most important processes for the healthy development of the plant root system and for the seed to reach water in a suitable environment. Today, soil tillage is done with technologically equipped machines. It is used in technological machines and tools that serve the basis of soil cultivation and the determination of the physical and chemical properties of the soil. The most widely used digital tool is the soil analysis device. This device provides information about soil temperature, soil pH, and nutrient content of the soil through infrared rays.

In Thrace, farmers' knowledge-based behavior regarding production processes, including soil analysis, is high [12]. In our research, knowledge levels and application need regarding digital applications for the emergence of current soil analysis and soil processing were generally determined as 88% and 78%.

The beginning of crop production is the sowing/planting process. Today, sowing/planting operations are carried out using technological tools and machines. It is shared in the literature that there are 2 types of robots that plow and distribute seeds, 7 types of robots that perform digging and sowing, 8 types of robots that sow seeds one by one, and 6 types of robots that plow the soil, plant seeds and irrigate [19]. While some of the robots are controlled remotely, some operate autonomously/semi-autonomously. With the help of GPS, seed location can be determined according to coordinates and planting can be done. Microcontrollers in the seed detection system transmit the seeds detected by the sensor to the computer with the help of serial port, and the transmitted data is recorded [20]. In our research, we tried to measure the knowledge level of producers about digital applications in determining planting time and the use of smart seeder and their request for the application. While the level of knowledge of the participants about using digital methods in determining the planting time is 75%, the level of knowledge about using smart planting machines is 74%.

Table 5. Mann Whitney results of the relationship between educational status and the preference for growing less risky crops with short production periods.

	N	Mean Rank	Sum of Ranks	Z	P
Educational Level/ LowRisk	30	87,47	2624,00	-1515	,130
	123	74,45	9157,00		

Since the P value is greater than 0.05, there is no significant difference between educational status and low-linkage product.

Table 6. Mann Whitney results on the relationship between producers' digital training and their age.

	N	Mean Rank	Sum of Ranks	Z	P
Age/Digital	41	70,54	2892,00	-1092	,275
	112	79,37	8889,00		

Since the P value is greater than 0.05, there is no statistically significant difference between age and digital education.

Table 7. Chi-square analysis results regarding producers' digital training and educational status.

	Digital	Educational Level
Chi-Square	32,948ᵃ	101,784ᵇ
df	1	5
Asymp.Sig.	,000	,000

Since the P value is less than 0.05, there is a statistically significant relationship between educational status and digital education status. As education level increases, the tendency towards digital education increases.

Table 8. Level of knowledge and demand for digital agricultural applications in plant cultivation.

Function	Digital Feature	Knowledge Level	Demand Level
		%	%
Soil Preparation	Soil Analysis	88	78
	Soil tillage time determination (sensor system)	88	69
Sowing	Sowing time determination (sensor system)	75	69
	Smart seeder usage	74	70
Irrigation	Irrigation water need detection (sensor application)	57	39
	Controlled irrigation (controlled pressure systems)	60	25
Fertilization	Smart device use	75	73
Chemical Application	Disease detection (warning system)	70	53
	Pest detection (warning system)	68	52
	Drug dosage adjustment (software)	77	56
	Drone application	84	38
Harvest	Harvest time determination (sensor system)	79	31
	Grain loss monitoring (visual system)	75	30
Marketing	Marketing Links with sales locations	90	30
Business Management	Deciding on product type	94	05
	Machine usage optimization (software)	58	22
	Labor utilization optimization	44	20
	Energy saving systems	57	44

