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FARMERS WATER USAGE PREFERENCES AND THEIR ATTITUDE TOWARDS EXCESSIVE IRRIGATION

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Abstract

One of the biggest risks that the world will face by 2050 is water scarcity. This problem is not only the main problem of underdeveloped and developing countries, but also of developed countries. Considering that the agricultural sector uses 70% of the global fresh water drawn from rivers, lakes and other sources, water waste in agricultural areas should be prevented and water should be used effectively. This research aims to determine the water usage preferences of the producers in the agricultural sector where water usage is the highest. For this purpose, a face-to-face survey was conducted with 412 producers residing in the rural areas of Bursa, Turkey. The data obtained as a result of the survey were analyzed with SPSS 25. 0. When the analysis results are examined; It is seen that 36.2% of the producers determine the amount of water they will use for irrigation according to their estimations, they have very little (50.2%) information about the useful water capacity of the soil, and 47.8% do not use drip irrigation, but they plan to use it. Although studies have been carried out to prevent water waste, the expected benefit has not been achieved. Extension service should be provided to the producers that excessive irrigation does not increase the yield.

Key words**:** *water use, producer preferences, water scarcity, drip irrigation*

INTRODUCTION

Water is one of the most important natural resources that living things need to survive [12]. People settled and lived in areas where they had access to throughout them. Water is a renewable resource and not infinite [37].

The negative effects of climate change are becoming more evident day by day. Changes in precipitation cycles, permanent droughts [7, 22] and more frequent natural disasters cause irreversible damage to water sources [36]. These problems occurring in water resources directly affect other resources [43]. These increasing symptoms also have negative consequences in agriculture, which is a main sector [17]. Problems such as climate change and drought, which have natural results, require more efficient use of water used in agriculture [8]. Research performed on the subject does not offer encouraging scenarios for the future. Therefore, water management in agriculture is a very important issue [7]. Kara and Yereli [17] stated in their research that consumer behaviors should be analyzed in subjects such as water management, food safety and nutrition in order to determine the impact levels of climate change on sectors.

According to the research conducted by the United Nations Economic Commission for Europe (UNECE) in 2020, with the rapid increase in population in 2050, the demand for food will increase by 50% , the demand for water by 55% [18] and the energy demand by 80% [35]. FAO reported that agricultural lands are an important issue in terms of global environmental change and food supply problems [11] These resources must be protected in order to meet the basic vital needs of people [1, 30]. States are responsible for preserving, developing water resources and also for distributing these to individuals [4]. The priority for the use of water can be ranked as; drinking-consumption, necessity for animals to survive, use in agricultural areas, use in energy and industry, use in trade, tourism and fishing [2].

70% of the world's water is used in agriculture [13, 26, 27, 39]. Since the global climate crisis directly affects the agriculture sector,

the rate of water used in agriculture is increasing [14]. In this case, the distribution of water between sectors also differs. In addition to the climate crisis, the unconscious use of water is another factor that causes the water crisis [42]. The use of wrong irrigation systems, technological inadequacies, transmission and distribution problems and infrastructure problems increase the waste of water [4]. Turkey is located in the semi-arid/semi-humid middle latitude region. As in other countries in this region, sometimes arid climate is seen periodically, and sometimes humid climate characteristics are observed [21, 29]. Agricultural production in arid and semi-arid areas is directly dependent on water [9]. The precipitation rate is not high. Therefore, the amount of water used in agriculture should be used adequately and effectively [10].

Table 1. Amount of water withdrawn from Turkey's water resources and usage areas (billion m3/year, %)

Years	2012	2014	2016	2018	2020
Irrigation	41.55	35.85	43.06	43.95	44.0
Thermal power plants	6.40	6.53	8.61	7.87	8.28
Municipalities	4.94	5.23	5.83	6.19	6.49
Manufacturing industry	1.79	2.20	2.12	2.68	2.60
Villages	1.04	0.43	0.38	0.39	0.42
Mining	0.11	0.21	0.23	0.24	0.27
Organized industrial zones	0.14	0.14	0.15	0.16	0.18
Total	55.96	50.59	60.38	61.48	62.24

Source: Ministry of Environment, Urbanization and Climate Change, 2022 [28].

When the water usage areas in Turkey are examined (Table 1), it is seen that agricultural irrigation has the highest share like other developing countries. In the agriculture sector, 1% savings amount corresponds to 6.6% water consumption in industry and 4.9% in drinking water consumption [41].

