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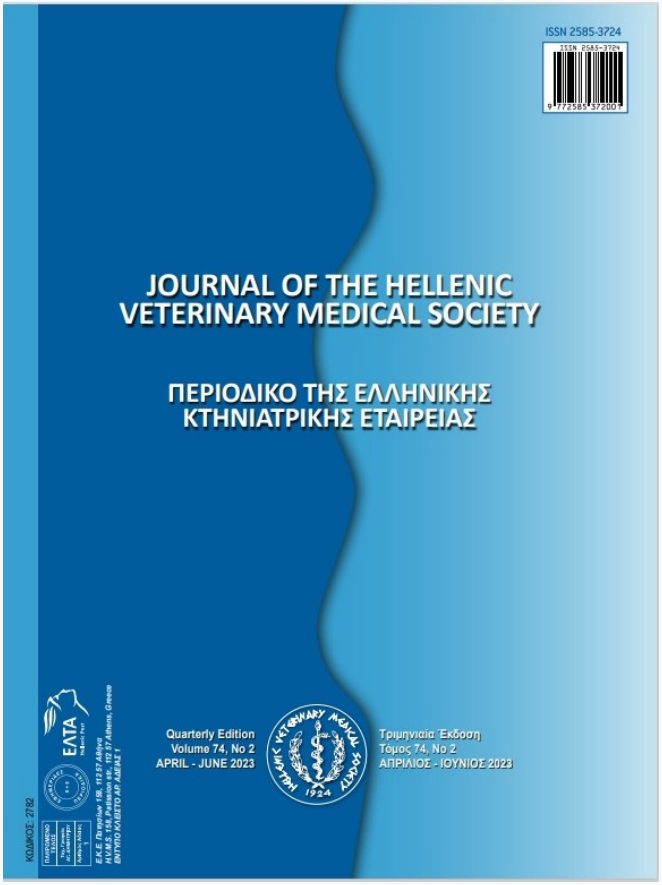

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Examining the Structural and Technical Characteristics of the Water Buffalo Farms in Sivas Province from the Perspective of Animal Welfare

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ABSTRACT: In Turkey, water buffalo husbandry is conducted generally by using the traditional methods in shelters designed for cattle. The present study reports the data of the items of a questionnaire, which was conducted with 122 water buffalo breeders which are located in Central, Şarkışla, and Suşehri districts of Sivas province, regarding the structural and technical aspects of shelters such as shelter location, shelter type, building material, ventilation, and lighting. It was determined that, among the water buffalo breeders in Sivas province, the shelters were generally (73.5%) located nearby the house, that the building materials used in construction of the shelters were stone in 55.4%, concrete in 21.5% and briquette in 16.5% ($p<0.0001$), and that the floor materials used were concrete in 99.2% ($p<0.05$), whereas the roofing material was sheet metal/eternit in 80% ($p<0.0001$). It was found that water buffalos and cattle were held together in closed tethered systems (95.8%) and the space needs of animals were met by using chains of 40-60cm in length (63.1%). In conclusion, considering the animal welfare and behaviors, it was concluded that the infrastructural improvements to ensure the standardization in water buffalo shelters should be prioritized, that the old shelters should be re-organized, and that the watering systems in shelters should be analyzed.

***Keywords*:** Sivas, Water Buffalo, Shelter, Animal Welfare

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INTRODUCTION

Since it is a cultural inheritance and offers advantages, water buffalo breeding is a field of animal husbandry that farmers in rural areas cannot recede (Soysal, 2014; Özdemir and Özdemir, 2016). Due to its adaptability to different production systems easily and its potential to be linked with sustainable farming and ecological animal husbandry, the water buffalo breeding becomes increasingly popular in many countries throughout the world (Sarıözkan, 2011; Atasever and Erdem, 2008; Yilmaz et al., 2012; Naveena and Kiran, 2014; Gültepe et al., 2019). Although extensive systems are generally used in the countries such as India (55%), Pakistan (17%), and China (13%), in which water buffalo husbandry is conducted most commonly in the world, intensive systems are applied in European countries such as Italy (Sarıözkan, 2011; Araújo et al., 2012; Founta et al., 2018; Gültepe et al., 2019; Yáñez-Pizaña et al., 2020; Fouda et al., 2021). In Turkey, however, water buffalo breeding is carried out by middle- and small-size family businesses using traditional methods and in shelters, which are generally designed for cattle, under forage-based extensive conditions (Atasever and Erdem, 2008; Borghese, 2010; Soysal, 2014; Degirmencioglu et al., 2015; Kocaman et al., 2015; Degirmencioglu et al., 2016). Increasing the productivity of animals raised in these environments is possible only by improving the sheltering conditions and genetic structure of the herd by focusing on animal welfare (Tripaldi et al., 2004; Napolitano et al., 2005; De Rosa et al. 2015; Kocaman and Kurç, 2020). Since animal welfare is a multidimensional concept, improving shelter conditions is associated with various parameters (De Rosa et al. 2015; Sabuncuoglu et al., 2020). From this aspect, the "five freedoms" recommended by the Council of Farm Animal Welfare (1993) are a good starting point (Tripaldi et al. 2004). In order to improve the welfare in environments where the animals are raised, they should not be left hungry and dehydrated, suitable shelter and environmental conditions should be provided, they should be protected from injury, impact, and diseases, they should be allowed to exhibit their normal behaviors, and they should be protected from stressful and fearful conditions (Farm Animal Welfare Council, 2009). The welfare of farm animals draws increasing attention and raises concerns among both breeders and consumers because of the factors such as public health, product safety, and health problems (Farm Animal Welfare Council, 2009; De Rosa et al. 2015; Sabuncuoglu et al., 2020). There are many studies reporting the effect of the main welfare criteria regarding the shelter conditions such as feeding, housing, health status, and behavior (Tripaldi et al., 2004; Ahmed et al., 2020; Kocaman et al., 2015; De Rosa et al. 2015; Gu et al., 2016; Kaplan et al. 2018; Gültepe et el., 2019).