Water is as important as soil in crop production. Approximately 70% of the water consumed worldwide is used in agricultural irrigation [21]. According to the results of Spearman correlation analysis, it was found that there is a statistically significant relationship between irrigated land and product diversity. In other words, as the amount of irrigated land increases, product diversity also increases. In water-deprived countries and countries that have to use water economically, modern technological methods are used in irrigation systems. Nowadays, digital applications are used to determine the water needs of the plant in the field/garden and to determine the irrigation time. The goal in precision agriculture is not only to increase yield [22]. It is also important to preserve the moisture, physical properties and chemical structure of the soil. There are many technological methods to determine the water content in the soil. First, technological devices that could measure how much water a plant absorbs, the amount of water in the soil, and soil temperature were used with tensionometers. With sensors measuring plant branch/trunk diameters, all data about plant water stress and plant growth can be measured and stored in cloud memory forever [23]. Digital applications are used to ensure that technological measurement methods provide reliable results. There are systems that can perform remote sensing using microwave technique to estimate soil moisture. The European Space Agency can measure soil moisture and ocean salinity through passive microwave devices (SMOS). Nowadays, with the use of advanced microwave devices (Earth Observation System -AMSR-E), surface soil moisture can be estimated with a temporal frequency of 1-2 days and a spatial resolution of 30-50 km [24]. Radar (Radarsat 1 and 2, ERS-1 and 2, JERS, ENVISAT, ASCAT) images, which provide more precise spatial resolutions (10-100 meters) on soil moisture, are also used [25]. In our research, we tried to measure the knowledge level of the participants about digital applications in determining water need and controlled irrigation and their request for the application. While the level of knowledge of the participants about the use of digital systems in determining irrigation water needs is 57%, 60% of the participants are knowledgeable about the use of digital methods in the controlled use of water. While 39% of the participants request digital applications in determining the water needs of the plant, the rate of those requesting digital applications in the controlled use of water is 25% (Table 8).

In order to ensure continuity in crop production, the nutritional value of the soil must be preserved. Since the nutrient consumption of plants varies according to species, it is necessary to know the nutrient level of the soil in plant cultivation in order to add nutrients. Technological methods are used in the nutritional supplement application called fertilization. Currently, fertilization is one of the main processes in which technological methods are applied in agricultural production. Today, with the remote sensing method, the nutritional content of both the soil and plant organs can be determined and the nutritional needs for their optimal development can be calculated. It has been shared that by adding GPS sensors to tractors in the USA, the fuel consumed in fertilization and agricultural spraying has decreased by approximately 40% [2]. In our research, while 75% of the participants have information that digital applications are also used in the fertilization process, the rate of those who demand digital applications in fertilization is 73% (Table 8).

Fighting against diseases and pests in plant production is one of the most important cultural processes. Control and protection procedures for diseases and pests vary from plant to field application, depending on their damage. Digital applications are used as much as traditional methods in disease detection and plant protection processes. The most common method for disease detection is the early warning system. Early warning system; it is a system that enables the detection and announcement of the time to fight against this disease or pest in case a disease agent or harmful organism is found in the area where a cultivated plant is grown. In Turkey, the early warning system is mostly carried out by the Ministry of Agriculture and Forestry. While 70% of the participants were aware that chemical application is used in disease detection, the rate of those requesting this application was determined as 53%. Pest detection can also be done with an early warning system using digital applications. In our research, while 68% of the participants had information that pests are detected with the early warning system, the rate of those requesting this application is 52% (Table 8).

In the world; among the agricultural control methods against diseases, pests and weeds, the most used method with a rate of 95% is chemical control [26]. During the research, it was determined that the issue that producers in Edirne province have the most difficulty in carrying out agricultural activities and need information the most is pesticide application. In our research, while 77% of the participants were aware of the existence of digital applications for determining drug dosages in the fight against diseases and pests, the rate of those who requested these applications was found to be 56% (Table 8).

In plant protection activities, helicopters are used to spray large areas. Drone (unmanned aerial vehicle) technology has been used in recent years to spray large areas as well as parcel-based areas and greenhouses. In the Thrace Region, in recent years, unmanned aerial vehicles have been used to spray paddy fields. The widespread use of the practice necessitated legal regulations, and Tekirdağ Governorship issued instructions for unmanned aerial vehicle (UAV or DRONE) systems and regulated how to carry out pesticide application [27]. In Kırklareli, field spraying against meadow caterpillar damage was carried out using unmanned aerial vehicles in some towns and villages [28]. In the research, 84% of the participants were knowledgeable about the use of unmanned aerial vehicles in the fight against diseases and pests. The rate of participants requesting drone application is 38% (Table 8).

