



## Problems of water buffalo breeding in Turkey and suggestions for its development

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**ABSTRACT** - The objective of the study was to present the current situation of water buffalo breeding in Turkey, determine the relevant problems, and propose suggestions for its improvement. The research data were collected at the “Focus Group Interviews” with the sector actors from the cities engaged in buffalo breeding between July and September of 2015. The cities included Afyonkarahisar, Bitlis, Diyarbakir, Istanbul, Muş, Samsun, and Tokat, where buffalo breeding was usually practiced by small-scale family enterprises that used traditional husbandry methods. The variables chosen as indicators of yield included milk yield, meat yield, and lactation period, which were found to be below global averages. The study revealed lack of adequate record-keeping of enterprises raising water buffalo. Buffalo breeders should take necessary steps to improve their strategies to increase buffalo milk yield, while government agencies should protect wetlands and prevent their unintended use, making relevant legal arrangements where necessary. Buffalo meat and milk should be promoted with an emphasis on their superior nutritional values. For the development of buffalo breeding in Turkey, necessary steps should be taken on both national and local levels.

Key Words: water buffalo, production, productivity, SWOT analysis

### Introduction

Although Turkey is a suitable country for animal husbandry due to its soil and climate characteristics, the present potential is not adequately exploited and the targeted success in animal production cannot be achieved. Animal production deficit is compensated through imports. These imports might include import of livestock or red meat, or sometimes both. The main reason for this is the lack of modern enterprises engaged in livestock production and the yield per unit animal is lower than in developed countries. Moreover, high marketing margins arising from the inadequacy of the marketing organization and its infrastructure at the level of such enterprises constitute a significant constraint in the development of animal production activities.

The value of agricultural production in Turkey was 248,925,000 TL (Turkish lira) in 2015 and the share of

animal production in agricultural production value was 51.73% (TUIK, 2017). The increase in the quantity and diversity of the support given to the animal husbandry in recent years has been accompanied by increases in both the number of animals and the amount of production. In fact, there was a 30.39% increase in the number of bovine animals, 295.39% increase in the red meat production obtained from bovine animals, and 191.48% in the milk production obtained from bovine animals between 2000 and 2016. The effects of support given to the livestock sector are seen both in the number of cattle, in red meat and milk production, and the increase is in a positive trend.

However, the rise in the number of bovine animals and animal production was not reflected in the number of water buffalo and buffalo products. The number of water buffalo was 146,000 in 2000, but this figure declined to 142,073 head in 2016 (2.69%), while the buffalo milk production decreased from 67,330 to 63,085 tons (6.31%) in the same period and buffalo meat production fell by 91.33%, from 4,047 to 351 tons (TUIK, 2017). Despite the state subsidies given to buffalo farming, there has been a decrease in buffalo population and production, which could be attributed to the fact that buffalo breeding largely rests on wetlands that are concentrated in certain regions, as well as to the low demand for buffalo meat and low milk yield.

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To improve buffalo breeding in Turkey, important state subsidies are granted as in other bovine animals, as well as sheep and goat breeding. In 2016, the government support for buffalo calves aged four months and older was designated as 350 TL per head and 500 TL per animal as a studbook support (RG, 2016).

The objective of the study was to determine the problems of water buffalo sector in Turkey and the areas needing improvement. To that end, a SWOT analysis was carried out through “Focus Group Interviews” with stakeholders directly or indirectly involved in buffalo breeding activities in Turkey, the problems of the sector were identified, and then, relevant recommendations were presented.

### Material and Methods

We designated seven cities (Afyonkarahisar, Bitlis, Diyarbakir, Istanbul, Muş, Samsun, and Tokat) where the primary data of the research were obtained based on the number of buffalo and the scale of buffalo milk production in that city. In this regard:

According to the data of 2015, the number of buffalo in Turkey was 133,766 heads. These seven cities contain 50.67% of this number (Afyonkarahisar, 3.87%; Bitlis, 5.68%; Diyarbakir, 8.60%; Istanbul, 8.61%; Muş, 4.55%; Samsun, 12.75%; and Tokat, 6.61%).

According to the data of 2015, the amount of buffalo milk production in Turkey was 63,085 tons. About 54.16% of this amount was produced in these seven cities (Afyonkarahisar, 3.76%; Bitlis, 6.38%; Diyarbakir, 9.75%; Istanbul, 9.84%; Muş, 4.51%; Samsun, 14.14%; and Tokat, 5.78%).