Sivas province, which has suitable conditions for animal husbandry, ranks 10th in terms of water buffalo assets in Turkey. The number of water buffalos in Sivas province increased to 6036 in 2018 (Anonymous, 2018). With many natural lakes, the other rivers feeding Kızılırmak, and the barrages and dams constructed on these resources, Sivas province has a structure that is very suitable for water buffalo husbandry (Anonymous, 2018). The present study aimed at determining the structural and technical aspects of water buffalo husbandry in Sivas province and examining the businesses' feeding-husbandry practices and raising systems in terms of welfare criteria.

MATERIALS AND METHODS

Data of the present study were obtained from a questionnaire conducted with water buffalo breeders. By using the stratified sampling method, the participants were selected among 177 water buffalo husbandry farms operating in villages in Central, Şarkışla, and Suşehri districts, and the information about breeders was obtained from the Sivas Water Buffalo Breeders Association and the Provincial Directorate of Agriculture and Forestry (Özdamar, 2013). The number of participants was calculated to be 122 in total (68 in Central district, 15 in Şarkışla district, and 39 in Suşehri district) in a total of 20 villages (Table 1). The questionnaire items were prepared by making

Table 1. Distribution according to their place of residence of the participants

Districts	Number of total village	Number of visited villages	Number of total breeders	Number of participants
Central	15	10	100	68
Şarkışla	6	3	21	15
Suşehri	10	7	56	39
Total	31	20	177	122

use of previous studies (Özdemir and Özdemir, 2016; Özdemir and Özdemir, 2018). The general properties of the water buffalo husbandry farms which belong to participants were traditional type and similar: The measurements (LxW) of smallest shelter was 8x8m and the largest shelter was 20x8m. Stocking density was minimum 8 and maximum 36 animals.

An in person interview was conducted based on a questionnaire between September 2019 and January 2020. Data was obtained from 36 questions of the questionnaire, which was directed to the participants, covering topics such as shelter location, shelter type, building material, ventilation, and lighting system.

The data obtained were analyzed using SPSS 17.0 package program. (Statistical Package for the Social Sciences, 2008)The significance of the relationship between items by the districts was analyzed using the Chi-Square (χ^2) independency test. By making use of the analyses of crosstabs, the results were presented using descriptive statistics, and frequencies, as well as p, and Pearson Chi Square (χ^2_p) values of variables (Özdamar, 2013).

RESULTS

The shelter type and structural characteristics of farms are presented in Table 2. It was found that, in water buffalo husbandry farms in Sivas province, the animal shelters were located generally (73.5%) near-by the houses, that the building materials used in the construction of shelters were stone at 50.4%, concrete at 21.5%, and briquette at 16.5% ($p<0.0001$), that floor material was concrete at 99.2% ($p<0.05$), and that roof cover material was sheet metal/eternit at 80% ($p<0.0001$).

As indicated in Table 3 presenting the data about ventilation and lighting, natural ventilation methods are used in farms. Moreover, 62.3% of shelters have 1-3 air shafts, whereas 13.1% have none. The number of windows was 1-3 in 43.4% of shelters, and artificial lighting was found to be used in 95.6% of the shelters owned by participants.

The structural characteristics of the shelters are presented in Table 4. It was determined that, water buffalo breeders (97.5%) tether their animals in closed tethered systems and the length of the chain used was 40-60cm in 63.1% and longer than 60 cm in 36.1%

Table 2. Shelter type and structural features of the farms

Questions	Parameters	Central		Şarkışla		Suşehri		Sivas Total		χ^2 / P
		n	%	n	%	n	%	n	%	
The location of the shelter	Under the house	9	14.3	-	-	7	17.9	16	13.7	7.702^{NS}
	Near the house	45	71.4	14	93.3	27	69.2	86	73.5	
	In the village land	4	6.3	-	-	-	-	4	3.4	
	Opposite the house	5	7.9	1	6.7	5	12.8	11	9.4	
The building material of the shelter	Rock	40	59.7	5	33.3	16	41	61	50.4	31.89***
	Adobe	3^{ab}	4.5	2^{b}	13.3	-	-	5	4.1	
	Briquette	12^{ab}	17.9	5^{b}	33.3	3^{a}	7.7	20	16.5	
	Concrete	11	16.4	3	20	12	30.8	26	21.5	
	Brick	-	-	-	-	8	20.5	8	6.6	
	Sheet metal	1	1.5	-	-	-	-	1	0.8	
Shelter floor	Concrete	68^{a}	100	14^{b}	93.3	39^{ab}	100	12	99.2	7.192*
	Soil	-	-	1	6.7	-	-	1	0.8	
Roof of the shelter	Wood	1	1.5	-	-	-	-	1	0.8	51.82***
	Tile	-	-	3	20	-	-	3	2.5	
	Nylon	1	1.5	-	-	-	-	1	0.8	
	Soil	1	1.5	1	6.7	-	-	2	1.7	
	Tin sheet	1	1.5	-	-	-	-	1	0.8	
	Sheet metal/Eternit	61^{a}	92.4	8^{b}	53.3	27^{b}	69.2	96	80	
	House	-	-	-	-	6	15.4	6	5	
	Concrete	-	-	-	-	1	2.6	1	0.8	
	Heat insulation (wood/glass wool) sheet metal	1^{a}	1.5	3^{b}	20	5^{b}	12.8	9	7.5	