Harvesting, the final process of plant production, has been done with machines for many years. Grain loss can be prevented with digital apparatus used in harvesting machines. Additionally, digital sensor systems are used to detect harvest time. It is also seen that new technological methods are used in plant species where harvesting is done by human power. Tokyo University of Agricultural Technology has developed a wearable mechanical skeleton system to prevent producers from experiencing waist, arm and leg pain during harvest. It has been noted that thanks to these clothes, leg fatigue and leg pain are reduced by 50%, and arm and shoulder fatigue and pain are reduced by 85% [2]. In our research, while 79% of the participants have information about the existence of digital applications in determining the harvest time, the rate of those who request this application is 31%. The rate of participants who are aware of the existence of digital applications to prevent grain loss in harvest is 75%, and the rate of those who request these applications is 30% (Table 8).

Since agricultural business in Turkey has a small-scale character, marketing stands out as the most important problem for businesses [29]. Organizations (cooperative formation) of producers who produce on a small scale or who do not have sufficient knowledge can expand their marketing opportunities and will also be an important gain in terms of market functioning of agricultural products and will also serve to protect the interests of producers [18]. Both individual producers and cooperatives have been using digital applications in agricultural product marketing in recent years. Infrastructure and other services for these applications are provided by governments in many countries. In the USA, the Agricultural Resource Management Survey (ARMS) provides services to the country's farmers through primary data on the financial situation of farm enterprises, production practices and resource use [30]. In New Zealand, farm management technologies that integrate cloud computing and artificial intelligence are used to provide producers with tools in the decision-making process to engage in agricultural activities [31]. The most common digital method in Turkey is the DİTAP (Digital Agriculture Market) application of the Ministry of Agriculture and Forestry. In practice, producers can benefit from the method via e-government or by entering the DİTAP website [32]. In our research, 89% of the participants were found to be knowledgeable about the existence of digital applications for connections with sales locations. The rate of those who benefit from or request these applications is 28% (Table 8).

The view on agriculture in Turkey has remained far from the economic approach for many years. This situation did not allow agricultural activities to be handled at a business level [29]. The study titled "The Place of Agricultural Memory in Social Life: Küçünlü" [33]. provides the opportunity to observe the light transmission between the whole and the part from a wider angle. The relationship between the rural sector and the state in the globalizing world can be exemplified by the relationship between the part and the whole. In general, emphasis is placed on the social character of the individual, including individuals [34]. In this context, the change in Küçünlü Village was discussed by considering the crop production activities and the change in the producer's land holdings with a full census sample size. The most effective part of the study is the management of agriculture with traditional agricultural conditions and patriarchal decision-making authority. In another change, it is the 'father' who decides which product will be produced in production. In the research; When manufacturers decide to determine the product pattern; family elders, relatives, neighbors (45.88%), the producer himself (35.15%), agricultural consultant (7.84%), agricultural engineers or agricultural technicians (3.76%), cooperatives and associations (3,73%), vendor company representatives (2.98%), headman (0.38%) and others (0.28%) are effective. As in the example of Küçünlü village, the producer or his family elders mostly decide which product to grow, that is, production planning. This situation prevents taking risks, seeking new production diversity, that is, the entrepreneurial spirit. This traditional production method seen in Küçünlü village can be generalized for all of Thrace. This can be explained by the fact that while the rate of deciding to produce the same product is 94%, the rate of deciding to produce different products is as low as 5%. It has been found that the localism in Küçünlü Village is valid for the entire Thrace Region. On the other hand, the Ministry of Agriculture and Forestry has recently switched to a basin-based production model. This model has limited the products that producers can grow. Strategic products for the country have been identified and directed to planned production. In other words, the producer will be able to produce strategic products determined by the Ministry, but will not be able to grow products that are outside the basin-based production model. In this case, it is a situation that will prevent producers from looking for alternatives.

In other words, the father, who is the decision-maker in the agricultural enterprise, has great importance in determining the product pattern. In the statistical analysis performed by the Mann Whitney method, no significant difference was found between age and demand for cultivable products other than wheat, sunflower, rice or canola plants.

Since the P value is greater than 0.05, there is no statistically significant difference between age and low-risk product (Table 5). In other words the demand for growing crops is unrelated to age, except for wheat, sunflower, canola and rice, which are grown with traditional cultivation. The same situation has similar results with education level and business size. Since the P value is greater than 0.05, there is no statistically significant difference between business size and product diversity. This fact can be explained by the fact that the knowledge level of product pattern selection (94%) and the demand level (88%) are quite high.

