

Evaluation of Water Buffalo Holdings in Yozgat Province in terms of Environmental Factors Affecting Animal Welfare

Yusuf Kaplan¹, Zehra Bozkurt², Mustafa Tekerli²

¹ General Directorate of Agricultural Research and Policies Ministry of Food, Agriculture and Livestock

²Afyon Kocatepe University, Faculty of Veterinary Medicine, Department of Animal Husbandry

Geliř Tarihi / Received: 20.06.2018, Kabul Tarihi / Accepted: 23.11.2018

Abstract: This study has been conducted to assess resource-based and management-based factors affecting animal welfare in water buffalo husbandry holdings in Yozgat province in order to obtain basic data for a water buffalo welfare assessment protocol to be developed. An measurement, observation and evaluation form was developed to obtain the data by using that the results of studies recently published on water buffalo health and welfare and the dairy cattle assessment protocols the Welfare Quality® and AssureWel and the Unified Field Index protocol. One hundred thirty holdings in Yozgat province and districts were visited and resource-based and management-based measurements and evaluations were made according to the developed measurement, observation and evaluation form and face to face interviews with business owners and employees were carried out. It was observed that water buffalo husbandry holdings were small and medium scale and the animal husbandry was implemented traditionally. As a result, it was found that, the existing farm standards in buffaloes holdings concerning to the resource-based and management-based factors affecting animal welfare were satisfactory with respect to good feeding principles but were poor for both of the good housing and good health principles. Besides, it was concluded that the farm owners and workers did not have sufficient knowledge and skills in of the development and implementation of sustainable animal welfare management strategies in buffalo farms.

Key words: Yozgat province, holdings, environmental factors, animal welfare, water buffalo

Hayvan Refahını Etkileyen Çevresel Faktörler Bakımından Yozgat İli Mandacılık İşletmelerinin Değerlendirilmesi

Özet: Bu araştırma geliştirilecek olan bir manda refahı değerlendirme protokolüne temel veri elde etmek üzere, Yozgat ili mandacılık işletmelerinin hayvan refahını etkileyen kaynak-tabanlı ve idare-tabanlı faktörler bakımından değerlendirilmesi amacıyla yapılmıştır. Manda sađlığı ve refahına ilişkin yapılmıř arařtırma sonuçları ile süt ineklerinde refahın değerlendirilmesi için geliřtirilen Welfare Quality® ve AssureWel protokolleri ve The Unified Field Index'den yararlanılarak bir ölçüm, gözlem ve değerlendirme formu geliřtirilmiřtir. Yozgat ili ve ilçelerinde bulunan 130 işletme ziyaret edilmiř, geliřtirilen ölçüm, gözlem ve değerlendirme formuna göre kaynak-tabanlı ve idare-tabanlı ölçüm ve değerlendirmeler yapılmıř, işletme sahipleri ve çalışanlar ile yüz yüze görüřülmüřtür. Mandacılık işletmelerinin geleneksel manda yetiřtiriciliđi uyguladıkları ve küçük ve orta ölçekli oldukları görülmüřtür. Sonuç olarak, hayvan refahını etkileyen kaynak-tabanlı ve idare-tabanlı faktörlere iliřkin olarak mandacılık işletmelerinde mevcut çiftlik standartlarının iyi besleme prensibi bakımından yeterli olduđu ancak iyi barındırma ve iyi sađlık prensipleri bakımından ise zayıf olduđu belirlenmiřtir. Ayrıca, işletme sahipleri ile çiftlik çalışanlarının manda çiftliklerinde sürdürülebilir hayvan refahı yönetimi stratejilerinin geliřtirilmesi ve uygulanması bakımından yeterli bilgi ve beceriye sahip olmadıđı sonucuna varılmıřtır.