*n: Frequency, %: Percent, χ^2: Chi Square, P: Significance Level, NS: Not significant, p>0.05, *: p<0.05, ***:p<0.0001.*
a,b: Within a row, different superscript letters indicate statistically significant differences between compared frequencies.

Table 3. Shelter ventilation and lighting features of the farms

Questions	Parameters	Central		Şarkışla		Suşehri		Sivas Total		χ^2 / P
		n	%	n	%	n	%	n	%	
Number of ventilation air shafts in shelters	None	9	13.2	-	-	7	17.9	16	13.1	14.369^{NS}
	1-3	46	67.6	7	46.7	23	59	76	62.3	
	4-6	9	13.2	7	46.7	8	20.5	24	19.7	
	7-10	3	4.4	-	-	-	-	3	2.5	
	Roof length	1	1.5	1	2.6	1	2.6	3	2.5	
Number of windows in shelters	None	2	2.9	-	-	-	-	2	1.6	6.528^{NS}
	1-3	29	42.6	5	33.3	19	48.7	53	43.4	
	4-6	29	42.6	5	33.3	15	38.5	49	40.2	
	7-10	8	11.8	5	33.3	5	12.8	18	14.8	
Artificial lighting in the shelter	Yes	63	92.6	15	100	38	100	116	95.6	4.065^{NS}
	No	1	1.5	-	-	-	-	1	0.8	
	Occasionally	4	5.9	-	-	-	-	4	3.3	

n: Frequency, %: Percent, χ^2: Chi Square, P: Significance Level, NS: Not significant, p>0.05.

Table 4. Structural features of shelters

Questions	Parameters	Central		Şarkışla		Suşehri		Sivas Total		χ^2 / P
		n	%	n	%	n	%	n	%	
Type of shelter	Closed	67	98.5	15	100	37	94.9	119	97.5	5.095^{NS}
	Open	-	-	-	-	1	2.6	1	0.8	
	Semi-open	-	-	-	-	1	2.6	1	0.8	
	Closed in winter, open in summer	1	1.5	-	-	-	-	1	0.8	
Housing Systems (tie stall or loose type)	Closed tethered systems	67	98.5	15	100	39	100	121	99.2	0.801^{NS}
	Closed loose housing system	1	1.5	-	-	-	-	1	0.8	
Length of the link / chain	<40 cm	-	-	-	-	1	2.6	1	0.8	21.424***
	40-60 cm	34^{a}	50	8^{a}	53.3	35^{b}	89.7	77	63.1	
	>60 cm	34^{a}	50	7^{a}	46.7	3^{b}	7.7	44	36.1	
Space needs of water buffalos	50-90cm	4	6.2	-	-	4	10.8	8	6.8	61.892***
	100-150cm	58	89.2	13	86.7	31	83.8	102	87.2	
	>150cm	3	4.6	2	13.3	2	5.4	7	6	
Do you house your cattle and water buffalo together?	Yes	63	95.5	15	100	35	94.6	113	95.8	0.804^{NS}
	No	3	4.5	-	-	2	5.4	5	4.2	
Sick animal department	Yes	4	5.9	-	-	-	-	4	3.3	3.284^{NS}
	No	64	94.1	15	100	39	100	118	96.7	
Birth department	Yes	3	4.4	-	-	-	-	3	2.5	2.442^{-}
	No	65	95.6	15	100	39	100	119	97.5	
Milking department	Yes	1	1.5	1	6.7	-	-	2	1.6	3.013^{NS}
	No	67	98.5	14	93.3	39	100	120	98.4	
Ranging area	Yes	12	17.6	3	20	8	20.5	23	18.9	0.920^{NS}
	No	56	82.4	12	80	31	79.5	99	81.1	
Shade area	Yes	12	17.6	3	20	7	17.9	22	18	0.046^{NS}
	No	56	82.4	12	80	32	82.1	100	82	
Hayloft	Yes	65	95.6	15	100	37	94.9	117	95.9	0.763^{NS}
	No	3	4.4	-	-	2	5.1	5	4.1	
Fodder stocking area	Yes	60	88.2	14	93.3	39	100	113	92.6	5.033^{NS}
	No	8	11.8	1	6.7	-	-	9	7.4	
Calf area	Yes	36	52.9	9	60	24	61.5	69	56.6	0.828^{NS}
	No	32	47.1	6	40	15	38.5	53	43.4	

*n: Frequency, %: Percent, χ^2: Chi Square, P: Significance Level, -: p>0.05, ***:p<0.0001.*
a,b: Within a row, different superscript letters indicate statistically significant differences between compared frequencies.