As in other sectors of agriculture, business management has become important as the business aspect has come to the fore. It is important to make annual accounting calculations in order to make future planning in agricultural enterprises [35]. So what; it is known that in practice most manufacturers do not keep business records [36]. In our research, within the scope of business management; It was tried to learn whether the producers are aware of the existence of digital applications in machine use, labor use and energy saving and their demand for these applications. While 58% of the participants are aware of digital applications that will provide optimal benefit in machine use, the rate of those who request these applications is 22%. While 44% of the participants have knowledge, that digital methods can be used in the optimal use of the workforce, the rate of those who want to benefit from these applications is 20%. While the rate of participants who are aware of the existence of digital applications in energy saving is 57%, the rate of those who request these applications is 44% (Table 8).

4. Conclusion

Although the Thrace Region, consisting of the provinces of Edirne, Tekirdağ and Kırklareli, corresponds to 4.21% of Turkey's territory; It is a very effective region in terms of productivity obtained per unit area. In the survey conducted in this region, traditional agriculture is carried out in dry conditions with an average farm size of 294.320 decares.

Education is extremely effective in helping individuals adopt new technologies. With this awareness, the educational status of the producers was determined. 45,75% of the producers have primary school education, 16.33% have secondary school education, 16,33% have high school education, 7,84% have college education, 9,15% have university education, and 4,57% have postgraduate education (Table 3).

The knowledge level of the producers regarding soil analysis and tillage time allocation (sensor system) from the soil preparation function was determined as 88% and 88%, and the demand for this application was determined as 78% and 69%. The demand level for soil preparation functions is quite high. This function follows the sowing function (Table 8).

The knowledge level in the sowing function, which consists of determining the sowing time and using smart seeder, is 75% and 74%. The demand level is calculated as 69% and 70% in parallel with these functions (Table 8).

Dry farming is mainly done in Thracian lands. This situation is reflected as 57% and 60% in the water need determination (sensor application) and controlled water delivery function (controlled pressure systems) in the irrigation function. Although the level of knowledge is partially high for the irrigation function; the demand level is low (39% and 25%) (Table 8).

In the fertilization function, the knowledge level of producers (75%) and the demand level (73%) are close to each other and quite high (Table 8).

The issue of pesticide application in the field is one of the most difficult issues for producers. For this reason, it is among the most consulted and researched topics. The level of knowledge was determined in terms of disease detection (warning system) (70%), pest detection (warning system) (68%), drug dosage adjustment (software) (77%) and drone application (84%). Demand levels were determined as 53%, 52%, 56% and 38%, respectively (Table 8).

In the harvest function, the information level of sensor harvest determination was found to be 79% and visual grain loss monitoring was found to be 75%. The demand on these issues was found to be 31% and 30% respectively for both. The fact that producers have been making a living from the same production patterns for a very long time has caused them to specialize in harvest determination. This specialization has reduced demand (Table 8).

In the Thrace Region, producers have been planting mainly wheat, sunflower, paddy and recently canola for a long time. Market channels were also created in this region a long time ago. Although manufacturers' knowledge about digital marketing is high (90%), but their demand for the subject is low (30%) (Table 8).

It is the function with the lowest level of awareness in the business management function. Within this function, machine usage optimization was calculated as 58%, labore utilization optimization as 44% and energy saving systems as 57%. In these functions, the demand level is much lower than the information level and is calculated as 22%, 20% and 44% respectively. Here, the remarkable level of knowledge and demand in energy saving systems can be explained by the fact that manufacturers are looking for elements to reduce their increasing costs (Table 8).

Agriculture in the classical understanding of agriculture; it consists of a very complex structure in terms of its features and content. Its dependence on weather conditions and soil, and being highly affected by various events within the ecosystem, increases risk and uncertainty. This situation; it causes a stable structure not to be formed and the agricultural sector to be kept in the background. Economists' approaches on this issue were supportive of the industry and service sectors [37]. When we look at the definitions of developed countries, which brought about many debates, it was seen that there were many elements that would highlight agriculture, such as "the high proportion of the population living on agriculture and the country's economy being based on agriculture". During the pandemic and its aftermath, this perception towards the agricultural sector was sharply broken of agriculture.