Anahtar kelimeler: Yozgat, işletmeler, çevresel faktörler, hayvan refahı, manda

introduction

The number of water buffaloes, which have an important role in providing milk, meat and work force in the agricultural economy of many developing countries, has increased steadily to 199.7 million in the world [13]. Although the majority of the buffalo population is located in South Asia, the growing importance of buffalo farming in Mediterranean countries, Latin America, Central and Northern Europe

has been increasing in recent years [25,33]. The share of buffalo milk, which is antiobesitic, antidiabetic and anticarcinogenic with high fat, protein, lactose, dry matter and Conjugated Linoleic Acid content in world milk production, has increased to 12.7% [26,36]. The importance of water buffalo breeding is also increasing in Turkey and the Country Project for the Improvement of Anatolian Water Buffalo on Public Condition has been initiated in 2011 under the coordination of the General Directorate

for Agricultural Research and Policies with the aim of increasing production and economic efficiency in Anatolian Buffaloes with pure breeding and selection method. The number of water buffaloes has increased by 60% between 2011 and 2017, namely from 97 to 161 thousand heads [32]. The developments in modern animal breeding and reproductive techniques as well as water buffalo improvement studies have incurred a significant increase in the milk yield of water buffaloes [4,31,35,36].

In fact, the modern animal farms, developed in parallel with many years of genetic breeding of cattle, are a difficult environment for the buffaloes to cope with and has a negative impact on their well-being in many ways. [18,29]. Moreover, water buffaloes have special welfare needs such as enough space and water baths for social contact and grooming [1,24,26]. There is no yet an on-farm welfare assessment protocol for buffaloes although monitoring of their welfare status is even more important than other farm animal species. [1,10,37]. In evaluating animal welfare, addition to the animal-based indicators directly related to the animal itself, the resource-based indicators such as shelter and facilities, as well as management-based indicators including holding policies and animal management strategies are also taken into account. [6,7,8]. Since the number of researches on buffalo welfare is still very few the resource-based and management-based indicators are crucial for assessment of the risks from low animal welfare status and, to development of related solution strategies. [14,22].

This study has been carried out with the intention of assessing resource-based and management-based factors affecting animal welfare in water buffalo husbandry holdings in Yozgat province for obtain basic data for a water buffalo welfare assessment protocol to be developed.

Material and Method

Development of the measurement, observation and evaluation form

A measurement, observation and evaluation form has been developed for use in the study. Scientific studies on water buffalo health and welfare and welfare requirements of buffaloes have been examined

[8,10,12, 23] and the Regulation on General Provisions on Livestock Welfare has been taken into consideration for this purpose [2]. Furthermore, the Welfare Quality® [34] and the AssureWel [28] protocols which have been developed to assessment of dairy cow welfare and The Unified Field Index [9] that has been proposed recently to animal welfare assessment at farm level were used. The measurement, observation and evaluation form that are used consists of four parts; the agricultural activities, the characteristics of the land and animal stock of the visited holdings for resources-based factors, and the properties of the owners and the workers for management-based factors.

Within the scope of resource-based measurements for the evaluation of the good feeding principle, the land and animal stock properties and agricultural activities were examined (Table 1), the type of watering troughs was determined and the holdings were scored as yes (1) or no (2) by examining the cleaning of the water bottles, their occurrence in the working condition and ease of use [9,34]. The amounts of roughage and concentrate feed fed to buffaloes each day (kg/day/animal) were determined by asking questions to the holding owners [34]. For the other management-based measures used for evaluation of this principle, the farm owners were also asked about suckling period, the age and criterions that have been taken into account for weaning of buffalo calves. (Table 2) [28].

Under the resource-based measurements, for the purpose of examination of good housing principle, type and conditions of animal barns were detected in terms of whether animals can move easily and comfortably, the length, width and height of the barn have been measured by using a meter gauge and, the buffaloes in the barn were counted. Then, buffalo farms were examined and scored as yes (1) or no (2) by the way of the presence of pet animals, tethering of the animals, type and slipperiness of barn floor, usage of separation and bedding materials and, the existence of grooming and cooling opportunities. Barn air quality was scored subjectively as clean (0), with mild odor (1) or strong odor (2) [9,28,34]. The holding owner was asked about weekly barn cleaning frequency (Table 2).