The cities determined within the scope of the research represent half of Turkey’s data in terms of the number of buffalo and the amount of buffalo milk production. At the same time, they are the main places in Turkey engaged in water buffalo breeding.

The research material consisted of the data collected at the “Focus Group Interviews” with the participation of sector actors (buffalo farmers, producer associations, agricultural engineers, food engineers, veterinaries, cooperatives, chamber of agriculture, and private sector representatives) from the cities intensely engaged in buffalo breeding.

Focus group interview is a general concept used for interviews conducted by the researcher with the participation of many people, instead of one individual, at the same time (Punch, 2005). It is also described as a series of discussions

aimed at obtaining perceptions on a previously determined subject (Yıldırım and Şimşek, 2011). The focus group interview is also defined as a qualitative method designed to learn about conscious, semi-conscious, or unconscious behaviours, as well as psychological and sociocultural characteristics of the groups and about the reasons behind such behaviour (Kroll et al., 2007). Focus group interviews are conducted in a social environment where participants can hear the views of other participants and reflect on their own views accordingly (Büyüköztürk et al., 2008; Çokluk et al., 2011). Detailed and multidimensional qualitative information on the individual’s own viewpoints, experiences, tendencies, thoughts, perceptions, emotions, attitudes, and habits about the subject is determined in the direction of the research purpose (Stewart and Shamdasani, 1990; Krueger, 1994).

Conducted with a small group of participants on a specific topic, focus group interviews are usually carried out with a group of six to ten people with a common history of experience (Patton, 2002). These interviews usually last for 1-2 h and the participants are sought to share a common history of the subject or issue. The researcher can obtain the desired information in these interviews by asking questions one by one and by letting the group members discuss the subject matter (İslamoğlu, 2009).

Water buffalo breeding is predominantly practiced in Asia and about 98% of the global water buffalo population is contained in Asia, followed by Africa, America, and Europe (Table 1). The global water buffalo population was 164,144,424 head in 2000 and this figure increased by 18.49%, reaching 194,463,729 in 2014 (FAOSTAT, 2017). In Turkey, on the other hand, the water buffalo population decreased from 146,000 head in 2000 to 122,141 in 2014, showing a 16.37% fall in 14 years. In the same period, the Turkish share in the global water buffalo population declined from 0.08 to 0.06%.

Water buffalo breeding is practiced for the production of meat, besides milk production. Major countries with high meat and milk productivity include Bulgaria, India, Iran, Malaysia, Egypt, and Pakistan. According to 2014

Table 1 - Number of buffalo in the world (head)

Continent	Number (2014)	Share (%)
Asia	188,792,665	97.08
Africa	3,949,287	2.04
America	1,326,495	0.68
European	395,037	0.20
Oceania	245	-
World	194,463,729	100.00

Source: FAOSTAT (2017).

statistics, the country with the highest meat yield per buffalo was Egypt with 330.7 kg, followed by Turkey with 241.6 kg, Bulgaria with 194.3 kg, and Malaysia with 181.4 kg. The world average in buffalo meat yield is 142.0 kg/head. In terms of milk yield per buffalo, Pakistan (1934.5 kg/head) ranks the first place, followed by India (1880.7 kg/head), Egypt (1652.0 kg/head), Iran (1511.1 kg/head), Malaysia (1457.4 kg/head), and Bulgaria (1440.9 kg/head). The world average in milk yield per buffalo is 1722.7 kg/head (Table 2).

Turkey's production of water buffalo meat is above the world average, while its milk production still remains below the global average. The average meat production per buffalo increased from 138.3 kg in 2000 to 142.0 kg in 2014, showing a 2.67% growth. In the same period, meat yield per buffalo in Turkey increased by 40.38%, from 172.1 to 241.6 kg. The milk yield in Turkey is 998.4 kg/head, which is below the world average. Although there was an increase by 20.86% in the world average in milk yield per buffalo in

the period between 2004 and 2014, this increase remained as low as 3.20% in Turkey (FAOSTAT, 2017).

In water buffalo breeding, Turkey is above the world average in meat yield (kg/head) and although it ranks second in the world, its milk yield per animal remains below the world average, placing the country among those with the lowest productivity. This indicates that milk production and milk productivity in water buffalo breeding in Turkey has not developed at the desired level.

