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Milk Production and Evaluation in Farms Raised Anatolian Water Buffalo (*Bubalus bubalis*); A Case Study of Iğdir Province

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ABSTRACT: This study conducted a questionnaire with 98 enterprise owners rearing Anatolian water buffalo in 2018 in Iğdir city of Turkey. The average daily milk yield, annual milk yield, and sales price of buffalos milk of the enterprises were determined as 5.48 ± 0.07 (kg), 1228.56 ± 15.60 (kg/lactation), and USD1.06 (price/per kg), respectively. At the same time, 3.0% of the produced raw milk was put on the market as raw milk, 20.90% as product, and 76.10% as raw milk + product. Therewithal, 81.54% of the processed milk was marketed as butter+cream+curd cheese, 7.69% as butter + cheese + curd cheese, and 10.77% is marketed as butter + cheese + yoghurt + curd cheese. It was determined that out of the companies selling raw milk, 88.70% sold to street milk + grocery stores, and 11.30% sold to dairy farms. As a result, to ensure sustainable buffalo breeding in Iğdir province, buffalo milk collection centers, processing facilities, and buffalo breeders' association should be established. There is need to protect Anatolian water buffaloes reared in Iğdir province as genetic resources crossbreeding with other buffalo breeds should not be allowed. It should be remembered that animals adapt to their environment after many years. Matings made to increase the amount of milk can negatively affect the properties like butter and cream yield. However, inbreeding of animals raised in the province should not be allowed. Cows must be mated according to a system.

Keywords: Water buffalo; farms, milk production; evaluation; marketing

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INTRODUCTION

Water buffaloes are raised in many different places and regions of the world. Water buffaloes in other areas have an economic importance specific to their region. Buffalo is an efficient converter of poor-quality roughages into valuable products such as milk and meat and is known as the black gold of Asia (Javed et al. 2018). Water buffalo husbandry in Turkey is performed in some provinces of the Black Sea, Marmara and Central Anatolian Regions. The provinces with the highest amount of water buffalo existence are listed as Samsun, Diyarbakır, Istanbul, Tokat, Bitlis, Muş, Afyon, Kayseri, Sivas and Amasya (Ermetin, 2017)

Milk contains high levels of vital components such as water, protein, lactose, minerals and vitamins. Therefore, it is an animal food that is of great importance in human nutrition (Soysal, 2006). Although water buffaloes give less meat and milk compared to cattle, they have the advantages of higher meat and milk quality and resistance to diseases, poor nutrition and environmental conditions (Ermetin, 2020). The protein ratio of buffalo milk is higher than cow's milk. For this reason, buffaloes milk is important in cheese production due to its high casein protein content (Shakerian et al., 2016)

Water buffalo milk has superior nutritional value since it contains high levels of protein, fat, and minerals (especially calcium and phosphorus). High milk quality and processing of various milk products (especially mozzarella, cream, yogurt, etc.) increase the demand for water buffalo milk (Damé et al., 2010; Canbolat, 2012). Buffalo milk is generally used in making mozzarella cheese pizza (Pamuk and Gürler, 2010). Water buffalo is an important farm animal species in terms of protecting the local gene resources of Turkey (Yilmaz et al., 2012). Water Buffaloes in Turkey originate from Mediterranean water buffaloes from the subgroup of the water buffaloes and are called "Anatolian water buffalo" (Soysal, 2006; Ata-sever ve Erdem, 2008; Ermetin, 2020). Water buffaloes need wet areas (such as water, streams, swamps, lake, ponds, and seas) to cool down in the place they inhabit (Soysal, 2006).

Although the share of agriculture in employment is very high and its share in national income is very low meager, as its social, economic, and environmental dimensions, the agricultural activities, which are the livelihood of billions of people living in rural areas of the world (Losch et al., 2012), have

maintained its their importance in terms of macroeconomic indicators everytime (Anomymous, 2014). The agricultural sector produces essential foodstuffs for the nutrition of the country's population, provides inputs to the industrial sector, supports industrial accumulation through relative prices, and plays an accelerating role in the growth of industry (Byerlee et al., 2009; Rajadurai et al., 2022).