Excessive Irrigation and Water Holding Capacity of the Soil

Farmers do not have enough information about the relationship of the plant with water and soil. Excessive use of water does not only harm the plant, but also has negative effects on the environment. Farmers who do not have enough information tend to use excessive water as they are traditionally accustomed to [10]. There are some factors that should be considered in order to determine the correct irrigation method. Determining the properties of the soil is one of these factors. Soil analysis is very useful to determine soil structure and needs [40].

[16] stated in their study that half of the agricultural lands of Osmaniye province contain high levels of Na, and therefore salinization is observed in the soil, while the remaining soils have low levels of P. According to the research, balanced fertilization and drip irrigation system should be used in agricultural soils in this region. Drip irrigation system is seen as superior to other irrigation systems [6], due to the fact that it can irrigate large areas with limited water, its water application efficiency is high, it requires less labor, and it needs low energy [7]. In addition, weed, disease and pest reproduction rates are low in drip irrigation method [15].

The water holding capacity of the soil is very important in order to store the water in the soil and to provide the water needed by the plant [31]. Water holding capacity is defined as the difference between field capacity and wilting point [24]. Organic materials are components that bind the grains in the soil, reveal nutrients to plants, and control the movements of water in the soil. In this way, the water holding capacity of the soil also increases. The effect of organic materials on increasing the water capacity of the soil is not effective in increasing the water resources [38].

MATERIALS AND METHODS

This research was carried out in Bursa province in June and July 2022. Bursa province is Turkey's 4th largest city and is located in the south of the Marmara region. As of 2021, the population of Bursa was announced as 3,147,818 [34]. Research data were obtained by using face-to-face survey method with 412 producers.

The research consists of two parts. In the first part, previous studies were examined and the literature part of the research was formed. In the second part, analyzes were made using the research data and the results of the analysis

were interpreted. Necessary literature research was carried out while forming the survey questions. While some of the questions were taken from previous studies, the rest were prepared uniquely for this study. The prepared survey questions were finalized by pre-interview with 15 people and approved by an expert academician. The obtained data were analyzed with SPSS 25.0 (Statistical Package for the Social Sciences). Frequency analysis and Chi-square test were used in the analysis of the data.

The following formula was applied to obtain the sample size [23, 32]:

$$n=(z)^2\ p(1-p)/d^2 \quad (1)$$
$$n=(1.96)^2/(4(0.05)^2\ )=384.16$$

n: sample size,
z: level of confidence according to the standard normal distribution (for a level of confidence of 95% (1.96),
***p*=** sampling proportion (0.5),
***d*=** tolerated margin of error (0.05)

When the above formula is applied, the 412 participants in the current study has been deemed to be sufficient.

RESULTS AND DISCUSSIONS

In this part of the research, the demographic characteristics of the producers, their knowledge about irrigation, their knowledge about over-irrigation and soil capacity were analyzed. Analysis results were analyzed and compared with previous studies and interpreted.

Table 2 shows the demographic information of the producers. When this information is examined, it is seen that the producers are mostly between the ages of 36-45 and their marital status is married. The number of households of 133 producers is 6-8 people. When the farmers' education levels were examined, it is seen that 274 people can only read and write. According to agricultural production data, 34.5% of the producers have been producing for 6-10 years and 40.3 % of the producers stated that their production areas was between 51-100 decares.

Table 2. Demographic information of producers

Age	**N**	**%**
25-35	40	9.7
36-45	156	37.9
46-55	62	15.0
56-65	126	30.6
66+	28	6.8
Total	412	100
Household size	**N**	**%**
1-2	26	6.3
3-5	129	31.3
6-8	133	32.3
8+	124	30.1
Total	412	100
Education	**N**	**%**
Not literate	10	2.4
Literate	274	66.5
Primary school	81	19.7
High school	39	9.5
University	8	1.9
Total	412	100
Marital status	**N**	**%**
Married	363	88.1
Single	49	11.9
Total	412	100
Experience in agriculture	**N**	**%**
1-5	51	12.4
6-10	142	34.5
11-20	104	25.2
21+	115	27.9
Total	412	100
Arable area owned	**N**	**%**
1-20	41	10.0
21-50	148	35.9
51-100	166	40.3
101- 200	41	10.0
201+	16	3.8
Total	412	100

Source: Own results.