Water buffalo breeding in Turkey is mainly concentrated in Bitlis and Muş, in the Eastern Anatolia; Afyonkarahisar, in the Aegean region; Diyarbakir, in the Southeastern Anatolia; Kayseri and Sivas, in the Central Anatolia; Çorum, Samsun, and Tokat, in the Black Sea region; and Istanbul, in the Marmara region.

While Turkey's water buffalo population was 146,000 head in 2000, it saw a decrease by 2.69% and dropped to 142,073 head in 2016 (Table 3). In the same period, the buffalo population shrank in some cities, such as Samsun and Tokat, whereas other cities such as Bitlis, Diyarbakır, and Istanbul saw substantial increases.

Water buffalo husbandry in Turkey is generally performed for milk production. The annual buffalo milk production was 67,330 tons in 2000, but this figure showed a significant decrease (6.31%) in 2016, dropping to 63,085 tons (Table 4). In Turkey, total milk production, which was 8,408,568 tons in 2001, increased by 2.2 times, reaching 18,489,161 tons in 2016. In the same period, there was no change in the amount of buffalo milk production; therefore,

Table 2 - World buffalo productivity indicators (2014)

Important country	Meat (kg per head)	Milk (kg per head)
Bulgaria	194.3	1440.9
India	139.2	1880.7
Iranian	166.3	1511.1
Malaysia	181.4	1457.4
Egypt	330.7	1652.0
Pakistan	117.9	1934.5
Turkey	241.6	998.4
World	142.0	1722.7

Source: FAOSTAT (2017).

Table 3 - Number of buffalo in Turkey per year (head)

Year	Province								Total
	Afyon	Bitlis	Diyarbakır	İstanbul	Muş	Samsun	Tokat	Others	
2000	4,960	3,590	3,480	8,160	6,970	19,670	15,770	83,400	146,000
2001	4,890	3,590	3,420	7,920	6,690	18,290	14,660	78,540	138,000
2002	4,190	3,659	3,502	7,976	5,635	17,045	10,880	68,190	121,077
2003	3,953	3,268	4,047	7,088	5,228	18,185	9,197	62,390	113,356
2004	2,991	4,403	3,670	5,728	5,668	14,903	9,454	76,583	109,900
2005	2,608	5,518	3,727	4,351	5,292	13,467	8,176	61,826	104,965
2006	2,776	6,098	3,401	4,364	6,025	12,262	7,997	58,093	100,516
2007	2,378	4,764	2,562	4,466	6,101	8,581	6,994	48,809	84,705
2008	2,519	3,115	2,601	7,027	6,456	8,515	7,044	49,020	86,297
2009	2,558	3,301	3,750	8,883	3,657	10,769	6,488	47,801	87,207
2010	2,165	4,870	5,853	9,475	4,703	11,380	6,731	39,549	84,726
2011	5,258	6,037	7,824	9,497	4,595	13,152	6,830	44,039	97,632
2012	5,085	5,599	8,905	10,513	5,879	14,041	7,809	49,604	107,435
2013	5,476	5,998	9,950	10,982	6,382	14,324	8,125	61,284	117,591
2014	4,957	5,705	10,932	10,284	6,098	16,483	8,473	59,182	122,114
2015	5,183	7,594	11,510	11,518	6,087	17,043	8,839	65,992	133,766
2016	5,598	8,338	13,165	11,100	7,435	17,944	9,094	69,399	142,073
% (*)	112.86	232.25	378.30	318.96	106.67	91.22	57.66	-	97.31
% (**)	3.87	5.68	8.60	8.61	4.55	12.75	6.61	49.33	100.00

Source: TUIK (2017).

(\*): 2016 year (2000 = 100).

(\*\*): Share of Turkey in 2015.

it remained at the same level. In 2001, the share of buffalo milk production in total milk production of Turkey was 0.75%, but this ratio decreased to 0.34% in 2016.

In Turkey, while total water buffalo meat production saw a decline and meat productivity (kg/head) improved, no significant change occurred in buffalo milk production and productivity. During the period between 2000 and 2016, the buffalo slaughter rates fell by 93.63% and meat production declined by 91.33%, while meat productivity

per buffalo saw a strong growth that accounted for a 36.07% increase (Table 5).