Factors such as information, change, communication, and distribution of innovations among farmers are realized with institutional cooperation and connections, and this institutionalism can be achieved by cooperatives or producer associations (Bilgin and Demirer, 2009). While agricultural cooperatives are a driving force in the development, guidance, industrialization, and financing of agriculture in the EU (Turan, 1997), the desire to partner with organizations such as cooperatives is relatively high in rural areas in Turkey due to the minimal works for cooperation (Özdemir et al., 2011).

Water buffalo farms in Turkey are concentrated in the coastal areas of Black Sea; in the Middle Black Sea region; in Central Anatolia Region; in Aegean region; Istanbul in the Marmara region; in Eastern Anatolia Region; and in Southeastern Anatolia region (Işık and Gül, 2016).

In this study, Iğdır province, which is one of the provinces where water buffalo is raised in the Eastern Anatolia Region, was chosen as the study area. As a result of the literature review, there is no study on the water buffalo farms in Iğdır province. Agriculture is the primary source of income in the province, and planting feed crops suitable for livestock farming and meadows has a high potential for new investments. Iğdır province is the region receiving the minimum rainfall in Turkey. Agricultural lands are irrigated with waters of the Aras river in the Iğdır plain. Therefore, there are a large number of irrigation channels in the Iğdır plain. The buffaloes get into the water in these channels and crop the meadows and the reed-mace around these channels.

MATERIALS AND METHODS

Material

The material of this study, Anatolian water buffalo reared farms in Iğdır province. The status of water buffalo breeding was evaluated in these farms based on milk production capaprovince. The descriptive

values of the characteristics addressed in this context were presented with tables and the results obtained in the study were discussed comparatively with the other regional or local studies conducted in Turkey. Thus, the province has a surface area of 3.588 km², an altitude varying between 800-900 m and 26% (922 km²) of the province involves plain, 74% (2.617 km²) involve mountainous and rough areas, the province has the average annual temperature of 12.1 °C and average yearly precipitation of 258.6 mm, and the temperature varies between 39-42 °C in June-August. Because Iğdir Plain and its surrounding are involved within the “microclimate” area, the terrestrial climate conditions close to the Mediterranean climate in the region and the semi-humid cold climatic conditions dominate the high places.

This study was conducted by carrying out a questionnaire with 98 farm owners rearing Anatolian water buffalo in 2018 in Iğdir province of Turkey situated climate and breeding conditions outlined above

Method

The method of the study was composed of the data obtained through questionnaires from processing facilities making animal production or rearing only water buffalo and operating in Iğdir province. Since the information obtained through full counting when the data were collected through the questionnaire method reflects more correct results; if the population is small and it is easy and cheap to reach the desired information, then full count should be made (Çiçek and Erkan, 1996; Yamane, 2010). Otherwise, although N showing the total number of farms is known (in Iğdir province), in the cases where no detailed studies were conducted in the region and since the standard deviation and variance values were not known, the following sampling formula used by Arıkan (Arıkan, 2007), and Yamane (Yamane, 2010) from the Simple Random Sampling was used to determine the number of farms to be applied with the questionnaire.

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

n=Number of Sample

N= Cluster size

D=Accepted or desired sampling error

t= Table value

p=The ratio wanted to be calculated

q=1-p

Thus, the data for Anatolia water buffalo were taken from Turkey Statistical Institute (TSI). Accordingly, the total number of water buffaloes in Iğdir province was 2235 heads (319 farms) in 2017 (TUİK, 2018). The farms rearing water buffalo in Iğdir province are in the Center, Karakoyunlu, and Aralık districts. The questionnaires were conducted with face-to-face interviews with question and answer method in 2018 with 98 breeders selected from among 319 water buffalo producers by performing Simple Random Sampling procedure to apply a questionnaire. The information obtained by using both the questionnaires and institution records was regulated with the help of Excel spreadsheet program and made ready for analysis. While comparing the farm groups in terms of different characteristics, Group Comparison (t-test) in properties having continuous and normal distribution or Analysis of Variance tests were used. Non-parametric tests were used when the distribution of farm groups was not normal. χ^2 - test was used for the analytical evaluation (Yildiz et al., 2011). In this study, the farm owners were evaluated by obtaining information such as their educational level, age and experiences, how obtained raw milk was used, sale price of raw milk, the number of water buffalo in the farms, their sale preferences for raw milk, their methods of processing raw milk, the forms of introducing processed milk products to the market, their marketing methods, organizational status of breeders and their expectations from the government.