(p<0.0001), and that the space needs of water buffalos were met by tethering them with 1-1.5 m space (, p<0.0001). It was found that water buffalos and cattle were co-housed in 95.8% of the shelters. It was determined that 80% of farms had a pasture for animals outside the shelter and that they didn't have a special arrangement in their shelters except for spaces such as hayloft (95.9%), fodder stocking area (92.6%), and calf area (56.6%).

It was found that the percentage of farms having shelter with waterer was only 6% and the main source of water was tap/trough located in village lands or forages (51%) and brooks or rivers (22%) (Figure 1).

The water resources used in order to meet the water needs of water buffalos are illustrated in Figure 2.

The information regarding the fodder sources and feeding methods of farms is presented in Table 5. Among participants, 92.6% stated that they were cultivating forage crops (p<0.0001). Breeders underlined that, although they were farming forage crops, they were also purchasing fodder (p<0.05). Moreover, 54.5% of breeders stated that they were feeding the animals while milking them. The usage rates of silage, licking block, and fodder in feeding the animals were declared to be 23.8%, 71.9%, and 24.8%, respectively. It is important that some of the breeders were adding silage in forages for their water buffalos. Pastures are the shared properties of villages (p<0.05) and it was found that breeders in Sivas province were actively using them between April and November (69.2%) (p<0.0001).

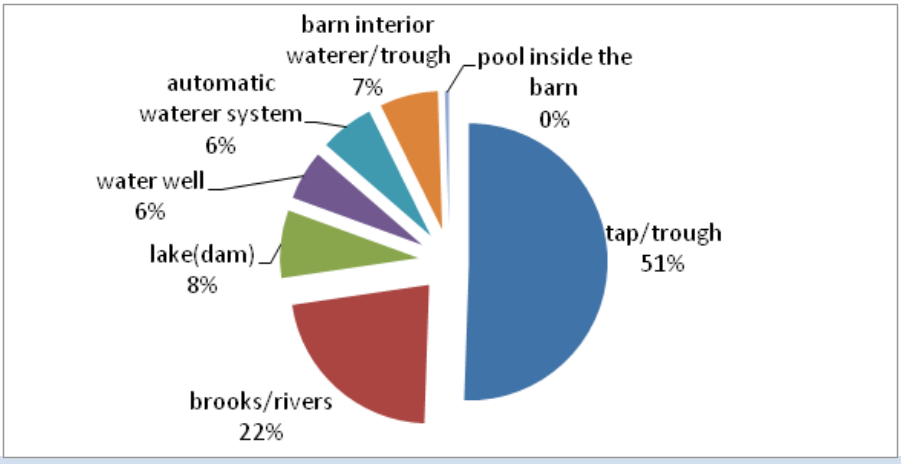

Figure 1. Drinking water sources used for buffaloes

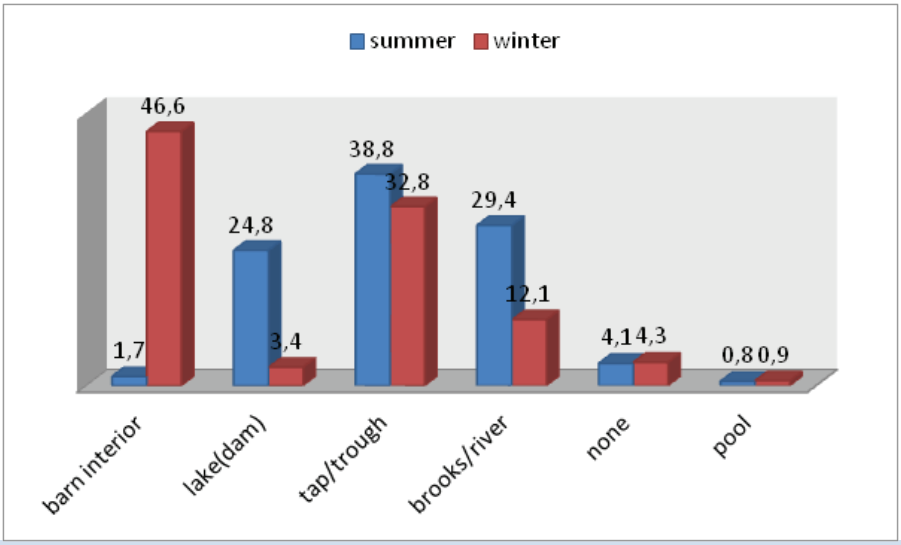

Figure 2. Water resources used for the wetland needs of water buffaloes

The data about the use of barley, oat, wheat, alfalfa, and triticale as feeding plants in water buffalo husbandry farms in Sivas province are provided in Graph 3. The participants in central district reported that they were cultivating barley, oat, wheat, and triticale, respectively, as forage plants. It was found that the breeders in Şarkışla district preferred oat, alfalfa, wheat, and barley as forage plants. In Suşehri district, breeders were found to prefer triticale, wheat, and alfalfa as forage plants.