In Turkey, the total meat production was 435,778 tons in 2001 and increased about 2.69 times, reaching 1,173,042 tons in 2016. During the same period, buffalo meat production decreased from 2,295 to 351 tons, which accounted for an 84.71% fall. In 2001, while the share of buffalo meat production in Turkey's total meat production was 0.52%, this ratio decreased to 0.03% in 2016.

Table 4 - Buffalo milk production per year in Turkey (tons)

Year	Province								Total
	Afyon	Bitlis	Diyarbakır	İstanbul	Muş	Samsun	Tokat	Other	
2000	3,430	1,513	1,144	7,162	4,024	8,288	7,224	34,545	67,330
2001	3,458	1,525	1,102	6,688	3,658	7,966	6,767	32,163	63,327
2002	2,964	1,475	992	6,978	2,874	6,523	4,197	24,922	50,925
2003	1,438	1,319	1,613	3,813	3,149	7,694	4,314	25,438	48,778
2004	1,670	1,288	1,251	3,129	2,960	4,170	3,941	20,870	39,279
2005	877	1,670	1,260	2,573	2,655	3,907	3,445	21,671	38,058
2006	805	1,602	1,279	2,526	3,149	3,847	2,855	20,295	36,358
2007	811	1,519	1,003	2,593	3,117	2,229	2,518	16,585	30,375
2008	1,014	1,069	755	3,387	3,323	3,125	2,122	16,627	31,422
2009	861	1,109	1,651	3,915	1,789	3,863	2,053	17,202	32,443
2010	1,224	1,242	2,958	4,302	2,446	5,264	2,251	15,800	35,487
2011	2,088	1,439	4,016	4,552	2,353	5,580	2,370	17,974	40,372
2012	2,346	1,416	4,562	5,362	3,221	6,309	2,698	21,075	46,989
2013	2,605	1,464	5,127	5,733	3,437	6,735	2,858	23,988	51,947
2014	2,263	1,752	6,099	5,339	2,841	8,147	3,050	25,312	54,803
2015	2,359	4,007	6,121	6,179	2,834	8,873	3,619	28,769	62,761
2016	2,607	4,172	6,619	5,823	3,035	8,782	3,060	28,987	63,085
% (*)	76.00	275.74	578.58	81.30	75.42	105.96	42.35	-	93.69
% (**)	3.76	6.38	9.75	9.84	4.51	14.14	5.78	45.84	100.00

Source: TUIK (2017).

(\*): 2016 year (2000 = 100).

(\*\*): Share of Turkey in 2015.

Table 5 - Productivity indicators with buffalo meat and milk production in Turkey

Year	Meat			Milk		
	Number of animals slaughtered (head)	Meat production (ton)	Yields (kg per head)	Number of animals milked (head)	Milk production (ton)	Yields (kg per head)
2000	23,518	4,047	172.08	69,602	67,330	967.35
2001	12,514	2,295	183.39	65,356	63,327	968.95
2002	10,110	1,630	161.22	51,626	50,925	986.42
2003	9,521	1,709	179.49	57,378	48,778	850.11
2004	9,858	1,950	197.80	39,362	39,279	997.89
2005	8,920	1,577	176.79	38,205	38,058	996.15
2006	9,658	1,774	183.68	36,553	36,358	994.66
2007	9,532	1,988	208.56	30,460	30,375	997.20
2008	7,251	1,334	183.97	31,440	31,422	999.42
2009	4,857	1,005	206.91	32,361	32,443	1,002.53
2010	15,720	3,387	215.45	35,362	35,487	1,000.53
2011	7,255	1,615	222.60	40,218	40,372	1,003.82
2012	7,426	1,736	233.77	46,959	46,989	1,000.63
2013	2,403	336	139.82	51,940	51,947	1,000.13
2014	2,176	526	241.72	54,891	54,803	998.39
2015	1,391	326	234.36	62,999	62,761	996.22
2016	1,499	351	234.15	63,329	63,085	996.14
Index (*)	6.37	8.67	136.07	90.98	93.69	102.97

Source: TUIK (2017).

(\*): 2016 year (2000 = 100).

## Results

The SWOT analysis and interpretation of the data from focus group interviews yielded similar results obtained from the individual interviews (Table 6). After the focus group interviews, the researcher transferred the voice recordings from the interviews to the computer and completed the analysis in a text document. A common template for focus group interviews is presented below:

Regarding the focus group interview, first, the research team and the participants introduced themselves and, then, the participants were told about the scope and objectives of the research. After this phase, the focus group interview was initiated and continued within the context of the following questions:

What is the status/structure of water buffalo breeding in your region?

