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THE EFFECTS OF AGRICULTURAL MONITORING AND INFORMATION SYSTEM ON PRODUCERS

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Abstract: The aim of this study is to evaluate the effects of Agricultural Monitoring Information System (TARBIL) on producers and their opinions about TARBIL. Questionnaires were administered to 105 farmers in 19 Mayıs district of Samsun province about their internet usage habits, access to information and evaluation of Agricultural Monitoring Information System. The effectiveness of information management systems in agriculture was tried to be determined by identifying farmers' opinions about TARBIL, a producer-based analysis was made. In general, it was observed that farmers have an awareness towards TARBIL system. However, it was concluded that farmers face some obstacles in using the system and therefore the need for training is evident. Although farmers' attitudes towards the use of technology are generally positive, it was also determined that there is a need for more ease of access and training support for the effective use of applications. Study results revealed that the views that the internet can influence farmers' production decisions received lower scores and farmers' lack of equipment and competence in computer and internet use showing that farmers have difficulties both in entering data into the system accurately and regularly and in accessing technology. TARBIL is considered to be very important for food safety, environmental and economic sustainability of agricultural production. From this point of view, the importance of making new regulations and further development of the system for the effective and efficient use of TARBIL system is once again understood.

Keywords: Agricultural monitoring and information system, TARBIL, Agricultural information management, Samsun, Türkiye

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1. Introduction

Agricultural Monitoring and Information System (TARBIL), it is an integrated system in which the country's agriculture is recorded in every field with satellites, stations and field personnel, data are kept, reporting is made and the results are observed. TARBIL is the collection of all kinds of agricultural activities, agricultural data, agricultural lands, human and physical real coordinates in a common database (UTGB, 2021). It is a system for performing various analyses on the data according to the purpose and displaying the results in the form of tables, graphs and maps. TARBIL is primarily a system created to record agricultural lands, to observe agricultural production within the system, to predict efficiency and yield, to determine the right investment and the right strategies. In addition, it also aims to develop national policies, control and follow-up of products and production, ensure food security, protect natural resources and ensure sustainability (Anonymous, 2024). TARBIL Project was initiated in 2008 as a 3-year project under the name of 'Agricultural Yield Forecasting and Drought Monitoring (TARIT)'. Later on, the scope of the project was developed and a protocol was signed between the Ministry of Agriculture and Forestry, Turkish Statistical Institute (TURKSTAT), Istanbul Technical University Rectorate on 31.10.2011 and TARBIL project entered into force. It is a system created by integrating 42 databases such as enterprise registration, animal registration, parcel registration, agricultural inputs database, milk database and organic agriculture database (Anonymous, 2009).

TARBIL is based on two main pillars; the first pillar is the production and use of accurate, instantaneous data. Data is obtained by taking live images with cameras from 400 stations, which have already been completed, where 39 different parameters such as wind speed, humidity, climatic conditions, soil temperature are recorded. The most important feature of the system and the most different feature compared to its equivalents is that the need can be determined according to the developmental stage of the plants. The second pillar is the Agriculture Information System (AIS), which also includes mobile applications. TBS is a system in which data, information, documents and processes belonging to all agricultural activities throughout Türkiye are grouped according to the types of activities, where follow-up is provided, all institutional authorisation and auditing processes can be carried out, and data dumps of all relevant processes are followed in an integrated manner (Anonymous, 2019). By mixing small and meaningless data obtained from producers in agriculture with other components such as

climate data, satellite images, databases and agricultural observations, TBS obtains data suitable for agricultural planning by drawing a meaningful model adapted to the whole country (Anonymous, 2024). Due to the increases in population, it became a necessity to obtain the maximum yield from the unit area in the agricultural sector due to the limited resources, gradual decrease in agricultural land, and the constant change in climatic conditions. TARBIL is of great importance for the Turkish farmer to be more successful, for the country's agriculture to reach an advanced level, to ensure the supply-demand balance by keeping the pulse of the market, to determine agricultural policies and for the development of the country (Gürbüz and Bayar, 2018).