In Table 3 producers' knowledge about irrigation can be seen. Regarding irrigation, 267 of the producers who received technical information support from agricultural engineers stated that they rarely consulted for support and 298 of them stated that they did not attend any seminar or meeting on irrigation and fertilization.

Producers get information about irrigation mostly from provincial and district agriculture directorates (40.7%) and television programs (31.3%).

More than half of the producers can only read and write. The low level of education prevents them benefiting from more information channels.

Table 3. Information status of producers about irrigation

Status of receiving technical information support on irrigation	**N**	**%**
Yes	97	23.5
Very rare	267	64.8
No	48	11.7
Total	412	100
Status of participation in training meetings on irrigation	**N**	**%**
Yes	114	27.7
No	298	72.3
Total	412	100
Information sources about irrigation	**N**	**%**
Provincial Directorates of Ministry of Agriculture and Forestry	168	.
Private institutions	17	
From journals/books about agriculture	98	
TV Programs	129	
Total	412	
Method for determining the amount of water	**N**	**%**
Checking the moisture at the roots	132	32.0
Calculation	131	31.8
Estimation	149	36.2
Total	412	100
State of knowledge about the water holding capacity of the soil	**N**	**%**
Yes	74	18.0
Very little	207	50.2
No	131	31.8
Total	412	100
Drip irrigation usage	**N**	**%**
Yes	97	23.5
No but I'd like to	197	47.8
No because it's expensive	101	24.5
Hard to manage	17	4.2
Total	412	100

Source: Own results.

36.2% of the farmers determine the amount of water used for watering the field according to their estimates. The producers, who are afraid to change their habits from the past, make irrigation according to their own wishes. The number of producers who have information about the water holding capacity of the soil is 74. 207 manufacturers have very little information. There are 97 producers using the drip irrigation method. On the other hand, 197 producers stated that they did not use it, but that they intend to use it in the future. 101 producers do not use drip irrigation because it is expensive. [3] concluded in their research that 63% of the farmers prefer the drip irrigation method because it is easy. [25] stated in their research that the initial installation of the drip irrigation system is costly, but it increases fruit yield from the first year.

Manufacturers do not abandon the traditional production methods they have adopted and see new production systems as unnecessary costs. Although it is known that the drip irrigation system increases the product yield, the producers still do not prefer this system. For individuals who spend their free time mostly in coffeehouses, the trainings to be given here and the information to be published in mass media such as television will be beneficial.

Table 4. Excessive irrigation conditions of producers

The situation of using the appropriate irrigation method	**Producers belief that more irrigation causes more yield**						**Chi-Square (X^2)**
	Yes		No		No idea		
	N	%	N	%	N	%	
Yes	179	83.6	89	65.4	38	61.3	86,797
No	35	16.4	47	34.6	24	38.7	
Total	214	100	136	100	62	100	

Source: Own results.

Table 4 shows the Chi-square test results of the questions "The more irrigation is applied, the more the belief in yield increase" and "The situation of using the appropriate irrigation method". According to the test results, 83.6% of the producers who have the perception that the more irrigation is done, the more the yield will increase, think that they are irrigating appropriately. The rate of those who do not have the perception that the more irrigation is done, the more yield will increase and think that they are doing proper irrigation is 65.4%.

Excessive irrigation in agriculture causes soil salinization and erosion as well as reducing crop yield. Producers are not aware of the adequacy of their irrigation. [19] stated in their research that producers do not pay the real cost of the water they use and therefore they tend to over-irrigate. 31.1% of the producers participating in the research believe that excessive irrigation increases the crop yield. According to [5] research, producers commonly believe that over-irrigation will increase yields.

For this reason, much more water is used than is needed. In the studies reviewed, it is seen that there are similar results with the current study.

Although the studies are in different regions, producers have a similar perception towards water use.

Table 5 shows the Chi-square test results of "Knowledge about the water holding capacity of the soil?" and "Having knowledge about the harms of watering the soil too much?". According to the test results, only 17 of the

producers who have knowledge about the useful water capacity of the soil think that adding too much water to the soil is harmful. 66.3% of the producers, who have little knowledge about the useful water capacity of the soil, state that giving too much water to the soil is partially harmful. According to the research of [33], 59% of the producers do not have information about the water holding capacity of the soil. The rate of those with very little knowledge is 4%. Producers do not have enough information about the amount of water their soil needs.