How do you perceive water buffalo breeding?

What are the most important problems in water buffalo farming in your region?

What should be done to improve buffalo breeding in the region?

Are there any other considerations you would like to add?

Regarding the status/structure of water buffalo breeding in Bitlis, Eastern Anatolia region, the participants reported that: breeding activities were conducted in the old barn system relying on the existing wetlands; the buffalo milk productivity was low; producers were unconscious and uneducated; and there were people who bred water buffalo just to receive some state subsidy.

Among the most important problems in water buffalo breeding in the region, there were: unconscious production, inadequate utilisation of buffalo products (meat, milk, and calf), lack of knowledge among producers, lack of feed, problems in government support, and inadequate advertising and publicity.

Table 6 - SWOT analysis of Water Buffalo

Strength	Weakness	Opportunity	Threat
Proper utilisation of pasture grounds	Need for pasture ground	Regions engaged in water buffalo breeding have suitable climate and wetlands	Shrinking of wetlands
Resistance of animals to diseases	Inadequate pasture ground	Increase in demand for buffalo milk	Converting pasture lands into agricultural areas and zoning for urban settlement
Long lifespan of animal	Small-scale enterprises	Diversification and branding of buffalo milk products	High feed and input prices
All types of feed can be utilised	Practicing buffalo breeding through classical methods	Advertising and promotional activities to inform the public about high nutritional value of water buffalo meat and milk	Low and gradually decreasing number of breeders
High rate of feed utilisation	Low milk yield	Encouraging and supporting young farmers	Lack of interest of the younger generation in water buffalo farming
High nutritional value of buffalo milk	Difficulty with milking	Continuation of the Anatolian Water Buffalo project	Inadequate workforce
High meat productivity	Consumers do not prefer buffalo meat and demand is inadequate	Increase in grants and subsidies	Urbanization (airport construction, Metropolitan Act)
High nutritional value of buffalo	Inadequate milk collection and processing facilities	Establishment of modern enterprises and growth of business scale	Lack of knowledge about buffalo products among breeders
Less labour demand	Challenges in marketing buffalo milk and meat	Establishment of buffalo breeder union	Low number of firms to market buffalo products
The production costs in buffalo breeding are low compared with other animal husbandry (dairy cows, etc.)	Inadequate technical knowledge among breeders	Improvement studies to increase milk yield	High input prices
Subsidies for water buffalo breeding	Inadequacy of producer organization	Emphasis on rural development studies and encouraging on-site employment	Lack of qualified staff
	Existing breeder associations/unions are not effective and influential	Development of contracted production	Lack of efforts towards improving buffalo breeding practices
	Lack of operating capital		
	Lack of data on buffalo enterprises		
	Inadequacy of agricultural publishing activities		

For the development of water buffalo farming in the region, the participants suggested that: loan procedures should be streamlined and low-interest loans should be allocated to those actually engaged in breeding activities; the state support was important and should continue; high-yielding races should be bred or imported; facilities devoted to water buffalo products like dairies and meat processing factories should be set up; and better control mechanism should be established.

In Muş, Eastern Anatolia region, the participants commonly reported that: breeding was usually carried out by small-scale enterprises; it was based on wetland breeding system; there were no young producers; farmers preferred not to breed water buffalo as it is wilder than other bovine animals (difficulty in milking); and enterprises usually had two or three buffalo only.

The most significant problems of buffalo breeding in the region were: water shortages, difficulties in marketing buffalo products, inability to utilise young calves, and lack of young producers.

For the development of water buffalo farming in the region, the participants stated that the current state could be improved by: increasing milk yield, protection of wetlands, setting up processing facilities, raising awareness among producers, increasing and streamlining state subsidies, increasing the scale of the farms, and allocating sales spots in district markets for buffalo producers.

In Afyonkarahisar, Aegean region, the participants commonly reported that: breeding was usually carried out by small-scale family enterprises; buffalo breeding was becoming widespread day by day due to support and loan opportunities; establishment of a water buffalo producer association had a positive impact; cream from water buffalo milk was utilised in the region; and they made sausage from buffalo meat.