RESULTS

According to data from FAO for 2015, it has been reported that water buffalo is commonly bred in 34 countries worldwide. The number of water buffaloes in these countries increased from 97.3 million (between 1961 and 1970) to 194.1 million (between 1961-2010). This increase was 99.5%. The biggest share in 2010 in terms of the number of farms rearing water buffalo undoubtedly belonged to India with the rate of 57.53%, which Pakistan followed with the rate of 15.86% and China with 12.16%. China is the second country to rear water buffalo after India. However, due to social structure, Pakistan has become the second country over time. When analyzing the period, the number of water buffaloes increased 13 times in Brazil, 8 times in Italy and 4 times in Nepal (Işık and Gül, 2016). In Turkey, the project of breeding Anato-

lian water buffalo was put into practice in 2011 to increase water buffalo breeding, improve the milk yield, and keep the number of water buffaloes. Water buffalo has been an indispensable part of livestock of Turkey for centuries (Yilmaz et al., 2012).

As a result of agricultural production, there is a need for quality labor for the maintenance, feeding, cleaning, and healthy sheltering of buffaloes, processing and marketing of the products. Complete evaluation of the farm's current workforce is ensured by regularly keeping records of milk and fertility of the heads. To ensure that the health protection and spreading service brought to the farms in the province are understood and applied in accordance with the procedure and the educational level of individuals employed in the labor force must be high so that the use of labor per animal is less and of high quality.

For this reason, the professional experience and educational level of the farm owners were questioned based on the districts investigated within the scope of the study and the obtained results are summarized in Tables 1 and 2. For buffalo breedings in Iğdir province can be asserted that the owners were composed of enough professional experience of farmers. According to the variance analysis result, a significant relationship was not found between farm sizes and breeders' animal breeding experience ($P>0.05$). Although not statistically significant, the most experienced breeders were found to have 1-5 animals.

The educational levels of the farm owners were also examined and it was determined that in terms of the educational levels, all of the breeders were at least literate, and they had different educational levels (Table 2). Farms owners rearing Anatolian water buffaloes in Iğdir province were 100% literate. When examining the educational level of the farm owners rearing Anatolian water buffalo from this information, it is possible to assert that they were composed of educated people.

Within the scope of this study, the sizes of the farms were divided into three (3) groups in terms of the presence of Anatolian water buffalo and presented in Table 3. Comparing the animal number in farms according to districts, farms rearing Anatolian water buffalo were highest, middle and lowest districts Karakoyunu, Center and Aralik districts respectively. But, these differences were not significant ($p>0.05$).

The land sizes of the farms, the subject of researchers, were classified as 0.1-1.9 hectares (ha.), 2.0-4.9 (ha.), 5.0-9.9 (ha.), 10.0-19.9 (ha.), and 20.0+ (ha.) and the distribution of these farms to these classes was arranged in Table 4 for total lands. All of these lands were irrigable lands. According to districts, the amount of land owned by the farms is 2.0-4.9 hectares.

As in dairy farming, it is desired to have high yield in water buffalo breeding and maintaining this high yield is also important. Information about the milk

Table 1. Animal breeding experiences of owner's farms by number of animals

Farms size	N	\bar{X}	$S_{\bar{x}}$	Minimum	Maximum	F	p
1-5 head	79	36.79	1.37	2.00	61.00	0.044	ns
6-10 head	16	32.44	2.37	15.00	44.00		
11+ head	3	30.00	6.66	19.00	42.00		
Total	98	35.87	1.19	2.00	61.00		

ns: non- significant

Table 2. The Educational level of the farmers and statistical analysis results

Districts	N/%	Educational level of the enterprise owners				Total
		Literate (no diploma)	Primary School	Middle-School	High School	
Center	n	0	23	2	5	30
	%	0.0	23.5	2.0	5.1	30.6
Karakoyunlu	n	2	29	9	6	46
	%	2.0	29.6	9.2	6.1	46.9
Aralik	n	1	10	5	6	22
	%	1.0	10.2	5.1	6.1	22.4
Total	n	3	62	16	17	98
	%	3.1	63.3	16.3	17.3	100