Table 1. The results on agricultural activities and the characteristics of the land and animal stocks in the buffalo holdings

Factors	Variables	Results
Agricultural land	Presence of arable land	Yes (88.40 %), no (11.60 %)
	The amount of agricultural land (decare)	103.63±15.51
	The characteristic of agricultural land	Dry (76.50%), wet (0.90%) combine with dry and wet (22.60%)
Plant production	Presence of plant production	Yes (85.30%), no (14.70%)
	The plant products	<i>Cereals</i> : Wheat (83.10%), Barley (36.90%) <i>corn</i> (2.30%) <i>Industrial plants</i> : Sugar beet (10.80%) <i>Vegetable</i> : Garbanzo bean (22.30%)
	Marketing of plant products	Yes (52.20%), no (47.80%)
	Presence of forage plant production	Yes (75.20%), no (24.80%)
	Forage plant products	<i>Leguminous forage crops</i> : Vetch (3.10%) Alfalfa (10.80%) <i>Wheatgrass feed crops</i> : Oat (3.10%), corn stover (0.80%) <i>Other</i> : Rapeseed (Kanola) (2.30%)
Animal Production	Animal production	Yes (100.00%)
	Animal species	Water buffalo (9.30%) Water buffalo +cattle (83.80%) Water buffalo +cattle+small ruminant (6.90%)
Number of animals in the holding (head)	*Total number of cattle	28.32±3.93
	*Total number of small ruminants	137.00±22.93
	Total number of water buffalo	15.91±1.47
	Buffalo cows	7.30±0.76
	Buffalo bulls	1.99±0.27
	Buffalo calves	3.49±0.32
	Buffalo heifers	2.02±0.32
	Buffalo calves(1 ≤ age old)	1.12±0.20
Agricultural organization	Breeding buffalo breeders association	99.23%
	Agricultural Credit Cooperative	11.53%
	Sugar Beetle Production Cooperative	3.85%
	Milk Association	0.77%

*Average numbers of cattle and small ruminants were calculated based on the holdings in that cattle and small ruminant breeding.

In evaluation of the principle of appropriate behaviour, some resource-based measurements were conducted in the farms such as whether or not there is an open loafing area, shading area or protection precautions from against pets. The housing area per animal (m^2/animal) was calculated. The farm owners were also consulted the time that buffaloes were held in the farms, the distance between barn and pasture, tethering in the barn, yearly and daily access to pasture (hour/day/year) (Table 2) [28,34].

The information was requested from the owners on the identification methods and vaccines implemented for calves as well as diseases, culling and deaths causing production losses in buffalo calves

that occurred in the past 12 months, in an effort to the management-based measures carried out for the researching of the good health principle. The information on buffalo health was obtained by reviewing of farm records or asking questions to owners about the cases of disease, euthanasia, emergency slaughter, animal death and culling in the last 12 months (Table 3). Furthermore, the information and data given by the farm owners with regard to the manure disposal, the surgical procedures (dehorning, tail and hoof cutting), artificial insemination, milking properties (type and frequency of milking in a day), daily milk yield, marketing of milk products and animal fattening procedures were also taken into consideration (Table 3) [28,34].

Table 2. The results on the resource-based factors affecting animal welfare in the buffalo holdings

Factors	Variables	Results
Good Feeding	Water resource	Village tap (43.41%), river water (41.86%), well water (14.73%).
	Type of watering troughs	Constant concrete troughs (100.00%)
	Cleanness of watering troughs	Clean (98.50%) slightly dirty (1.50%)
	Suitability of watering troughs	Yes (100.00%)
	Ease of use of troughs	Yes (100.00%)
	The type of feeder	Constant concrete feeders (100.00%)
	Feeder cleanliness	Clean (99.24%) slightly dirty (0.76%)
Good housing	Ease of use of feeders	Yes (100.00%)
	Feed resource	Own production (6.90%), partially purchased (34.50%), totally purchased (58.60%)
	Roughage intake (kg/animal/day)	9.08±0.40
	Concentrate feed intake (kg/animal/day)	4.09±0.14
	Barn High (m)	2.75±0.05
	Barn length (m)	16.66±0.58
	Barn Width (m)	7.61±0.11
Appropriate behaviour	Total floor area of barn (m ²)	128.79±5.18
	Housing area per animal (m ²)	11.05±0.53
	Weekly barn cleaning frequency	1.83 ± 0.06
	Barn type	Open (0.80%), close (0.80%), semi-open (98.40%)
	Partition in the barns	Available (57.70%) non available (42.30%)
	Presence of tethering for cows	Yes (100.00%)
	Slipperiness of the floor	Floor is not slippery (0.80%), floor is slippery (91.00%), floor is dangerously slippery (8.20%)
	Usage bedding on resting areas	No (100.00%)
	Barn air quality	Clean (1.50%), with mild odor (87.70%), strong odor (10.80 %)
	Grooming practice	Yes (90.80%), no (9.20%)
Appropriate behaviour	Grooming method	Automatic brush (0.85%), manuel dany brush (99.15%)
	Cooling practice	Water sprinklers (29.50%), dam lakes and ponds (46.80%), streams and rivers (18.00%), no cooling (5.70%)
	Time of tethering in the barn(day)	184.53±1.59
	The time that buffaloes are held in holdings (year)	9.58±0.26
	Distance of pasture (km)	2.58±0.09
	Days with access to pasture per year	180.47±1.59
	Hours per day on pasture	8.12±0.12
	Having access to pasture	Yes (94.60%), no (5.40%)
Appropriate behaviour	Outdoor loafing area	Available (51.50%) non available (48.50%)
	Presence shelter in outdoor loafing area	Available (24.70%) non available (75.30%)
	Special protection from other pets (dogs)	No (100.00%)