As for the most crucial problems in water buffalo breeding in the region, the participants reported that: breeding activities in Afyonkarahisar would be endangered due to the Metropolitan Act; wetlands had been destroyed; products obtained from buffalo were undervalued; there were no modern breeding systems; and urbanization was picking up pace.

For the development of buffalo farming in the region, the group members suggested that: buffalo breeding needed to spread to rural areas rather than to central villages; the types of subsidies had to be increased; areas such as meadows and wetlands should be protected; measures should be taken to minimize the adverse effects of the Metropolitan Act; large-scale buffalo slaughtering facilities must be established; membership to the union should be

promoted; the relevant union should be authorized to implement any type of project on behalf of the farmer; new brands should be created and promoted; the Water Buffalo Breeding Project should continue; the number of brood animals should be increased; government support should be provided for farmers to facilitate the transition to modern breeding systems; and state subsidy should be granted for small businesses to set up milking units and cold-air tanks.

Regarding the state/structure of water buffalo breeding in Diyarbakır, Southeast Anatolia region, the participants reported that breeding enterprises were small-scale businesses with buffalo breeding remaining as secondary importance. They stated that buffalo breeding tended to increase in the region, which was primarily driven by the Anatolian Water Buffalo project and state subsidies.

Among the most prominent issues associated with water buffalo breeding in the region are: lack of information among producers, market constrains, conversion of pasture lands into agricultural areas, quarrels between producers about pastures, and lack of interest in buffalo milk and meat.

For the improvement of buffalo breeding in the region, the participants recommended that: utilisation of buffalo products should be varied (such as ice-cream from buffalo milk); awareness should be raised among producers; investments should be made in modern production and processing facilities; the union should be more effective; breeding efforts should be continued; buffalo products should be better promoted; and state subsidies should continue and payments should be made in two instalments.

Regarding the state/structure of water buffalo breeding in the District of Terme, Samsun - Black Sea region, the participants reported that: an old system of farming was maintained in wetlands and swamps; enterprises were small family businesses; products were mostly sold in the form of individual sales; buffalo farming was given secondary importance (main products are rice and hazelnut); and breeding was primarily based on pasture farming (the animals remained in the wetlands from April until November, so the animals were not given concentrate feed and the pasture feeding was sufficient).

The most significant problems of buffalo breeding in the region were: reduction of pasture grounds, inability to recognize the gestation in female buffalo, low yield of buffalo meat (maximum carcass weight 200 kg), shrinking of pasture lands, high mortality rate of calves, physical reduction in size among the buffalo breeds in the region, high input costs, and low productivity (2-3 kg milk per milking, 4-6 kg per day).

For the development of buffalo farming in the region, the participants suggested that: new brands of buffalo products should be created and promoted; larger buffalo breeds should be introduced; advertising and promotion should be increased; government support should be granted to the real producers; and support should be allocated to entrepreneurs, rather than the existing farmers.

In the District of Bafra, Samsun - Black Sea region, the participants reported that: breeding activities were mainly pasture-based farming; there were only small-scale family enterprises; and breeding was predominantly carried out in old-fashioned systems.

The most important problems in buffalo farming in the region were: poisoning of animals due to paddy irrigation seeping into streams or river waters (chemicals in the irrigation of paddy fields), lack of pasture ground, lack of market, incidents related to buffalo entering paddy fields, emigration of young population to urban areas, and low milk yield (3-4 kg per day on average).

For the development of water buffalo farming in the region, participants reported that: input costs should be lowered; different approaches such as opening dairies dedicated to water buffalo products should be developed; state support was very important and is essential for the continuation of the breeding; state subsidies should be granted to real producers; proper education should be provided to the farmers; and the new Metropolitan Act should be streamlined in favour of the breeders.

In Tokat, Black Sea region, the interviewed participants reported that: water buffalo breeding was mainly practiced by small-scale family enterprises; pasture-based breeding system was common; old-fashioned barn system was used; there was an increase in the number of breeders due to the project; breeding was easy; and the production was mainly done for those favouring buffalo products.

The most important problems of buffalo farming in the region were: lack of buffalo bulls, the lack of interest of the younger population in continuing the business, shrinking wetlands, difficulty in marketing male water buffalo, lack of available shepherds quick darkening of buffalo meat, and prejudice about buffalo products (a misconception that women eating yogurt made from buffalo milk will get pregnant at older ages because the female buffalo give birth at a relatively older age than cattle).