Studies concerning the research topic, knowledge and knowledge management (Akgün and Keskin, 2003; Tonta, 2004; Odabaş, 2005; Güçlü and Sotirofski, 2006; Atılgan, 2009; Müderrisoğlu, 2012; Selvi, 2012), the use of knowledge management in agriculture and other sectors (Güler and Kara, 2005; Erdal and Çallı, 2013; Atalay, 2017; Mercan et al., 2017; Tunç et al., 2017; Özğan, 2017; Gülter et al., 2018; Altıntaş, 2019) and evaluating TARBİL and TBS in terms of agricultural engineers and technicians (Bayar, 2019) are abundant in the literature. Although there are studies on knowledge management, information technologies, and internet usage of farmers in Türkiye, no studies on TARBIL and TBS at farmer level, which makes this study as a unique were not found in the literature. With this study, it is aimed to reveal the characteristics that determine the internet usage tendencies of the farmers in 19 Mayıs district of Samsun province and how effectively they use TARBIL. With the research, it is also aimed to develop suggestions for the use of TARBIL and TBS.

2. Materials and Methods

The main material of the study consisted of primary data obtained from surveys conducted with farmers engaged in agricultural production in 38 neighbourhoods in 19 Mayıs district of Samsun province. The questionnaires were applied in August and September 2022. In addition, secondary data obtained from published articles, books, research reports, theses, Ministry of Agriculture and Forestry, TURKSTAT, etc. on the subject were also used.

The main sample of the research consisted of 1650 enterprises engaged in agricultural production in 19 Mayıs district of Samsun Province. Simple random sampling method was used to determine the number of enterprises to be surveyed. In the sampling process, the margin of error allowed for the average was accepted as 10% and 95% confidence level was used. The number of enterprises to be surveyed was determined as 91 with the help of the formula given below (Yamane, 2001). However, just in case, 15% of the participants were also included to the study. Therefore, a total of 105 producers, 60 from the central neighbourhood and 45 from other neighbourhoods, representing each neighbourhood from 38 neighbourhoods in 19 Mayıs district of Samsun province, were included in the study.

$$n = \frac{N(zS)^2}{Nd^2 + (zS)^2} \quad (1)$$

In the equation 1; n is the number of enterprises to be surveyed, N is the number of enterprises in the main population, S is the standard deviation and d is the margin of error allowed in the research.

SPSS statistical package programme was used in the evaluation and analysis of the data collected at the end of the research. Descriptive statistics consisting mainly of mean, standard deviation, frequency and percentages were used in the study Farmers' opinions and awareness levels about TARBIL were tried to be determined by using a five-point Likert scale. For example, for each question prepared to determine the level of TARBIL usage, farmers responded on a five-point Likert scale as follows; 1: Strongly disagree, 2: Disagree, 3: No opinion, 4: Agree 5: Strongly agree. The following interpretation scale was used to interpret the averages (Palaz and Boz, 2008). Mean between 1.00-1.49 = Strongly Disagree (SD), between 1.50-2.49 = Disagree (D), between 2.50-3.49 = No Opinion (NO), between 3.50-4.49 = Agree (A) and between 4.50-5.00 = Strongly Agree (SA).

3. Results and Discussion

Approximately 76% of the farmers participating in the study were male and 24% were female. The fact that the majority of the farmers were male in the interviews conducted in the research area is due to the fact that men take an active role in agricultural production in 19 Mayıs district of Samsun province. While the average age of the farmers was 45.53 years, the average age of male farmers was found to be approximately 46 years and 43 years for female farmers. Approximately 65 percent of the farmers are high school or university graduates. 51 percent of the interviewed farmers are engaged in farming only. Approximately 49 percent of the farmers work in the public or private sector and also farm at the same time. The average land size of the farmers is 22.47 decares (Table 1).

In the examination of the internet usage habits of the farmers, mobile phone was found to be to be the most common device used for internet access. While 68.79% of the participants use mobile phones, other devices such as desktop computers (24.11%) and laptops (4.26%) are less preferred (Table 2).