Table 5. Information on the feeding methods and feed sources of the farms

Questions	Parameters	Central		Şarkışla		Suşehri		Sivas Total		χ^2 / P
		n	%	n	%	n	%	n	%	
Where do you get the feed you give to animals?	myself	4	5.9	-	-	1	2.6	5	4.1	13.263*
	myself + buy	49[a]	72.1	14[ab]	93.3	38[b]	97.4	101	82.8	
	buy	15[a]	22.1	1[b]	6.7	-	-	16	13.1	
Forage plantsproduction	Yes	60	88.2	14	93.3	39	100	113	92.6	5.033[NS]
	No	8	11.8	1	6.7	-	-	9	7.4	
Feeding during milking	Yes	36	52.9	12	80	18	47.4	66	54.5	4.780[NS]
	No	32	47.1	3	20	20	52.6	55	45.5	
Silage use	Yes	12	17.6	7	46.7	10	25.6	29	23.8	5.822[NS]
	No	56	82.4	8	53.3	29	74.4	93	76.2	
Licking bloke	Yes	47	69.1	13	86.7	27	71.1	87	71.9	1.893[NS]
	No	21	30.9	2	13.3	11	28.9	34	28.1	
Fodder	Yes	20	29.4	2	13.3	8	21.1	30	24.8	2.120[NS]
	No	40	70.6	13	86.7	30	78.9	91	75.2	
Pasture use	Yes	67	98.5	15	100	39	100	121	99.2	0.801[NS]
	No	1	1.5	-	-	-	-	1	0.8	
Village pasture/grassland	Yes	66	97.1	15	100	39	100	120	98.4	1.615[NS]
	No	2	2.9	-	-	-	-	2	1.6	
Pasture property	Rent	-	-	1	6.7	-	-	1	0.8	7.192*
	Village common pasture	68[a]	100	14[b]	93.3	39[ab]	100	121	99.2	
The months you use the pasture	April-November	33[a]	50	13[b]	86.7	37[b]	94.9	83	69.2	27.546***
	April-October	13	19.7	2	13.3	-	-	15	12.5	
	May-November	13[a]	19.7	-	-	2[b]	5.1	15	12.5	
	May-October	7	10.6	-	-	-	-	7	5.8	

*n: Frequency, %: Percent, χ^2: Chi Square, P: Significance Level, NS: Not significant, p>0.05, *: p<0.05, ***:p<0.0001.*
[a,b]: Within a row, different superscript letters indicate statistically significant differences between compared frequencies.

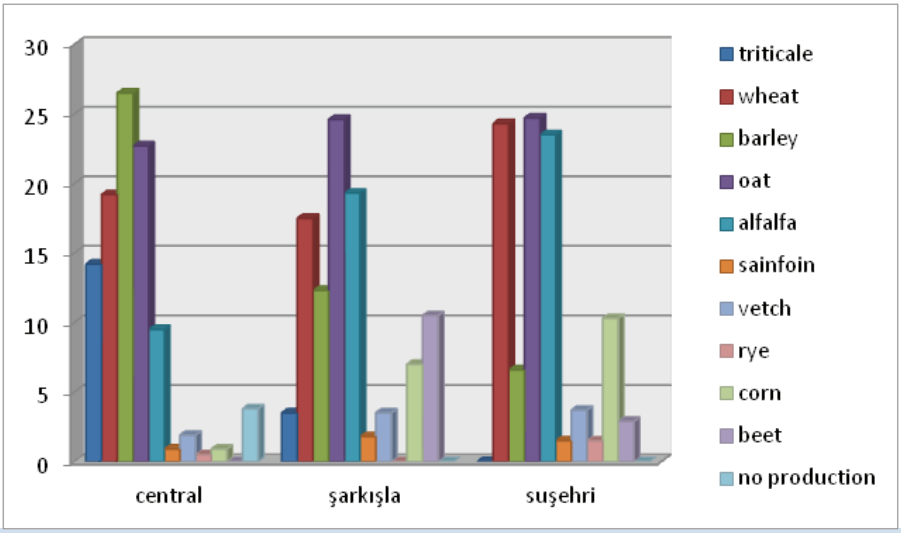

Figure 3. Forage plant production in Sivas province

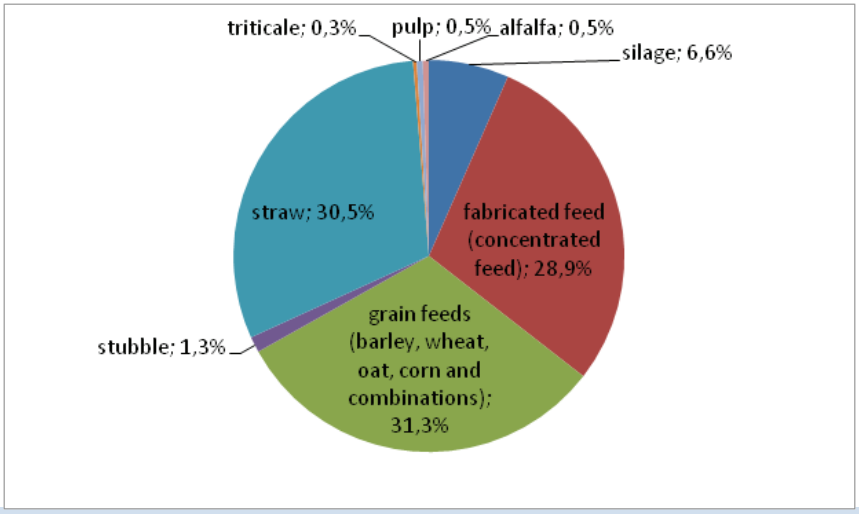

Figure 4. Feed sources

As observed in Figure 4, it was determined that, in addition to the forage, breeders were using grain feeds (barley, wheat, oat, corn and combinations) and straw and fabricated feed (concentrate feed) (χ^2:100.821, $p<0.0001$).