In addition to contributions such as the contribution of agriculture to the product and market, population and workforce contribution, obtaining foreign currency from agricultural product exports, contribution to the industrial sector, contribution to national income, responding to the increasing food demand and self-sufficiency of countries were accepted as economic state policies, especially of developed countries.

Giving priority and importance to these issues has led to a heavy emphasis on digital agricultural technologies. The agricultural sector, which has managed to separate itself from various events within the ecosystem such as growing products independent of climate changes, obtaining products without soil, and biological warfare will increasingly be able to continue its efforts to minimize risks and uncertainties in the coming years.

In this strategy, which is based on countries' self-sufficiency, Turkiye needs to find, patent and develop problem and solution methods for the problem in a very short time, in cooperation with the public, private sector, universities and producer units, in order to support R&D activities and changes.

Technological developments determine the direction of the sector in agricultural activities, as in almost every field. Today, every country has policies developed regarding digital agricultural technologies. The institutions cooperated in the implementation of these policies vary. It can be said that each institution operating in the field of digital agricultural technologies in Turkiye has developed independently of each other as the state, private sector and university.

The demand of Turkish farmers, who are getting older day by day, for digital agricultural technologies is undeniable. In a country like Türkiye, where a wide variety of fruits and vegetables can be grown, the agricultural technologies needed by the producers may also vary greatly. Efforts should be made to develop the demands for bottom-up and bottom-up digitalization of agriculture in cooperation with relevant public institutions, private sector and universities. With the awareness that digital agricultural technologies will develop in the coming years and make significant contributions to the agricultural sector and that interest in the sector will increase, informative training should be started for farmers in this field.

Declaration

Author Contribution: Conceive– E. Irmak; Design– M. Sarıoğlu; Experimental Performance, Data Collection and Processing– H. Başaran; Analysis and Interpretation– H. Başaran; Literature Review– M. Sarıoğlu; Writer– E. Irmak; Critical Review– H. Başaran.

Conflict of interests: The authors declare that they have no know competing financial interest or personal relationships that could have appeared to influence the work reported in this paper.

Orcid-ID

Ebru IRMAK https://orcid.org/0000-0002-3378-0723
Hayati BAŞARAN https://orcid.org/0000-0003-0506-1649
Muaffak SARIOĞLU https://orcid.org/0000-0001-8803-7139

References

[1] B. Ertaş, "A Tarım 4.0 İle Sürdürülebilir Bir Gelecek," *ICONTECH INTERNATIONAL JOURNAL*, vol. 4, pp. 1-12, 06/21 2020, doi: 10.46291/ICONTECHvol4iss1pp1-12.

[2] F. Saygılı, *Türk tarımının global entegrasyonu ve tarım 4.0*. İzmir: İzmir Ticaret Borsası (in Turkish), 2019.

[3] "Farming 4.0 : Future of agriculture." Comité Européen des Groupements de Constructeurs du Machinisme Agricole. https://euagenda.eu/upload/publications/untitled-62960-ea.pdf (accessed 2024).

[4] "World Bank World Development Indicators (WDI), Database." http://data. worldbank.org (accessed 2024).

[5] F. Çoşkun. "Tarım 5.0'a hızla yaklaşırken…." http://www.turktarim.gov.tr/Haber/775/tarim-5-0a-hizla-yaklasirken (accessed 14.10.2023

[6] "Tarım İşletme Sayısı." TUIK. https://data.tuik.gov.tr/Kategori/GetKategori?p=Tarim-111 (accessed 09.08.2024.

[7] Y. Odabaşı, A. A. Bir, Ed. *Sosyol Bilimlerde Araştırma Yöntemleri*. Anadolu Üniversitesi, 1995.

[8] G. Bilgin, "The agricultural structure in Thrace region, production and the productivity analysis of the major agricultural products," M. Sci, Tarım Ekonomisi Ana Bilim Dalı, Tekirdağ Namık Kemal University, Tekirdağ, 2017.