Table 3. The results on the management-based factors affecting animal welfare in the buffalo holdings

Factors	Variables	Results
Buffalo calves care	Weaning age of buffalo calves (days)	137.12±4.19
	Criterion for weaning	Age (76.20%), body weight (23.80%)
	Identification of calves	Ear tags (100.00%)
	Vaccination for male calves	Pox, foot and mouth disease (FMD)
	Vaccination for female calves	Pox, foot and mouth disease (FMD), brucella
Surgical procedure	Hoof cutting and care	No (100.00%)
	Dehorning	No (100.00%)
	Tail cutting	No (100.00%)
Milking	Daily milk yield (kg)	4.37±0.10
	Milking method	Hand (97.70%), machine (2.30%)
	Time at morning milking	5:30-7:30 (74.38%), 7:30-9.0(25.62%)
	Time of afternoon milking	17:0-18.30 (69.03%) 18:30-20.00 (30.97%)
	Usage of buffalo milk	Family consumption (42.50%), Marketing (57.50%)
	Marketing of milk products	Yoghurt (57.50%), butter and cheese (9.45%)
Fattening	Holding ratio applying fattening	23.84%
	*Average fattening period (days)	138.00±5.92
	*Average number of fattening animal (head)	3.90±0.78
Breeding	Breeding	All year round (100.00%)
	Artificial insemination	Not practiced (100.00%)
Dogs	Average number of dogs (head)	1.74±0.15
	Presence dog	Yes (78.90%), no (21.10%)
Animal health at last 12 months	Reasons of calves losses	Premature (10.93%), malformed or death (1.82%), sickness (1.82%), aborting (1.22%), unknown reasons (7.29%)
	Reasons of culling	Low productivity (13.76%), aging (9.17%), behavioral problems (1.83%), diseases and abortions (6.42%), capacity insufficiency (1.83%)
	Detected diseases	Respiratory (4.60%) and digestive (2.30%) system diseases, abort or prolapsus uteri (2.30%), mastitis (1.50%), eye (0.80%) and foot diseases (3.10%)
	Health checks	Yes (8.46%), no (91.54%)
	Absence of herd health and animal welfare monitoring program	No (100.00%)
	Vitamin applications	Yes (81.90%); no (18.10%)
	The holding ratio of at least one fattening animal was sick	0.77%
	Mortality rate	1.83%
	The holding ratio where buffalo culling occurred.	33.11%
	The holding ratio of animal disease detected	14.60%
	The ratio where calve losses occurred.	23.08%
	‡The average number of loosed calves	1.26±0.13
‡The average number of culled buffaloes (head)	1.71±0.23	

*Average number of fattening calves and the average fattening period were calculated based on the holdings applying fattening.

‡Average numbers of loosed calves and culled buffaloes were calculated on the base of the holdings that buffalo culling and calve losses were occurred.

Table 4. The results on the properties of workers and owners as a resource-based factor in buffalo holdings.