DISCUSSION

Various methods were developed in order to evaluate the animal welfare under farm conditions. In these methods, besides the structural and technical aspects of shelters and criteria such as hygienic and climatic conditions, also the performance criteria such as animal behavior, health, and physiology are examined. However, in order to holistically analyze the animal welfare, design and performance criteria should be considered together (Napolitano et al., 2004; Napolitano et al., 2005; De Rosa et al., 2015; Sabuncuoglu et al., 2020). Examining the structural and technical aspects of water buffalo farms, it was determined that the shelters were constructed nearby the house and the main construction materials used were stone ($p<0.0001$), concrete, and briquette (Table 2). Many studies reported that constructing the shelters close to the houses poses risks in terms of hygiene and health conditions for humans and animals (Kocaman et al., 2015; De Rosa et al., 2015; Çiftçi and Yılmaz, 2019). The location of the farm, its material selection, design and construction are generally affected by the economic conditions and previous construction practices in the region. In the present study, it was determined that farms preferred concrete as floor material ($p<0.05$) (Table 2). Okuyucu et al., (2018) reported that concrete was used as a floor cover in water buffalo shelters in Samsun province. Even though concrete has certain advantages such as cleanness, low cost, extended period of use, and durability, the floor should be designed considering the animal comfort and welfare. It was reported that the natural floor cover increased the self-grooming and resting behavior (by laying) that are important welfare indicators for water buffalos, whereas rough or slippery grounds decreased the natural behavior frequency and milk and growth hormone production of animals and increased the infection frequency and risk of injury and lameness (De Rosa et al., 2009; De la Cruz-Cruz et al., 2014; Gu et al., 2016; Okuyucu et al., 2018; Kaplan et al., 2018; Gültepe et al., 2019). The shelter systems that are not suitable for animal behaviors and needs specified in the 5-Freedom concept impair animal welfare (Tripaldi et al., 2004; Napolitano et al., 2004; De Rosa et al., 2015). It was determined that the buffalos sheltered on a rubber floor laid down on the ground more than those sheltered on a concrete floor (Gültepe et al., 2019). As stated in the regulations on animal welfare, the ground should be solid, flat, and suitable for the size and weight of animals and not slippery in order to prevent any injury. The ground for lying down should be comfortable and clean, and appropriate for each species and ages of animals (Anonymous, 2014). It was determined that the roof covering material used in shelters was generally sheet metal and eternit (80%) ($p<0.0001$) (Table 2). Although these materials are used since they are light and affordable, as well as being easy to procure, they can negatively affect the ambient temperature in case of no insulation because they have high heat transmission (Avci, 2015; Gu et al., 2016).

While 13.1% of shelters have no air shaft, 62.3% were found to have at least 1-3 air shafts (Table 3).

In-shelter ventilation is an important criterion for the ideal growth and development of animals, as well as for the preservation and maintenance of the animal welfare and health (Tripialdi et al., 2004; Kaplan et al., 2018; Gültepe et al., 2019). Insufficient in-shelter ventilation conditions negatively affect human health too (Çiftçi and Yılmaz, 2019). Okuyucu et al., (2018) reported that, in Samsun province, the doors and windows used for ventilation in water buffalo were insufficient. In the present study, it was found that water buffalo shelters had sufficient infrastructure in terms of the number of windows and the artificial lighting (Table 3). Lighting is an important climatic environmental condition that has positive effects on animal welfare, productivity, and hygiene (De Rosa et al., 2009; Araújo et al., 2012; Kocaman et al., 2015). Sufficient lighting in the shelter is a necessity for effective fertility management, early detection of animal diseases, and for breeders to regularly control and monitor the animals (Napolitano et al., 2005; Araújo et al., 2012). According to the Farm Animal Regulation No. 29183 (article 10/6), the animals in shelters should not be held in darkness or be subjected to artificial lighting constantly and they should be provided with sufficient time for resting in terms of lighting. In order to meet the animal behavior and physiological needs in shelters, the regulation states that there should be a system allowing sufficient natural or artificial lighting for different climate conditions (Anonymous, 2014). In shelters not appropriately designed in terms of floor area and number of animals, insufficient air shafts and window areas negatively affect the climatic conditions and ventilation. Considering the isolation, heating, and ventilation of shelters, air circulation, dust level, temperature, relative humidity of air, and gas concentrations should be kept within the levels that are not harmful to animals (Anonymous, 2014). In modern water buffalo farms, in order to eliminate the negative effects of high temperatures, a good ventilation system (mechanical ventilation) should be used and shelters supported with a cooling system such as pool, pond, fogging, fan, and water spraying (Avci, 2015; De la Cruz-Cruz et al., 2014; Gu et al., 2016; Yáñez-Pizaña et al., 2020).