[9] M. Gezici, B. Pakdemirli, N. Birişik, İ. Aslan, and B. Sönmez, "Türk Tarımında Dijital Teknolojilerin Kullanımı ve Tarım-Gıda Zincirinde Tarım 4.0," (in tr), *Toprak Su Dergisi*, vol. 10, no. 1, pp. 78-87, March 2021, doi: 10.21657/topraksu.898774.

[10] TUIK. https://data.tuik.gov.tr/Kategori/GetKategori?p=tarim-111&dil=2 (accessed 14.10.2023).

[11] H. Hurma. https://www.iklimin.org/wp-content/uploads/2018/01/Bo%CC%88lu%CC%88m3_Harun_Hurma.pdf (accessed.

[12] E. Irmak, "Extension approach in agricultural cooperatives: The example of Edirne province, Lalapaşa district," Ph.D, Tarım Ekonomisi Ana Bilim Dalı, Tekirdağ Namık Kemal University, Tekirdağ, 2019.

[13] B. Aydın, "Determining the structural characteristics and productive efficiency of farms in Thrace region," Ph.D, Tarım ekonomisi, Tekirdağ Namık Kemal University, Tekirdağ, 2014.

[14] C. Bilgin, M.Sci, Trakya bölgesindeki uygulanan arazi toplulaştırmasının çiftçiler üzerindeki etkinliğinin irdelenmesi., Tekirdağ Namık kemal University, Tekirdağ, 2014.

[15] "Official gazette." https://www.resmigazete.gov.tr/eskiler/2021/01/20210129-1.htm (accessed 2024).

[16] N. Şenmerdan, "Eğitimde yeni yaklaşımlar ve öğrenci merkezli eğitim," 2015.

[17] K. Sürur, "Reach to information levels of women worker in small livestock enterprises in Karapinar distirict of Konya and extention approaches," Ph.D, Tarım Ekonomisi Ana Bilim Dalı, Selçuk University, Konya, 2010.

[18] H. Başaran and E. Irmak, "Edirne'de Tarımsal Amaçlı Kooperatiflerde Ortaklık Yapısı ve Kooperatif Faaliyetlerinin Değerlendirilmesi," (in tr), *Kahramanmaraş Sütçü İmam Üniversitesi Tarım ve Doğa Dergisi,* vol. 21, pp. 116-122, December 2018, doi: 10.18016/ksutarimdoga.vi.472753.

[19] C. Ulu. "Teknofest havacılık, uzay ve teknoloji festivali, tarım teknolojileri yarışması, Proje Detay Raporu." https://cdn.teknofest.org/media/upload/userFormUpload/Q7OWiDIUj33zPSnXYVJ55 KuCIvz8PiOF.pdf (accessed 23.10.2023.

[20] E. Özdemir, "Design of seed detection system based on GPS for seeders and determination of seed distribution maps," M.Sci, Tarım Makineleri ve Teknolojileri Mühendisliği Ana Bilim Dalı, Akdeniz university, Antalya, 2019.

[21] T.C. Tarım ve Orman Bakanlığı Tarım ve Orman Bakanlığı. (2021). *Tarımsal Sulama Sektör Politika Belgesi 2021 - 2025*. [Online] Available: https://www.tarimorman.gov.tr/TAGEM/Belgeler/yayin/Tar%C4%B1msal%20Sulama%20SPB_2021-2025.pdf

[22] U. Türker, M. A. Dayıoğlu, and U. Yegül, "Hassas Tarım için Tarım Makinalarında ISO 11783 Standardı ve Elektronik Kontrolü," (in tr), *Journal of Agricultural Faculty of Gaziosmanpaşa University (JAFAG),* vol. 33, no. Ek Sayı, pp. 61-69, August 2016. [Online]. Available: https://dergipark.org.tr/tr/pub/gopzfd/issue/65806/1024194.

[23] "Tarımda dijitalleşme hayatımızı nasıl kolaylaştırıyor?" Netafim. https://www.netafim.com.tr/akademi/tarmda-dijitalleme-hayatmz-nasl-kolaylatryor (accessed 09.09.2023

[24] V. Mishra, J. F. Cruise, J. R. Mecikalski, C. R. Hain, and M. C. Anderson, "A Remote-Sensing Driven Tool for Estimating Crop Stress and Yields," *Remote Sensing*, vol. 5, no. 7, pp. 3331-3356, 2013. [Online]. Available: https://www.mdpi.com/2072-4292/5/7/3331.