Table 5. Information status of producers about soil capacity

The state of having knowledge about the harms of watering the soil excessively	Knowledge about the water holding capacity of the soil						Chi-Square (X^2)
	Yes		Very little		No		
	N	%	N	%	N	%	15,083
Yes	17	22.9	25	12.1	17	13.0	
Partially	49	66.3	117	56.5	73	55.7	
No	8	10.8	65	31.4	41	31.3	
Total	74	100	207	100	131	100	

Source: Own results.

They should be informed about the damages caused by excessive irrigation not only to the crop but also to the soil and the environment. The measures that will be taken are very important in reducing water scarcity, which is one of the most important problems of the future [20].

[8] in their research, farmers were asked whether over-irrigation is harmful, and 61% of the farmers answered that over-irrigation is not harmful. In the same study, it was stated that the scarce water resources in the region should be used more efficiently and water should not be given more than the water holding capacity.

Similar results were obtained in the present study in comparison with the studies reviewed. Producers do not use water resources effectively and water waste continues in the agricultural sector.

CONCLUSIONS

All of the future research about the subject focuses on water scarcity and the negative consequences that will occur with it. Water scarcity, which poses a great threat to future generations, shows its effects today as well. Despite this, water waste continues in the agricultural sector, where water use is the highest. This unconscious use of water in the agricultural sector also poses a risk to other sectors.

When the results of the analysis are examined, it is seen that the producers believe that the more they irrigate, the more yield they will get. Producers are not aware of the damage caused by excessive irrigation and think that they use the most appropriate irrigation. In addition, producers who believe that excessive watering of the soil is not harmful, do not have enough information about the water holding capacity of the soil.

The education level of most of the producers is literate. The number of producers with a high level of education is quite low. For this reason, it would be useful to provide information about irrigation systems in the mass media that producers follow. Producers often spend their free time in coffee houses. Trainings and informing in coffeehouses are more efficient for producers. Producers who think that excessive irrigation will increase the yield are not aware of the damage they cause to the environment. Although it has been determined in many studies that the use of water at the required rate increases the efficiency, producers do not prefer systems that provide sufficient water use, such as drip irrigation. The research was carried out within the borders of Bursa province, located in the south of the Marmara region. The region is an important region in terms of Turkey's agricultural potential, as well as one of our leading provinces in terms of education level.

The current research, if applied more comprehensively in other geographical regions, will shed light on establishing a model for Turkey.

REFERENCES

[1]Acikose, S., Gurbuz, I.B., 2018, Export Investigation of Cherry for the City of Bursa. Turkish J. Agric. Nat. Sci. 5(2), 191–202.

[2]Aksoy, A., Demir, N., Goksen Özturk, F., 2014, Agricultural Water Use and Sustainability in Turkey

(In Turkish). In: Ceyhan, V., Hazneci, E., Hazneci, K., Yıldırım, Ç., (Eds.), XI. National Agricultural Economics Conference, Ondokuz Mayıs Unıversitesi, Samsun, pp. 462–9.

[3]Aydin Eryilmaz, G., Kilic, O., Gulser, C.,2022, Farmers' Preferences Regarding Irrigation Methods in Sinop Province (In Turkish). Turkish J. Agric. Res. 9(2), 209–2015, Doi: 10.19159/tutad.1077848.

[4]Aydogdu, M.H., Manci, A.R., Aydogdu, M., 2015, The Changes in Agricultural Water Management; Water User Associations, Pricing and Privatization Process (In Turkish). Electron. J. Soc. Sci. 14(52), 146–60, Doi: 10.17755/esosder.82927.

[5]Bahceci, B., 2019, Interaction of irrigation, drainage and soil salinity in Harran Plain (In Turkish). Derim 36(2), 183–91, Doi: 10.16882/derim.2019.552382.

[6]Celik, A., Akca, E., 2021, Description of the Quarter-Century Effect of Conversion from Rainfed Farming to Irrigated Farming on a Micromorphological Scale (In Turkish). Eur. J. Sci. Technol. (21), 207–15, Doi: 10.31590/ejosat.816239.

[7]Celik, Z., Özcelik, Ş., Albayram Dogan, Z., Aydin, B., 2022, Benefiting from Drip Irrigation Grants and Behaviors of Producers: Case Study of İzmir, Manisa, Denizli (In Turkish). Turkish J. Agric. Econ. 28(1), 111–22, Doi: 10.24181/tarekoder.1030950.