Fisher $\chi^2=9.429$. $p>0.05$

Table 3. Sizes of Anatolian water buffalo in the enterprises

District	N/%	Number of water buffaloes on farms			Total
		1-5 heads	6-10 heads	11+ heads	
Center	n	24	6	0	30
	%	80.0	20.0	0.0	100
Karakoyunlu	n	39	5	2	46
	%	84.8	10.9	4.3	100
Aralik	n	16	5	1	22
	%	72.7	22.7	4.5	100
General	N	79	16	3	98
	%	80.6	16.3	3.1	100

Fisher $\chi^2= 3.235$, $p>0.05$

Table 4. Land size distributions of enterprises according to the districts

Districts	N/%	Distribution of total land assets (hectare)*					Total
		0.1-1.9	2.0-4.9	5.0-9.9	10.0-19.9	20.0+	
Center	n	12	11	7	0	0	30
	%	44.4	28.2	29.2	0.0	0.0	30.6
Karakoyunlu	n	11	17	12	4	2	46
	%	40.7	43.6	50.0	66.7	100.0	46.9
Aralik	n	4	11	5	2	0	22
	%	14.8	28.2	20.8	33.3	0.0	22.4
General	N	27	39	24	6	2	98
	%	27.6	39.8	24.5	6.1	2.0	100

$\chi^2= 8.356$, $p>0.05$; *: All lands are irrigable.

yield and production was obtained based on the statements of the farm owners breeding Anatolian water buffalo (Table 5). According to Table 5, the average daily milk in the farms was obtained the highest in the central district. The lowest daily milk yield was obtained from the farms in Aralik district.

According to the analysis of variance (ANOVA), the districts where the buffalo cows were raised caused variation in the average daily yield and Lactation length (day/lactation) ($p<0.001$). But, it did not create a variation in annual milk yield by districts. However, while the highest milk yield average of the farms has

been owned by the central district, Karakoyunlu and Aralik districts followed this respectively.

Table 6 shows the data about the evaluations by the answers to the questions asked to the farms rearing Anatolian water buffalo and being subjected to questionnaire, about their primary problems about the sale of the water buffalo milk and the services they expected from the government. Accordingly, the views of the farm owners breeding Anatolian water buffalo about the primary problems and their expectations from the government were found to be statistically significant ($P=0.001$). As a result, the breeders stated

Table 5. Daily and annual average milk yields in the farms for the district

Milk Yields	Districts	N	\bar{X}	S_v	Minimum	Maximum	F	P
Average daily milk yield (kg/day)	Central	28	6.22	0.15	4	11	57.91	***
	Karakoyunlu	54	5.34	0.08	3	9		
	Aralik	16	4.67	0.07	4	7		
Lactation length (day/lactation)	Central	28	207.36	1.538	150	240	189.81	***
	Karakoyunlu	54	222.80	1.758	180	305		
	Aralik	16	269.00	4.509	180	305		
Annual milk yield (kg/lactation)	Central	28	1275.16	28.38	840	2310	1.301	ns
	Karakoyunlu	54	1200.40	23.19	540	2430		
	Aralik	16	1241.67	22.61	840	1525		

***: $p<0.001$, ns: non-significant

Table 6. Primary expectations from the government of farmers

Districts	N/%	No problem	There is a problem	Problems and Expectations		Total
				Milk Marketing	Milk Processing Problem	
Center	n	14	15	13	2	(15)* 29
	%	48.3	51.7	(86.7) 44.8	(13.3) 6.9	100.0
Karakoyunlu	n	27	20	18	2	(20) 47
	%	57.4	42.6	(90.0) 38.3	(10.0) 4.3	100.0
Aralik	n	22	0	0	0	(0) 22
	%	100.0	0.0	(0.0)0.0	(0.0)0.0	100.0
General	n	63	35	31	4	(35) 98
	%	64.3	35.7	(88.6) 31.6	(11.4) 4.1	100.0

Fisher $\chi^2=16.417$, $p<0.001$; *:values inside () show the farms having the product selling problem.

that they expected the authorities to support their investments in marketing and milk processing facilities.

The sale of raw milk or processed dairy products is important for the sustainability of the farms. The milk utilization forms of farm owners in this study were generally determined as domestic consumption and selling. Milk sales methods of farm owners' home consumption, raw milk, product selling and raw milk+product were determined as 31.60% (n=31), 2.0% (n=2), 14.30% (n=14), and 52.0% (n=51), respectively.