Factors	Variables	Results
Owners	Gender	Male (94.60%), female (5.40%)
	Education level	Not literate (3.80%), primary school (80.80%), secondary school (6.20%), high school (7.70%), university (1.50%)
Workers	Number of farm workers	2.75±0.10
	Number of male workers	1.58±0.07
	Number of female workers	1.16±0.05
	Number of not literate workers	0.23±0.05
	Number of primary school graduated worker	1.93±0.11
	Number of secondary school graduated worker	0.37±0.07
	Number of high school graduated worker	0.17±0.05
	Number of university graduated worker	0.05±0.02
	Presence workers trained on animal health and welfare	Yes (0.77%), no (99.23%)
Milkers	Gender	Male (10.80%), female (89.20%)
	Education level	Not literate (6.90%), primary school (86.90%), secondary school (5.4%), high school (0.80%)
Herdmen	Presence a herdmen	Available (34.60%) non available (65.40%)
	Herdmen	Owner (25.80%), common village herdmen (56.30%), holding's own paid staff (17.90%)

Data collection and Analysis

The study was carried out in all of the 130 water buffalo holdings within the scope of the sub-project numbered as TAGEM/66MANDA20015-01 under the Country Project for the Improvement of the Anatolian Water Buffalo in Public in Yozgat province. These holdings were located in 41 villages of Yozgat province center and the districts such as Akdağmadeni, Çekerek, Kadişehri, Saraykent, Sorgun and Çayıralan. The study was carried out in March and May. Each of the holdings were individually visited, resource-based and management-based measurements and evaluations were made according to the developed measurement, observation and evaluation forms and face to face interviews with holding owners and workers. Furthermore, a perception scale regarding animal welfare was applied on the animal owners and workers and these results will be published in another article. All measurements, evaluations and face-to-face interviews with each holding were made by the same person and completed within the same day. The descriptive statistics (percentages, means ± standard error of mean) were used in the analysis of the data to

determine the present situation in terms of the properties of agricultural activities and animal stock, resource-based and management-based factors affecting animal welfare in Anatolian Water Buffalo holdings. The statistical analysis was performed using SPSS 14.01 for Windows and Microsoft Excel 2007 programs.

Results

The results related to agricultural activities, land characteristics and animal existence in Yozgat province Water Buffalo holdings are presented in Table 1. In this context, characteristics of agricultural lands, plant and animal production characteristics and agricultural organization structure were determined in the buffalo holdings. The results on the resource-based factors affecting animal welfare in the buffalo holdings are shown in Table 2. It had been noted that drinking water for animals was supplied from sources such as rivers or streams and that the feed and watering troughs were clean and practical. The average daily concentrate feed and roughage consumption of water buffaloes were calculated as

4.09 kg and 9.08 kg, respectively. According to the findings from the principle of good housing, water buffaloes were mainly kept in semi-open and tie-stall barns. It was determined that the barns had a housing area of 11.05 m²/per animal, the floors were concrete and slippery, the air quality in the barns was poor and the barns were cleaned about twice per week. Of the holdings, 9.20% did not practice grooming and 64.80% of the holdings used dam lakes, ponds and rivers to cool the water buffaloes and 5.70% of holdings did not cool buffaloes at all. It was determined that the buffalo cows were tethered in the barn an average for 184.53 days and having access to pasture in spring and summer an average for 180.47 days in a year.

Table 3 shows that the findings related to the management-based factors such as care of water buffalo calves, surgical procedures, buffalo health, breeding practices, fattening practices, dog and manure management and keeping holding records. Water buffalo calves were weaned in an average of 137.12 days of age and the age was the main criterion for weaning. In the last 12 months, the mortality rate was calculated as 1.83% and 33.11% of the holdings had applied buffalo culling for reasons such as diseases and low productivity. Of the holdings, 91.54% did not have regular veterinary care, and none applied an animal health and welfare monitoring program. In general, it has been determined that artificial insemination and surgical procedures (e.g. dehorning) for the calves were not applied, hand milking has been preferred and the main economic evaluation form of the buffalo milk (average 4.37 kg per animal per day) was yoghurt. Only 23.84% of the holdings applied a fattening program for their calves. The buffalo farms, which had an average of 1.74 dogs, were sprinkling the manure to their own agricultural land.