To improve buffalo farming in the region, the participants suggested that: state subsidies should continue and increase; regional development initiatives should be launched; support cuts should be reduced; and transition to an effective publication system should be encouraged.

Regarding the status/structure of water buffalo breeding in the District of Arnavutköy, Istanbul - Marmara Region, the participants reported that: the enterprises were large-scale businesses (usually containing more than 20 head of buffalo); a combination of pasture feeding and hand feeding (usually straw, silage, sunflower seeds, wheat-barley crumbs) was utilised; and it was a good business as the region was close to the markets.

The most important problems of buffalo farming in the region were: lack of labour, inability to build new facilities due to the conservation status of the area (drinking water of Istanbul is supplied from Terkos Lake), difficulties in the sale of milk (no contracts were offered), lack of adequate pasture land due to the construction of a new airport, urbanization, and inability to continue and develop animal husbandry due to the world's largest airport construction and operation.

For the development of water buffalo farming in the region, the priorities were reported to be: advertising and publicity and governmental support in social security premiums of the workers employed.

Regarding the status/structure of water buffalo breeding in the District of Çatalca, Istanbul - Marmara region, the participants reported that: the enterprises were large-scale businesses; a combination of pasture feeding and hand feeding was utilised; and water buffalo breeding became an important line of business due to the proximity of the region to the markets.

The most important problems of buffalo farming in the region were: milk market problem (inability to sell milk from the neighbourhood) and difficulty of finding labour in buffalo farming.

For the development of water buffalo farming in the region, the participants suggested that: the products should be included in the ice-cream sector; milk sales should be increased; supply and demand should be balanced; government should pay the social insurance premiums of employed workers; efforts should be made to improve artificial insemination; animal insurances should be streamlined; people should be educated for a conscious and honest business conduct; and pasture grounds should be improved.

## Discussion

Buffalo breeding is mainly carried out in Asia, with about 98% of the world buffalo population contained in this continent. The countries with high buffalo meat and milk productivity include Bulgaria, India, Iran, Malaysia,

Egypt, and Pakistan. While the number of buffalo across the globe increased by 18.49% between 2000 and 2014, Turkey saw a huge decline (16.37%) in its buffalo population in the same period. Meat production per buffalo was above the world average in 2014. In the same year, the milk yield per head in Turkey (998.4 kg) was below the world average (1722.7 kg per head). The main reason for this low milk yield can be attributed to the low milk productivity of the buffalo breeds existing in the country and traditional methods of pasture-based aquaculture.

The research was carried out in seven cities of Turkey (Afyonkarahisar, Bitlis, Diyarbakır, İstanbul, Muş, Samsun, and Tokat), which collectively contained 50.67% of the buffalo population in Turkey in 2015. Buffalo farms were usually small-scale family enterprises that had one or two heads of buffalo (Soysal, 2014). Işık and Gül (2016) found that 64% of the farmers in the city of Muş had fewer than 11 buffalo. In Turkey, buffalo breeding was in no position to compete with cattle milk and meat production per head. For this reason, to improve the buffalo production and to increase the yield per buffalo, the Turkish government decided to subsidize buffalo farming within the scope of state subsidies allocated to the animal husbandry sector. In 2016, the buffalo breeders received 350 TL for each young buffalo calf they had and 500 TL for each adult buffalo in support of pedigree breeding (RG, 2016).

In general, the share of feeding costs accounts for about 70% of animal production costs. Since buffalo breeding generally relies on pasture feeding, the share of feeding costs tends to be much lower than 70%. Günlü et al. (2010) calculated the share of feeding costs in buffalo breeding as 42.84%, while Çiçek et al. (2009) found an even lower rate of 27.26%, and Işık and Gül (2016) determined it as 36.81%. The low feeding costs and low labour costs in buffalo breeding can be explained by the fact that most farmers are engaged in buffalo husbandry to meet their basic daily needs such as milk and meat. Despite regional differences, the rate of market-focused production among breeders still remained rather low.