Table 7 shows marketing locations about the sales of the water buffalo milks in farms breeding Anatolian water buffalo and participating in the questionnaire. It was determined that the farms sold as street milk and grocery stores of majority of raw milk produced in farms. According to districts, raw milk sale methods were found to be statistically (Fisher χ^2 -test) significant ($p<0.01$). The raw milk sales of the farms were generally in the form of street milk and grocery.

To ensure sustainability as in all dairy farms, in addition to the desire to have high milk yield in water buffalo breeding, the continuity of these high yields is also important. Yield continuity depends on the con-

tinuation of high daily milk yield throughout lactation. This will help the farms to work more profitably and earn higher revenues by enabling the milk sale in every period of the year. According to the answers given by the farm owners who reared Anatolian water buffalo in Iğdir Province, they were determined to average USD 1.05 per kg milk sale prices by 2018.

People participating in the questionnaire stated that processing the milk into a product for sale was preferred because of being more profitable and ease of marketing. While farms do not have milk selling and processing percent 33.67% (n=33), farms are processing to product percent 66.33% (n=65) of raw milk for sales. Product selling type of farm owners (n=65) was determined as for butter+cream+curd, butter+curd, and butter+yoghurt+curd 81.54% (n=55), 7.69% (n=4) and 10.77% (n=6) respectively.

For farms to be sustainable, it is necessary to determine whether or not there is sufficient consciousness among breeders about membership in organizations related to animal husbandry and to determine if its importance is understood sufficiently. Because production, processing, packaging, storage and marketing are the most important elements of sustainability.

Table 7. Statistical values and milk sale ways of the farms

Districts	N/%	Sales locations for raw milk			Total
		Not selling raw milk	Street milk+ grocery store	Dairy	
Center	n	14	15	0	(15) 29
	%	48.3	(100.0)51.7	(0.0) 0.0	100.0
Karakoyunlu	n	23	21	3	(24) 47
	%	48.9	(87.5) 44.7	(12.5) 6.4	100.0
Aralik	n	8	11	3	(14) 22
	%	36.4	(78.6) 50.0	(21.4) 13.6	100.0
General	n	45	47	6	(53)* 98
	%	45.9%	(88.7) 48.0	(11.3) 6.1	100.0

Fisher $\chi^2= 19.458$, $p<0.01$; *(): sales locations of farms selling milk.

Table 8. Memberships to an animal husbandry organization

Districts	N/%	Not a member	A Member	Organization		Total
				(Agricultural Cooperative)	(Breeding Association)	
Center	n	17	12	(0)	(12)	(12) 29
	%	58.6	41.4	(0.0)	(100.0)	100
Karakoyunlu	n	26	21	(2)	(19)	(21) 47
	%	55.3	44.7	(9.5)	(90.5)	100
Aralik	n	10	12	(3)	(9)	(11) 22
	%	45.5	54.5	(25.0)	(75.0)	100
General	N	53	45	(5)	(40)	(45) 98
	%	54.1	45.9	(11.1)	(88.9)	100

$\chi^2=0.929$, $p>0.05$; values inside () show the number and rates of member farms.

Table 8 summarizes the information related to marketing and organization. According to this situation, it can be asserted that the owners of the farms breeding Anatolian water buffalo were inadequate in the organization.

DISCUSSION

According to Notification (No: 2004/39) About the Registration of Breeds and Lines of Domestic Heads in Turkey (Anonymous, 2004), the average lactation milk yield of Anatolian Water Buffaloes is registered as 925.33 kg/lactation (between 186.0-2403.0 kg). When this information as compared with the determined yields (1228.56±15.60 kg/lactation) of Anatolian Water Buffaloes reared in Iğdir province, their milk yields were higher than the average in Turkey. High yield in Iğdir province may be associated with the quality roughage production (alfalfa plant) and the fact that the province is a Microclimate place where the annual rainfall is minimum in Turkey. The irrigation channels completely realize agriculture. These channels provide a suitable environment for meeting the need for water buffaloes to get into water due to naturally growing canes and meadows around these waters.