The results which are concerning to the demographics of animal caretakers, milkers and herdmen as well as those of water buffalo holding owners are given in Table 4. It has been determined that both holding owners and animal caretakers are predominantly male and primary school graduates and were not trained in animal health and welfare. The average number of workers per holding was calculated as 2.75 persons. The milkers were mainly female

and the water buffaloes were grazed by the village herdmen.

Discussion and Conclusion

Industrial plants and forage plants were produced in the majority of the water buffalo holdings yet half of the holdings could not get economic income from plant production. As a matter of fact, only 6.90% of the holdings produced grain and rough feed themselves. Therefore, 94.60% of the holdings grazed their buffaloes during the day for 6 months of the year. The ratio of buffalo holdings which were breeding water buffalo was only 9.30 % while other holdings were breeding cattle (83.80%) and sheep (6.90%) as a second production. The average number of dairy buffalo cow was 7.30 heads and these small and medium sized water buffalo holdings (91.60% of the holdings had 20 or less buffaloes) were performing combined meat and milk production. Breeding cattle and small ruminant (sheep and very few goats) in water buffalo holdings indicated that only buffalo breeding did not generate enough profits and that the most important cost item was animal feed (concentrate feed and roughage consumption 4.09 kg and 9.08 kg / per animal, respectively). It has been noted that the holdings sold the milk as yoghurt and this was an opportunity for the production and sale of traditional and geographically indicated water buffalo products. On the other hand, it was observed in some holdings that the male buffalo calves were also fattened and earned income from selling live animals. These results are in parallel with Borghese and Mazzi [5]'s results on the structure and operation capacity of buffalo breeding in Turkey and Iqbal et al [16]'s findings regarding the optimum daily feed consumption of water buffaloes. Except for being an invitation for microbiological and chemical threats via the use of rivers and streams as drinking water for the buffaloes, the feed and water troughs were clean and appropriate for easy use by the animals.

The assessments of holdings in terms of the principle of good housing indicated that the factors related to housing and facilities had the potential to negatively affect water buffalo welfare. The housing density was found as 11.05 m²/ per animal and this value is parallel to work done by Salzano et al [30] who reported that 10 m²/per animal living

area had no negative impact on reproduction performance. However, as the study was carried out at the beginning of summer, it is believed that this value was high because some of the non-milked buffaloes were housed in the outdoor loafing area. Inadequate housing space creates stress in water buffalo since they especially enjoy resting in different positions [23,33]. This stress suppresses the immune system which leads to a decrease in milk production and reproductive efficiency and eventually leads to sickness [11,37]. The air inside of the barns in these holdings was poor, the floor was concrete and slippery and there was no bedding in the rest area of the water buffaloes. The water buffaloes grazed in a pasture between April and October with an average walking distance of 2.58 km. The pasture had shades where the water buffalo could display their natural behaviors which had a positive impact on their welfare status [5]. It is believed that manual grooming, which provides supportive comfort for water buffaloes struggling with stress also had a more positive impact by providing positive human-animal interaction [2]. It has been determined that the rate of holdings providing cooling with water sprinklers was low (29.50%), while other holdings used lakes, ponds and water courses for this purpose. However, it has been assessed that the use of these resources for cooling buffaloes might be interrupted due to seasonal conditions or the herdmen's initiative and they might therefore be deprived of a significant defense mechanism to cope with heat stress and ectoparasites [24].

Although partitions in the barn for new born calves were available in 57.70 % of the holdings, no partitions were allocated to sick and calving animals in any of the holdings. Insight of these results, it was argued that the special housing and comfort needs could not met for the sick, pregnant or newborn buffaloes. In addition, these existing conditions provided a suitable environment for the spread of diseases. These results are inconsistent with the results obtained by Khadda et al [17] in a similar study in India, where they identified sick animal divisions in 65% of buffalo holdings. The weaning age was approximately 20 weeks. The weaning age determined for the calves in the study was higher than 5 weeks reported by Bharti [3] and 8 weeks reported by Rashid et al [27]. It is thought that the rea-

son of this finding could be due to the fact that the calves are kept with their mothers during the milking of the cows. In fact, the holdings consider the age of the calve (76.20%) as a criterion for weaning. It has been reported that the stress generated in calves and buffalo cows by the early weaning of calves is associated with the fear of abandonment caused by a strong maternal instinct [3]. In terms of animal welfare, the fact that dehorning and tail cutting which cause pain and suffering are not implemented on calves is considered positive [15]. But, the lack of hoof care is considered a negative aspect. There were on average 1.74 dogs per holding and no special measures to protect the buffaloes from social stress generated by dogs have been observed except for the temporary and primitive barriers for the barn entrance.