[8]Cifci, Ş., Degirmenci, H., 2022, Analysis of Water User Associations in Asi Basin with Irrigation Performance Indicators and TOPSIS Method (In Turkish). Kahramanmaraş Sütçü İmam Univ. J. Agric. Nat. 25(1), 169–80, Doi: 10.18016/ksutarimdoga.vi.885525.

[9]Degirmenci, H., Arslan, F., 2018, Operation and Maintenance Cost Analysis of Turnover Irrigation Schemes to Irrigation Associations (In Turkish). Su Kaynakları 3(1), 16–23.

[10]Dorak, S., Asik, B.B., Özsoy, G., 2019, The Importance of Water Quality and Water Pollution in Agriculture: Case of Nilüfer Creek in Bursa (In Turkish). J. Agric. Fac. Bursa Uludag Univ. 33(1), 155–66.

[11]FAO, 2017, Soil Organic Carbon: the hidden potential. Rome.

[12] Firat Ersoy, A., Hatipoglu Temizel, E., 2022, Investigation of the Suitability of Karadere River (Araklı-Trabzon) for Drinking and Irrigation Purposes (In Turkish). J. Nat. Hazards Environ. 8(2), 238–49, Doi: 10.21324/dacd.1005286.

[13]Gokce, N., 2022, Global Water Stress and Measurement Methods (In Turkish). Bull. Econ. Theory Anal. 7(1), 189–208, Doi: 10.25229/beta.1117054.

[14]Gürbüz, İ.B., Kadağan, Ö., 2019, How the metropolitan municipality law affects the rural areas; the case of Bursa. Bursa Uludag Üniversitesi Ziraat Fakültesi Derg. 33(2), 209–226.

[15] Gurbuz, I.B., Manoros, M., 2019, Impact of Coconut Production on the Environment and the Problems Faced By Coconut Producers in Lanao Del Norte Province, Philippines. Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, 19(3), 235–246.

[16]Kalkanci, N., Simsek, T., Aslan, N., Buyuk, G., 2021, Providing Sustainable Management by Mapping the Productivity Status of Agricultural Soils at Thematic Level: Case of Osmaniye (In Turkish). Kahramanmaraş Sütçü İmam Univ. J. Agric. Nat. 24(4), 859–70, Doi: 10.18016/ksutarimdoga.vi.800468.

[17]Kara, K.Ö., Yereli, A.B. (2022) Climate Change Management and Agriculture Sector (In Turkish). J. Disaster Risk 5(1), 361–79, Doi: 10.35341/afet.1100932.

[18]Karaca, C., Tekelioglu, B., Buyuktas, D., 2017, Efficient Use of Soil Moisture Sensors for Sustainable Agricultural Production (In Turkish). Acad. J. Eng. Appl. Sci. 2(3), 33–41.

[19]Kucuk, N., Parlakci Dogan, H., Aydogdu, M.H., 2022, Inter-Sectoral Competition for Water and a Research on Irrigation Perception of Agricultural Enterprises in Harran Plain (In Turkish) . Electron. J. Soc. Sci. 21(83), 1343–57, Doi: 10.17755/esosder.1073491.

[20]Mitrică, B., Mitrică, E., Enciu, P., Mocanu, I, 2017, An approach for forecasting of public water scarcity at the end of the 21st century, in the Timiş Plain of Romania. Technol. Forecast. Soc. Change 118, 258–69, Doi: 10.1016/j.techfore.2017.02.026.

[21]Mutlu, A., Tas, T., 2020, Investigation of Quality Traits with Yield and Yield Elements in Some Bread Wheat Varieties (T. Aestivum L.) Grown in Turkey under SemiArid Climatic Conditions (In Turkish). Eur. J. Sci. Technol. (19), 344–53, Doi: 10.31590/ejosat.738796.

[22]Ovchinnikov, A.S., Borodychev, V. V., Lytov, M.N., Bocharnikov, V.S., Fomin, S.D., Bocharnikova, O. V., Vorontsova, E.S., 2018, Optimum control model of soil water regime under irrigation. Bulg. J. Agric. Sci. 24(5), 909–13.

[23]Ozdamar, K., 2003, Modern Scientific Research Methods (In Turkish). Kaan Kitabevi, Eskişehir.

[24]Ozdemir, A., Kahraman, S., 2011, Soil science and Plant Nutrition. Gardening Handbook, İstanbul Metropolitan Municipality, İstanbul, pp. 709–33.