When the data obtained in Iğdir province were compared with the results of other researchers, Yılmaz (2013) reported that the average annual milk yield of Anatolian water buffaloes was 1205 (lt/lactation) under village conditions of Afyonkarahisar province, minimum and maximum milk yields varied between 600 and 2200 (kg/lactation), respectively. Şahin and Ulutas (2013) determined that lactation milk yield and daily average milk yield for the Anatolian water buffaloes reared in the province center and districts of Tokat province were 708.5±15.0 kg/year and 4.84±0.10 kg/day. In a study conducted

on Anatolian water buffaloes bred by the people in Amasya province, it was found that the daily milk yield was 2.76±0.10 kg/day and lactation milk yield was 470.91±9.78 kg/year (Kul et al., 2016). All of these results were found to be lower than the values obtained from Anatolian Water Buffaloes reared in Iğdir province. The milk amount (2229.87±93.70 kg/lactation) obtained by Pawar et al., (2012) for Murrah water buffaloes in Punjab, Ludhiana, India and the milk amount (1332.89 kg/lactation) obtained by Saner et al., (2022) for water buffaloes in Balıkesir province was found to be higher when compared with this study.

It has been reported that the milk obtained from Anatolian water buffaloes in breeder conditions in Afyonkarahisar province is primarily used for making cream. In addition to this product, 17% of these farms stated to sell processed milk to other dairy products like butter+cheese (similar to the rate of processed product of 20.90% in this study) and 3.0% sold the milk as raw milk (it was the same with the rate of 3.0% as marketing of raw milk in this study) (Yılmaz, 2013).

In the studies conducted in the farms marketing cow milk by processing it into products; It is reported that milk was marketed by processing it into products at the rate of 64.63% in Erzurum province (Erkmen et al., 2000), 38.77% in Şanlıurfa province (Bozkurt, 2005), 10.0% in Adana province (Güğercin et al., 2017), 13.90% in Erzurum province (Uçum and Gülçubuk, 2018), and 12.3% in Ethiopia (Duguma, 2022). These obtained values were lower than the 66.33% obtained in this study.

Yılmaz (2013) determined that in the enterprises breeding Anatolian water buffalo, 90% of the breed-

ers processed the water buffalo milk by themselves, 17% sold the milk to the milk collection companies (dairies) in addition to their processed products, 17% sold it to other buyers, and 3% sold it in the market by themselves. When compared with this study, it was found that while the rate of selling raw milk of water buffalo to the dairies was 11.3%, and the rate of 17% obtained for the habit of selling water buffalo raw milk (to the dairies) in the breeders under village conditions in Afyonkarahisar city was higher.

Besides, the rates of selling cow milk, produced in the farms, to dairies or factories were reported as 59.34% for Tokat province Pazar district by Yayar and Kargacier (1996), 43.0% for Hatay province by Tapkı (1996), 70.10% for Bolu province by Şahin (2000), 71.0% for Kars province by Demir et al (2014), and 90.0% for Adana province by Güğercin et al (2017). In this study, the same rate was found to be lower than all the reported rates (11.30%). The reason was the habit of selling cow milk to dairies more and processing of water buffalo milk in the farms at higher rates.

Farm owners need to be organized to solve the problems about processing, packaging, storing, selling, and marketing their products. In addition, it is also easier to utilize government supports. In this context, the status and ideas of the farms surveyed about the organization were asked. It was determined that 54.10% of the farm owners were not members of any institution about animal husbandry and 45.90% were members of an organization. Among those who were members of an organization, 11.10% were understood to be members of the Agricultural Development

Cooperative and 88.90% were the members of the Breeder Raising Association. However, it can be asserted that the farm owners breeding Anatolian water buffalo were inadequate about the organization. In the study conducted by Yilmaz (2013) on Anatolian water buffaloes in Afyonkarahisar province, it was reported that 83.0% of the breeders were members of Water Buffalo Breeding Association, 40% were members of Breeding Cattle Raising Association, and 7.0% were members of Milk Production Association. These values were significantly higher than the organization values obtained in this study (45.90%).

CONCLUSION

As a result of this study, milk yield of the Anatolian water buffaloes reared in Iğdir province were higher than the average in Turkey. High milk yield male and female buffaloes should be bred in farms to increase milk yield per animal. Also, water buffalo breeders need to be conscious about breeders organization. Firstly, Breeding Water Buffalo breeders' Association can be established in Iğdir province. In this way, buffalo milk production will increase and the buffalo breeding sector in the province will be developed. In order for the buffalo farms to be sustainable, there is a need to increase the competitiveness of product marketing. For this, the infrastructure of processing and packaging, storage and marketing of buffalo milk products should be strengthened in the province.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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