One third of the buffalo holdings (33.11%) have culled some water buffaloes from the herd within the past year before completing their economic lives as a result of sickness, low productivity and behavior problems. Other significant economic losses have been incurred with the loss of an average of 1.26 water buffalo calves per holding due to premature birth, birth as a malformed or death, aborting and sickness. The water buffalo mortality rate per holding was 1.83% while the mortality rate for fattening buffalo calves was 0.77%. The effect of low housing standards is considered to be influential in the economic losses caused by diseases and mortality. This comment is supported by the fact that both of prevention strategies of the holdings for infectious diseases has been limited to vaccination within the minimum legal limits and the incidence of observed diseases such as reproductive, respiratory, digestive, foot and breast diseases were high (a total of 14.60% of the holdings). Furthermore, the absence of a herd health and animal welfare monitoring program, the lack of reliable and fully archived records of breeding and disease as well as the lack of regular veterinary care are other management-based factors or problems seen in the holdings [10,12,37].

While most of the milkers were women, both holding owners and caretakers were predominantly male. The majority of workers, an average of 2.75 persons per holding, was primary school graduates and not trained in animal health and welfare. The staff profiles in water buffalo holdings is quite com-

patible with the farm workers profile specified for other livestock holdings in Turkey [20]. The low education level of the employees is considered a weakness in terms of delivering welfare requirements to the water buffaloes and reducing welfare losses [10,21,25]. The high perception of animal welfare in female farm workers [19] may increase the level of positive animal-human interaction [29].

In conclusion, the water buffalo holdings within the scope of the sub-project under the Country Project for the Improvement of the Anatolian Water Buffalo in Farm Condition in the province of Yozgat are small and medium scale and practice traditional water buffalo breeding that is common in Turkey. Resource-based factors, excluding feed purchasing costs, reflect good nutrition standards, while resource-based and management-based factors in terms of housing indicate poor housing standards. It seems that the opportunity for animals to exhibit natural behavior in winter conditions is restricted. It has been assessed that the sustainability of the welfare of the water buffaloes may be compromised due to the low education level of the holding owners and farm workers. However, it has been concluded that there is a need for further studies regarding resource-based and management-based factors and animal-based welfare indicators that affect animal welfare in water buffalo holdings.

Acknowledgement

We would like to thank Turkish Ministry of Agriculture and Forestry, General Directorate of Agricultural Research and Policies, Yozgat Buffalo Breeders' Association and the technical staff Rizvan ÖZCAN from Yozgat Buffalo Breeders' Association for their all valuable supports on application of this study.