Table 1. Socio-demographic characteristics of the farmers

		Frequency (%)	Mean (SD)
Gender	Male	80.00 (76.19)	-
	Female	25.00 (23.81)	-
	Total	105.00 (100.00)	-
Age	Male	-	46.46 (11.75)
	Female	-	42.56 (8.86)
	Total	-	45.53 (11.21)
Education	Primary school	6 (5.71)	-
	Middle school	28 (26.67)	-
	High school	34 (32.38)	-
	Licence	34 (32.38)	-
	Postgraduate	3 (2.86)	-
	Total	105 (100.00)	-
Employment status	Public institution	24 (22.86)	-
	Private sector	27 (25.71)	-
	Farmer	54 (51.43)	-
	Total	105 (100.00)	-
Land size (da)		-	22.47 (19.78)

Tor and Erden (2004), in their study on the use of social media and computers by farmers, concluded that computer use at home increased as the level of education increased. While 39.45% of the farmers use the internet between 1-3 hours daily, 32.28% of them go online for less than 1 hour. In terms of the purpose of internet use, the most common activities are communication (23.63%) and following the news (22.14%). Functional purposes of using internet such as search for information and banking transactions also occupy an important place, while socialising and entertainment purposes are less common (Table 2).

Table 3 reveals the farmers' views on TARBIL system and their awareness of this system. While 93.33% of the farmers are aware of the TARBIL system, 6.67% are unaware of this system (Table 3).

Table 2. Internet usage habits of farmers

		Frequency	(%)
Farmers' means of access to the internet*	Desktop computer	34	24.11
	Laptop computer	6	4.26
	Mobile phone	97	68.79
	Tablet	4	2.84
	Total	141	100.00
Distribution of the time farmers spend on the internet	Less than 1 hour	34	32.28
	1-3 hours	41	39.45
	3-5 hours	16	15.24
	5-7 hours	8	7.32
	7 hours and over	6	5.71
	Total	105	100.00
Distribution of farmers according to their purpose of using the internet*	Contact	95	23.63
	Following the news	89	22.14
	Search for Information search	73	18.16
	Banking transactions	68	16.92
	Socialisation	60	14.93
	Game / Entertainment	17	4.23
	Total	402	100.00

*More than one answer was given.

In a study conducted to determine the opinions of the personnel working in Bursa Provincial Directorate of Agriculture and Forestry on TARBIL, it was determined that 99% of the participants had heard of TARBIL (Bayar, 2019). While 78.57% of farmers define TARBİL as a 'farmer information system', 12.24% consider it as a 'system for informing politicians' and 9.19% as a 'system for agricultural engineers'. In terms of usage, 67.62 per cent of the farmers use TARBIL, while 32.38 per cent do not. 52.20% of the farmers find the system useful

primarily for farmers. The others believe that it will benefit agricultural engineers (24.18%) and politicians (17.58%). Farmers stated that the main factors limiting their access to TARBIL were lack of time (64.35%) and the complexity of the website (35.65%). This finding is supported by the results of the study conducted by Erdal and Çallı (2013) on the factors affecting the way of using the internet. In the study, it was concluded that approximately 84% of the farmers wanted training on the use of TARBIL (Table 3).

Table 3. Farmers' opinions about TARBIL system

		Frequency	(%)
Farmers' awareness of the TARBIL system	Yes	98	93.33
	No	7	6.67
	Total	105	100.00
Farmers' opinions on TARBIL	Farmer information system	77	78.57
	A system for informing politicians	12	12.24
	Agricultural engineer system	9	9.19
	Total	98	100.00
TARBIL usage status of farmers	Yes	71	67.62
	No	34	32.38
	Total	105	100.00
Farmers' views on who will benefit from TARBIL*	Farmers	95	52.20
	Politicians	32	17.58
	Agricultural Engineers/Technicians	44	24.18
	Research organisations	11	6.04
	Total	182	100.00
Factors limiting farmers' access to TARBIL*	Lack of time	74	64.35
	Complexity of the website	41	35.65
	Total	115	100.00
Would you like to be trained about the use of TARBIL?	Yes	88	83.81
	No	17	16.19
	Total	105	100.00

*More than one answer was given.

According to the scale created about the factors affecting the use of information processing systems and TARBIL by farmers, farmers strongly agree with one of the 17 factors included in the research, agree with 5 of them, disagree with 2 of them and remain undecided for 9 factors. As a result of the research, it was concluded that farmers strongly agreed that the Internet facilitates their lives (4.590) and that searching for information on the Internet is enjoyable (4.314). In addition, farmers stated that they can access the information they are looking for quickly (4.305). However, farmers have concerns about the adequacy of the information obtained from the internet (3.943) and their preference for the internet compared to other sources (3.914), but they have concerns about the security and accuracy of agricultural information. Farmers' views on the benefits of TARBIL implementation on agricultural supports and risks are complex. The high number of 'No Opinion' responses indicates that there is no clear opinion on the effectiveness of TARBIL. The views that the Internet can influence farmers' production decisions received lower scores (2.533), and farmers' lack of equipment (2.581) and competence (2.400) in the use of computers and the Internet were also observed. This shows that farmers have difficulties in entering data into the system accurately and regularly (2.229) and have difficulties in accessing technology (Table, 4).