It was found that shelters were closed tethered systems and water buffalos and cattle were co-housed in the shelters (Table 4). It was determined that, breeders tether their animals in the length of the chain used was 40-60cm in 63.1% ($p<0.0001$) (Table 4). Regarding the space needs of animals in the shelter, it was found that breeders tethered animals at 1-1.5m distance depending on the number of animals and the size of the shelter ($p<0.0001$). Participants stated that they tether their animals in order to take them under control and that, especially in cases of long chains, they experience animal behaviors such as aggression between animals and capturing the space of other animals and, thus, they had to tether their animals. The tethered systems have a negative effect on animal welfare by limiting the natural behaviors of animals and the social relationships between them (Tripaldi et al., 2004; De Rosa et al., 2009; Gültepe et al., 2019). In recent years, understanding the effects of semi-open and open shelters on animal welfare and productivity, they inclined to this type of shelter but the previous studies carried out on buffalo farms in different cities revealed that the closed shelters are widely used in Turkey (Yılmaz and Karaca, 2013; Okuyucu et al., 2018; Özdemir and Özdemir, 2018; Çiftçi and Yılmaz 2019). Water buffalo herd management and sheltering conditions suffer more than cattle because intensive production systems do not meet their need for natural conditions (De Rosa et al., 2009; De Rosa et al., 2015; Gültepe et al., 2019). The spaces in the shelter should be suitable for performing species-, gender-, and age-specific social behaviors (feeding, movement, grooming, rolling over, playing, etc.) and allow for three main positions (standing, sternal lying, and lateral lying) of the animals to maximize animal welfare (Napolitano et al., 2004; De Rosa et al., 2009; De Rosa et al., 2015). Limited areas increase the aggression among animals (Napolitano et al., 2013; De Rosa et al., 2009) and, by preventing them to behave normally, decrease animal productivity and compromise animal welfare (De Rosa et al., 2009; Gu et al., 2016; Gültepe et al., 2019; Yáñez-Pizaña et al., 2020). Kocaman and Kurç, (2020) stated that the most suitable type of shelter for water buffalos was the free-stall shelter system. In farms, each buffalo should be given a minimum of 15-18 m^2 as indoor space 4-6 m^2 for resting and 8-12 m^2 for ranging (Kocaman et al., 2015). In this study, an interesting finding is that mostly the farms had no specific department for sick animals, birth and milking (Table 4). The rate of farms having pasture areas or shade was 80% (Table 4). It was determined that breeders had no special planning in shelters other than hayloft (95.9%), fodder stocking area (92.6%), and calf area (56.6%) (Table 4). Weaknesses in herd management practices such as shelter-origin biosafety and preventive medicine would affect the profitability and sustainability of the business, as well as animal health and produc-

tivity (Yilmaz et al., 2012; Kaplan et al., 2018). Kaplan et al., (2018) reported that, although there were spaces for newborns in shelters in 57.70% of farms, no space was allocated for sick animals or those that recently gave birth in these farms of Yozgat province. Çiftçi and Yılmaz, (2019) reported that among the water buffalo shelters in Bitlis, 10.29% had hayloft and 3.68% had shade area for animals that are kept outside and none of them had a milking unit or any additional facility (birth, sick animal and calf area). Özdemir and Özdemir, (2018) determined that there was no separate space for milking and sick animals in farms located in Bingöl province. Okuyucu et al., (2018) reported that 50% of breeders took the heavily pregnant buffalos to the delivery spaces. Avci, (2015) determined that young water buffalos and adult ones were kept in different places in many buffalo farms.

As the sources for water used in the farms, generally the taps/troughs in the village lands and forages (51%) and the brooks or rivers (22%) were used and the rate of businesses having a waterer system in the shelter was found to be 6% (Figure 1). In businesses having no regular waterer system, it was determined that the water sources outside the shelter were used depending on the season. The daily water intake of animals varies depending on the physiological status, feed consumption, body weight, species, breed, and health status, as well as ambient temperature and humidity. For ensuring development and sufficient health and welfare status of animals, the shelter must incorporate high-quality, clean drinking water and waterer systems that are always available. Okuyucu et al. (2018) reported that, city water, brooks, and rivers were used as water sources, in addition to the underground waters (66.7%), for water buffalos. De Rosa et al., (2009) revealed that improvement of shelter conditions such as access to water sources or a pool and enlarging the area in shelter increased the social behaviors of animals, improved welfare, and increased the milk yield.

Participants cover the water needs of water buffalos, especially during the summer season, by using the water sources such as brooks, rivers, and lakes within the borders of the village, as well as many sources such as many taps and troughs located in the forages (Figure 2). Breeders make use of troughs/taps in village land and courtyard of shelter during the summer season (38.8%), while they meet the animals' water needs from waterers inside and outside the shelter during the winter season (46.6%). In addition to their daily water intake, water buffalos are semi-aquatic animals that must have wetlands in their habitats. With the Kızılırmak delta and its natural structure, Sivas province has an important potential for water buffalo husbandry. Their behaviors of rolling over and washing especially during the hot season are specific water buffalo behaviors carried out for thermoregulation and ectoparasite protection (Napolitano et al., 2013). Water buffalos require water bodies (such as rivers, brooks, marshes, lakes, dams, and sea) to regulate their body temperature because of their skin thickness, subcutaneous sweat glands, and hair cover structure (Napolitano et al., 2013). Because of the low level of hair density on their skins, water buffalos are sensitive to cold weather (Sarıözkan 2011; Kaplan et al., 2018; Yáñez-Pizaña et al., 2020). It should be noted that, for animals, high environmental temperature caused temperature stress and reduced the milk yield by 10-50% and the delivery by 20-30% (Değirmencioğlu et al. 2020; Yáñez-Pizaña et al. 2020).