[25]Ozturk, F.P., Kucukyumuk, C., Kacal, E., Yildiz, H., 2018, Economic Evaluation of Transition From Flood Irrigation Method to Drip Irrigation Method of Apple Trees in Yield Age . Kahramanmaraş Sütçü İmam Üniversity J. Agric. Nat. (21), 102–8, Doi: 10.18016/ksutarimdoga.vi.472705.

[26]Phasinam, K., Kassanuk, T., Shinde, P.P., Thakar, C.M., Sharma, D.K., Mohiddin, M.K., Rahmani, A.W., 2022, Application of IoT and Cloud Computing in Automation of Agriculture Irrigation. J. Food Qual. 2022, 1–8, Doi: 10.1155/2022/8285969.

[27]Polat Bulut, A., Topal Canbaz, G., 2022, Calculation of Water Footprint for Wheat, Barley, Sugar Beet, and Sunflower Production in Sivas Province. Bilecik Seyh Edebali Univ. J. Sci. 9(1), 249–55, Doi: 10.35193/bseufbd.1010315.

[28]Republic of Türkiye, Ministry of Environment, U. and C.C., 2021, Water Use.

https://cevreselgostergeler.csb.gov.tr/su-kullanimi-i-85738, Accessed on August 22, 2022.
[29]Sahin, Ü., Kurnaz, L., 2014, Climate Change and Drought. İstanbul.
[30]Samberger, C., 2022, The role of water circularity in the food-water-energy nexus and climate change mitigation. Energy Nexus 6, 100061, Doi: 10.1016/J.NEXUS.2022.100061.
[31] Sen, S., Yılmaz, G., Topdemir, T., Alkan, Ü., 2019, Effect of Micro Catchment Water Harvesting Technique and Some Applications that Improve the Soil Water Holding Capacity on Growth of Olive Sapling (In Turkish). Soil Water J. (Special Issue), 122–9, Doi: 10.21657/topraksu.655561.
[32]Sencer, M., 1989, Method in Social Sciences (In Turkish). 3., Beta Basın Yayın Dağıtım, İstanbul.
[33]Taspinar, M., Ertek, A., 2018, The Sustainable Management of Soil and Water Resources in Konya Kadınhanı-Beykavağı District Irrigation Cooperative. SDU J. Fac. Agric. 13(2), 73–8.
[34]TUİK, 2021, Population Statistics. https://data.tuik.gov.tr/Kategori/GetKategori?p=nufus-ve-demografi-109&dil=1., Accessed on August 28, 2022.
[35]UNECE, 2020, Towards Sustainable Renewable Energy İnvestment And Deployment – Trade-Offs And Opportunities With Water Resources And The Environment. Geneva.
[36]Velasco-Muñoz, J., Aznar-Sánchez, J., Belmonte-Ureña, L., López-Serrano, M., 2018, Advances in Water Use Efficiency in Agriculture: A Bibliometric Analysis. Water 10(4), 377, Doi: 10.3390/w10040377.
[37] Weinzettel, J., Pfister, S., 2019, International trade of global scarce water use in agriculture: Modeling on watershed level with monthly resolution. Ecol. Econ. 159, 301–11, Doi: 10.1016/J.ECOLECON.2019.01.032.
[38]WWF-Turkiye, 2022, Soil Conservation Methods Farmer's Handbook.
[39]Yalili Kilic, M., Adali, S., 2022, Rainwater Harvesting in a Shopping Mall Example (In Turkish). Uludağ Univ. J. Fac. Eng. 27(1), 29–40, Doi: 10.17482/uumfd.1034275.
[40]Yenikale, A., Yenikale, A., 2012, Designing Irrigation and Irrigation Methods.
[41]Yigit, Y., Cakmak, B., 2018, Evaluation of Water Use for Agriculture in Fırat Basin Irrigation Schemes. (in Turkish). SDU J. Fac. Agric. 13(1), 103–8.
[42]Yilmaz, M., 2010, Environmental Problems Caused by Ground Water Level Changes around Karapinar . Ankara Univ. J. Environ. Sci. 2(2), 145–63, Doi: 10.1501/Csaum_0000000033.
[43] Zhang, Y., Zhang, Y., Shi, K., Yao, X., 2017, Research development, current hotspots, and future directions of water research based on MODIS images: a critical review with a bibliometric analysis. Environ. Sci. Pollut. Res. 24(18), 15226–39, Doi: 10.1007/s11356-017-9107-1.