In the study, it was observed that the farmers agreed with all 10 factors that included the opinions of the farmers using TARBIL system about the system (Table 5). The farmers participating in the research believe that TARBIL provides significant advantages to them and that registering to the system does not create a disadvantage (4.156). In addition, they think that TARBIL helps farmers to obtain information about supports and production related issues (4.141). Farmers agree that TARBIL has positive effects on crop and animal production (4.125) and that it is a system that facilitates their work (4.109). The opinions that TARBIL is a necessary tool for producers to act in a systematic way (4.109) and that it plays an important role in the registration of farmers (4.047) are also high. However, issues such as the frequency of updating the data provided by TARBIL (3.938) and whether the data are sufficient to meet user needs (3.828) received slightly lower scores. Regarding trust in TARBIL data (3.797), it was concluded that farmers have some hesitation about the accuracy of the system (Table 5).

Table 4. Factors affecting farmers' use of information processing systems and TARBIL

n=105	Mean	SD	Participation Category
The Internet makes my life easier.	4.590	0.583	SA
It is enjoyable for me to search for information on the internet.	4.314	0.684	A
I can access the information I am looking for on the internet without spending much time.	4.305	0.722	A
The information obtained from the internet about production is sufficient.	3.943	0.897	A
I prefer doing research on the internet to doing research from other sources.	3.914	0.962	A
Device and internet ownership will put additional burden on farmers	3.514	1.136	A
With TARBIL, agricultural supports will be able to reach farmers very quickly.	3.257	1.152	NO
Agricultural risks will be minimised with TARBIL.	3.219	1.185	NO
Thanks to TARBIL data, farmers will be able to make agricultural planning.	3.124	1.182	NO
Farmers will have to pay more taxes if all their information is given.	3.105	1.200	NO
Thanks to TARBIL, agricultural products will be sold at the value they deserve.	2.990	1.213	NO
I can access specialised information about farming and production on the internet.	2.667	1.504	NO
Farmers can use devices such as computers/tablets/mobile phones	2.581	1.598	NO
Information about production obtained from the internet is reliable.	2.552	1.500	NO
Information obtained from the internet is effective in making decisions about production.	2.533	1.448	NO
Farmers have internet to enter and follow the data.	2.400	1.504	D
Farmers enter data into the system accurately and regularly.	2.229	1.361	D

Table 5. Opinions of farmers using TARBIL system about the system

n=71	Mean	SD	Participation Category
There is no disadvantage for me whether registered in the TARBIL system or not.	4.156	0.718	A
TARBIL helps me to have an idea about the supports I will receive.	4.141	0.639	A
TARBIL has positive effects on crop and animal production.	4.125	0.724	A
TARBIL is a system that facilitates the work of farmers.	4.109	0.737	A
As a producer, we need TARBIL to act systematically.	4.109	0.838	A
TARBIL is necessary for the registration of farmers.	4.047	0.785	A
I can access information that I cannot access elsewhere through TARBIL.	3.953	0.825	A
TARBIL data are regularly updated.	3.938	0.794	A
TARBIL data is sufficient to meet the needs of users.	3.828	1.001	A
I can trust TARBIL data.	3.797	0.800	A

As a result of the research, it was found that farmers in younger age groups had a higher rate of knowledge about TARBIL, and this rate decreased with age. These results show that young farmers are more prone to technology. In all age groups, the number of farmers who do not have information about TARBIL is limited (7 people). This shows that TARBIL system has a wide awareness level (Table 6).

As it can be seen from the cross tab table, farmers in the 36-45 age group and 46-55 age group use TARBIL more actively. However, the rate of TARBIL usage decreases significantly in higher age groups. As a result, it is seen that the use of TARBIL decreases as the age group increases. While young farmers use TARBIL much more because they are more technologically inclined, the rate of use decreases significantly in older farmers. The table also shows that a total of 34 farmers do not use TARBIL, but it can be said that TARBIL use is widespread (Table 7).