[25] E. Başdemir, "Using sensors in agriculture and a study on a soil moisture," M.Sci, Biyosistem Mühendisliği Ana Bilim Dalı, Tekirdağ Namık Kemal University, Tekirdağ, 2020.

[26] O. Tiryaki, R. Canhilal, and S. Horuz, *Erciyes Üniversitesi Fen Bilimleri Enstitüsü Fen Bilimleri Dergisi*, vol. 26, no. 2, pp. 154-169, April 2010. [Online]. Available: https://dergipark.org.tr/tr/pub/erciyesfen/issue/25574/269775.

[27] "Tekirdag Valiligi İnsansiz Hava Aracı İha veya Drone Sistemleri Talimati,." Tekirdağ Valiliği. http://tekirdag.gov.tr/tekirdag-valiligi-insansiz-hava-araci-iha-veya-drone-sistemleri-talimati (accessed 23.10.2023).

[28] M. Karaduman. "Trakya'da ayçiçeği tarlalarındaki 'çayır tırtılına' karşı dron ile ilaçlama sürüyor." https://www.aa.com.tr/tr/yasam/trakyada-aycicegi-tarlalarindaki-cayir- tirtilina-karsi-dron-ile ilaclama-suruyor/2639352 (accessed 23.10.2023).

[29] G. Keskin, G. Kaplan, and H. Başaran, *Harran Tarım ve Gıda Bilimleri Dergisi,* vol. 21, no. 2, pp. 209-218, June 2017, doi: 10.29050/harranziraat.321159.

[30] M. C. Vuran, A. Salam, R. Wong, and S. Irmak, "Internet of underground things in precision agriculture: Architecture and technology aspects," *Ad Hoc Networks,* vol. 81, pp. 160-173, 2018/12/01/ 2018, doi: https://doi.org/10.1016/j.adhoc.2018.07.017.

[31] B. Small, *Technological Foresight for Rural Enterprises and Rural Lives in New Zealand*. 2016.

[32] https://www.dijitaltarim.com/dijital-tarim-pazari-ditap-nedir/ (accessed 19.10.2023

[33] M. Sarioğlu and E. Irmak, "The Place Of Agricultural Memory In Social Life: Küçünlü," *ISPEC Journal of Agricultural Sciences,* vol. 6, no. 1, pp. 168-177, 03/25 2022, doi: 10.46291/ISPECJASvol6iss1pp168-177.

[34] Ş. Öztürk, "KIRSAL KALKINMA YAKLAŞIMLARI VE KÜÇÜK META ÜRETİMİ RURAL DEVELOPMENT APPROACHES AND PETTY COMMODITY PRODUCTION," *Anadolu Üniversitesi Sosyal Bilimler Dergisi*, vol. 9, no. 2, pp. 173-188, 2009.

[35] E. Irmak and M. Sarioglu, "Calculation of wheat production costs in Lalapaşa district, Edirne province," *Probe - Fishery Science & Aquaculture,* vol. 5, 12/20 2023, doi: 10.18686/fsa.v5i1.1807.

[36] Z. A. Bayramoğlu, Duygu and F. F. Tatlıdil, "Kaynakların rasyonel kullanımının üretim maliyetleri üzerine etkisi: Kanola yetiştiriciliği örneği," *Selçuk Tarım ve Gıda Bilimleri Dergisi*, vol. 24, no. 3, pp. 62-68, 2010. [Online]. Available: https://search.trdizin.gov.tr/tr/yayin/detay/107033?view=bibtex&download=107033.bib.

[37] A. Özsağır and A. Akın, "HİZMETLER SEKTÖRÜ İÇİNDE HİZMET TİCARETİNİN YERİ VE KARŞILAŞTIRMALI BİR ANALİZİ," (in tr), *Elektronik Sosyal Bilimler Dergisi,* vol. 11, no. 41, pp. 311-331, June 2012. [Online]. Available: https://dergipark.org.tr/tr/pub/esosder/issue/6155/82719.