Thanks to their proximity to the market and higher demand for the buffalo milk, producers in İstanbul and Afyonkarahisar were engaged in buffalo breeding mostly for milk production, while those in other regions were keeping buffalo for meat production. In İstanbul, the demand for buffalo milk increased significantly and, in Afyonkarahisar, the use of buffalo milk creams in various foods as an additive was on a growing trend, which enabled the development of buffalo breeding in these cities. Salari et al. (2013) reported that the increase in demand for mozzarella cheese

led to the development of buffalo farming and increased milk production. Therefore, promotion efforts for buffalo products should focus on informing the public about their valuable nutritional benefits. In that way, the scale of buffalo farming in Turkey could be enhanced, which would increase the amount of buffalo milk production.

The “Anatolian Water Buffalo Project”, initiated in 2011 by the Ministry of Food, Agriculture and Livestock in eight pilot cities, proved successful in promoting buffalo husbandry in Turkey, so the testing ground for the project was extended to cover even more cities. The majority of buffalo breeders stated that this project was of vital importance for the future development of buffalo breeding across the country. For this reason, the project should be continued and its scope should be further expanded into new regions.

At the level of farmers, steps towards the improvement of the sector should include: increase in the number of modern farms with larger scales, raising awareness among farmers of the importance of organized activity, encouraging better record-keeping to enable more effective database and monitoring in buffalo farming.

At the national level, it is necessary to increase the state subsidies allocated to the buffalo-breeding sector with efficient monitoring and evaluation and ensure the protection and better management of wetlands and pasture lands.

To increase the demand for buffalo products, the sector actors should collaborate and deploy resources to raise awareness of the nutritional value of buffalo milk and meat among consumers.

Based on our findings, the problems and suggestions for the sector can be summarized as follows:

Enterprises are made up of small-scale units, which increases production costs.

Water buffalo breeding is practiced by using traditional methods and the number of modern enterprises is close to zero.

Wetlands are shrinking in size – they have been transformed into fields for other agricultural production activities or zoned for construction.

The young generation lacks interest in water buffalo husbandry, so the number of breeders is decreasing.

The costs of agricultural inputs (feed, etc.) are high.

Milk yield per buffalo is rather low; no efforts have been made to increase the milk yield.

Farmers have difficulties in the marketing of buffalo meat and milk.

Milk collection and processing facilities are insufficient.



The nutritional value of buffalo milk and meat is not well known by consumers due to lack of publicity.

The enterprises suffer from insufficient operating capital.

There is an unmet demand for qualified staff.

Existing breeder associations/unions are not working efficiently and effectively and the breeders lack awareness about the need for organization.

There is no registration system and, thus, no reliable data can be collected.

The breeders lack access to research and publications, so they do not have adequate information about the practice.

The level of current state subsidies for animal husbandry is not adequate.

The suggestions for the sector involved efforts towards the improvement of breeding practices should be intensified and water buffalo breeds that are known to produce high milk yield should be raised.

Wetlands should be protected; their conversion into other agricultural areas or zoning for development should be prevented.

The incentive system should be improved for the establishment of modern enterprises and region-specific incentives should be granted.

The Anatolian Water Buffalo project should be developed and continued.

Promotion activities should focus on informing the public about the nutritional value of buffalo meat and milk, ensuring the continuity of such activities.

A database dedicated to water buffalo breeding should be created to collect and store reliable data.

A monitoring and assessment unit should be formed to ensure better practice of water buffalo breeding.

## Conclusions

Water buffalo breeding is usually practiced in regions where climate is favourable and wetlands are abundant because of the high animal feed utilization capacity, low labour demand, and low production costs. While the global water buffalo population is growing rapidly, it is following a declining trend in Turkey, which makes it necessary to concentrate on the structural and efficiency-related problems that constitute a constraint on the development of buffalo breeding across the country.

In recent years, there has been a significant decrease in the number of buffalo in Turkey, the sharpest fall in the world – between 2000 and 2016, the buffalo population shrank by 2.69%, meat production by 91.33%, and milk

production 6.31%. Breeding concentrated in small-scale family enterprises prevents farmers from creating economies of scale, thus not allowing them to minimize their production costs. On the consumers' side, there is rather limited demand for buffalo products (meat and milk); therefore, producers face serious problems in marketing their products. To overcome such issues, we suggest that the sector should focus on establishment of large-scale modern enterprises, creating demand for buffalo milk, diversification and branding of buffalo milk products, advertising and promotional activities to inform the public about high nutritional value of water buffalo meat and milk with special emphasis on certain buffalo products like the Italian Mozzarella cheese, development of contracted production, and encouraging and supporting young farmers.

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