Table 6. Cross-tab link between age and farmers' awareness of TARBIL system

	Have you heard of TARBIL?	Yes	No	Total
Age	18-35	18	1	19
	36-45	32	3	35
	46-55	30	1	31
	56-65	12	2	14
	Over 65 years old	6	0	6
Total		98	7	105

Table 7. Cross-tab link between age and farmers' use of TARBIL

	Do you use TARBIL?	Yes	No	Total
Age	18-35	12	7	19
	36-45	27	8	35
	46-55	23	8	31
	56-65	6	8	14
	Over 65 years old	3	3	6
Total		71	34	105

As a result of the cross table, it is seen that the rate of being aware of TARBIL system increases as the level of education increases. In total, 98 out of 105 farmers stated that they had information about TARBIL, while only 7 farmers stated that they did not have any information about this system. These findings show that the level of education plays an important role in obtaining information about TARBIL system and more educated farmers are more likely to be aware of such systems (Table 8).

Table 8. Cross-tab link between education and awareness of TARBIL system

Have you heard of TARBIL?	Yes	No	Total
Primary school	4	2	6
Middle school	26	2	28
High school	32	2	34
Licence	33	1	34
Postgraduate	3	0	3
Total	98	7	105

As a result of the cross table between education and TARBIL usage status, it is seen that as the level of education increases, the rate of TARBIL usage also increases. While 71 of the farmers use TARBIL, 34 of them do not use it. From this table, it can be clearly stated that the level of education is a factor that increases the use of TARBIL. This result reflects the positive relationship between education level and technology use (Table 9).

Table 9. Cross-tab link between education and TARBIL usage status

Do you use TARBIL?	Yes	No	Total
Primary school	3	3	6
Middle school	16	12	28
High school	24	10	34
Licence	26	8	34
Postgraduate	2	1	3
Total	71	34	105

4. Conclusion

The results of the study revealed that the participants were generally in the middle age group, the majority of them were male farmers, their education levels were distributed in a wide range and their land sizes varied. As a result of the research, it was found that farmers use the internet mostly for functional and practical purposes, especially for communication and information. This situation shows that the role of digital technologies in agricultural activities is gradually increasing. When farmers' views on TARBIL were analysed, it was seen that farmers have a general awareness of TARBIL system. However, it was concluded that farmers encountered some obstacles in use and therefore the need for training is evident. Although farmers' attitudes towards the use of technology are generally positive, it has been determined that more ease of access and training support is needed for the effective use of applications. Farmers using TARBIL system generally evaluate the system in a positive way. However, they think that factors such as data security and frequency of updates should be improved. It was also found that the awareness level of the farmers participating in the research about TARBIL system is high. As a result of the study, it was concluded that younger and middle-aged farmers and farmers with higher education level use TARBIL more actively.

TARBIL is considered to be very important for food safety, environmental and economic sustainability of agricultural production. From this point of view, the importance of new regulations and further development of the system for the effective and efficient use of the TARBIL system is once again understood. In addition to the development of the system, training programmes should be organised at farmer level to enable farmers to use the system more effectively. In this study, although positive results were obtained about the TARBIL system, it was determined that some of the agricultural producers were hesitant about their distrust of the digital environment and the complexity of the internet environment. It is very important for farmers to adapt to the digital environment. For this reason, trainings should be given and seminars should be organised periodically in order for agricultural producers to gain sufficient skills in the internet and digital environment. It is also recommended that more extension work should be carried out in order for farmers to be aware of innovations. The Ministry of Agriculture and Forestry and Provincial Directorates and District Directorates should increase agricultural production publications on their web pages and help producers to access TARBIL format more easily.

Author Contributions

The percentages of the authors' contributions are presented below. All authors reviewed and approved the final version of the manuscript.

	K.H.	E.H.
D	50	50
DCP	50	50
DAI	50	50
L	50	50
W	50	50
CR	50	50
SR	50	50

D= design, DCP= data collection and/or processing, DAI= data analysis and/or interpretation, L= literature search, W= writing, CR= critical review, SR= submission and revision.

Conflict of Interest

The authors declared that there is no conflict of interest.

Ethical Consideration

Ethical approval was obtained from the Ondokuz Mayıs University Social and Human Sciences Ethics Committee (approval date: March 17, 2020, protocol code: 2020 / 765).

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