In addition to their own farming, it was also determined that 82.8% of businesses were purchasing animal feeds (Table 5). Of the participants, 92.6% stated that they were cultivating forage plants and 54.5% stated that they give water buffalos with feed in front of them while milking because they are showing a bad temper during the milking process (Table 5). Feeding the animals during milking is considered a factor influencing the quality of milk. Çiftçi and Yılmaz, (2019) reported that 53.68% of businesses were not giving feed during the milking and breeders generally did not tend to feed during this process. Özdemir and Özdemir, (2018) determined that 64.7% of water buffalo breeders were feeding their animals during milking. In the present study, the ratio of those using silage in feeding animals was 23.8%, whereas the ratio of using licking block as a protective measure against mineral deficiencies was 71.9% and that of using hay was 24.8% (Table 5). Okuyucu et al., (2018) found that almost all water buffalo breeding businesses were using silage (95.6%), whereas the majority were using corn and grass (51.1%). Yılmaz and Karaca, (2013) reported the ratio of using silage was 87% among the water buffalo businesses. Forages are common properties of villages and it was determined that, in the entire Sivas province, breeders were actively using the forages for their animals in April and November (69.2%) (Table 5). Some of the participants stated that, because of the climatic and geographic conditions and because they couldn't find a cowman, they were using forages between May and October (5.8%) (Table 5).

In Turkey, water buffalo breeding relies traditionally on grazing (Borghese, 2010; Degirmencioglu et al., 2015). It is very important for water buffalo breeders to make use of forages as long as climatic conditions allow it (Borghese, 2010; Kaplan et al., 2018; Yáñez-Pizaña et al., 2020). De Rosa et al., (2009) reported that the milk yield of water buffalos ranging freely outside was higher than that of water buffalos that do not have access to an outdoor environment. Ligda and Georgoudis, (2005) reported that, while animals in regions, where the forages were used for the entire year, are fed mainly on the forage, the animals were provided with complementary feeding due to lack of grazing in regions, where the forages were used only between November and April. Okuyucu et al., (2018) determined that, in water buffalo businesses, the ratio of forage-based feeding was 86.4% and that of ad-libitum feeding was 84.4%, and that they provided the same diet to all the animals.

Sivas province is an important forage plant production location with its microclimate and rich agricultural product diversity. It ranks second in triticale and oat cultivation, third in sainfoin and wheat, and sixth in alfalfa in Turkey (Anonymous, 2018). Sivas province's forage plant cultivation potential, in addition to the forage conditions, brings an important advantage in terms of water buffalo breeding. Besides increasing the productivity in animal production, small companies generally aim to increase their income sources by making use of mixed method combining plant (cash flow) and animal (capital source) productions (Özdemir, 2021; Escarcha et al., 2020). Especially in the village herds, improving the feeding conditions, in addition to the forage conditions, for the water buffalos was reported to increase the milk yield and to influence the milk composition (Ligda and Georgoudis, 2005; de la Cruz-Cruz et al., 2014; Degirmencioglu et al., 2015; Degirmencioglu et al., 2016). Breeders were using grain feeds (barley, wheat, oat, corn, and their crushed versions) and forage and fabricated feed (concentrate feed) in addition to the pasture (Figure 4). Other researchers also reported that in Turkey, the water buffalos are fed on pasture and wheat straw during summer and fodder, concentrate feed, mixture of barley/corn during winter (Borghese, 2010; Degirmencioglu et al., 2015; Degirmencioglu et al., 2016).

CONCLUSION

It is important to construct shelters, which are suitable for the special conditions of water buffalos, and to improve the current breeding conditions. For the shelters that will be constructed from the beginning, it is considered that the projects that are suitable for animal welfare and behaviors are needed. It was determined that a more comprehensive study on the number of animals and appropriate ventilation arrangements considering the size and structural aspects of shelters would be useful. Natural ventilation methods are used in water buffalo shelters located in Sivas province. In closed tethered systems, it seems not possible for the general welfare level of animals, which are sheltered in limited and insufficient spaces, to be good. Having separate spaces for calves in shelters is a positive approach to the development and growth of animals. However, it is necessary to arrange suitable areas in the shelter according to the age and productivity season. While planning the water buffalo shelters, it should be paid attention to include large shadow areas, incorporate pool or pond in or around the shelter, and place practical cooling systems in the shelter. Providing the farm animals with a sufficient amount of high-quality water is a precondition of breeding in terms of animal health, productivity, and welfare, and it is important for the profitability of the business as well. A further study to examine the watering systems should be carried out specifically in Sivas province. Although the negative effects of the sheltering conditions in the short term seem to be overcome by the pasture, forage plant cultivation and wetland opportunities that Sivas province has, these negative effects may cause serious problems in terms of animal welfare, health and productivity in the long term. For this reason, it is necessary to increase the efforts and studies to improve the shelter conditions. Because breeders cultivate forage plants and use other sources (silage, concentrate feed, minerals), any practice or strategy that improves animal feeding conditions and animal welfare will ensure the sustainability of water buffalo breeding by increasing breeder revenues.. For the shelters, in which the breeder attitudes and behaviors and the shelter conditions were analyzed, it is considered that improvement works would, together with the positive characteristics in terms of animal welfare, create an extensive effect on animal breeding.

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CONFLICT OF INTEREST

The author declares no conflict interest.

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