References

- Anonymous (1995): Model code of practice for the welfare of animals—Farmed buffalo, prepared for the Standing Committee on Agriculture and Resource Management, published by CSIRO, 1995, SCARM Report Series No. 52.
- Anonymous (2011): Çiftlik Hayvanlarının Refahına İlişkin Yönetmelik. Resmi Gazete No: 28151, 23 Aralık 2011.
- Bharti PK, Dutt T, Patel BHM, Pandey HO, Tomar AKS (2015): Does age at weaning influences behaviour of Murrah buffalo calves under semi-intensive management conditions?. *Indian Journal of Animal Sciences*, 85 (9): 1031–1036.
- Borghese A (2013): Buffalo livestock and products in Europe. *Scient. Bull. Escorena*, 3: 47-73.
- Borghese A, Mazzi M (2005): Buffalo population and strategies in the world. In: Borghese, A. (Ed.), *Buffalo production and research*. Food and Agriculture Organization of the United Nations, Rome, Italy, 1–39.
- Botreau R, Veissier I, Butterworth A, Bracke MBM, Keeling LJ (2007): Definition of criteria for overall assessment of animal welfare. *Anim. Welfare*, 16: 225–228.
- Capdeville J, Veissier I (2001): A method of assessing welfare in loose housed dairy cows at farm level, focusing on animal observations. *Acta Agric. Scand. Sect. A*, 51: 62–68.
- Carvalho MVL, Sant'Anna AC, Páscoa AG, Jung J, Costa MJRP (2017): The relationship between water buffalo cow temperament and milk yield and quality traits. *Livestock Science*, 198: 109-114.
- Colditz IG, Ferguson DM, Collins T, Matthews L, Hemsworth PH (2014): A prototype tool to enable farmers to measure and improve the welfare performance of the farm animal enterprise: The Unified Field Index. *Animals*, 4(3):446-462.
- De Rosa G, Napolitano F, Grasso F, Pacelli C, Bordi A (2005): On the development of a monitoring scheme of buffalo welfare at farm level. *Ital.J.Anim.Sci.*,(4):115-125.
- De Rosa G, Napolitano F, Saltalamacchia F, Bilancione A, Sabia E, Grasso F, Bordi A (2007): The effect of rearing system on behavioural and immune responses of buffalo heifers. *Ital J Anim Sci*, (2):1260-1263.
- Di Palo R, Midea D, Campanile G, Rossi N, Zicarelli L (2001): Influence of management system on reproductive activity of dairy buffaloes during the hot season. In: *Proceedings of the 6th World Buffalo Congress, 2001, Maracaibo, Venezuela*. Maracaibo: WBC. pp. 130-136.
- FAO (2015): *FAO statistical pocketbook world feed and agriculture 2015*. Food and Agriculture Organization of the United Nations, Rome.
- Gaughan J, Mader T, Holt S, Lisle AA (2008): A new heat load index for feedlot cattle. *J. Anim. Sci.*, 86: 226–234.
- Guccione J, Carcasole C, Alsaad M, D'Andrea L, Di Loria A, De Rosa A, Ciaramella P, Steiner A (2016): Assessment of foot health and animal welfare: clinical findings in 229 dairy Mediterranean Buffaloes (*Bubalus bubalis*) affected by foot disorders. *BMC Veterinary Research*, 12:107.
- Iqbal ZM, Abdullah M, Javed K, Jabbar MA, Ahmed N, Ditta YA, Mustafa H, Shahzad F (2017): Effect of varying levels of concentrate on growth performance and feed economics in Nili-Ravi buffalo heifer calves. *Turk J Vet Anim Sci*, 41: 775-780.
- Khadda BS, Lata K, Singh B, Kumar R (2017): Study of buffalo husbandry practices in rural area of Central Gujarat in India. *Buffalo Bulletin*, 36 (1):75-87.
- Khan S, Qureshi SM, Ahmed I, Shah MS (2011): Milk composition and yield changes with advancing pregnancy in dairy buffaloes (*Bubalus bubalis*). *Turk. J. Vet. Anim. Sci.*, 5(6): 375-380.
- Kılıç İ, Bozkurt Z (2013) The relationship between farmers' perceptions and animal welfare standards in sheep farms. *Asian Australas. J. Anim. Sci.*, 26(9):1329-1313.
- Kılıç İ, Bozkurt Z, Tekerli M, Koçak S, Çelikeloğlu K (2013): Afyonkarahisar ili koyunculuk işletmeleri çalışanlarının hayvan refahını etkileyen faktörlerle ilgili algıları. *Lalahan Hay. Arast. Enst. Derg.*, 53 (1):29-38.
- Main DCJ, Whay HR, Green LE, Webster AJF (2003): Effect of the RSPCA Freedom Food Scheme on the welfare of dairy cattle. *Veterinary Record*, 153:227-231.
- Napolitano F, Pacelli C, Braghieri, A, Grasso F, De Rosa G (2017): *Animal - Environment Interaction: Buffalo Behavior and Welfare*, Chapter 4, pp:69-104. In: *Edit by Presicce G.A. (2017). The Buffalo (Bubalus bubalis) - Production and Research*. Bentham Science Publishers.

23. Napolitano F, Pacelli C, Grasso F, Braghieri A, De Rosa G (2013): The behaviour and welfare of buffaloes (*Bubalus bubalis*) in modern dairy enterprises. *Animal*, 7 (10):1704–1713.
24. Napolitano F, De Rosa G, Grasso F, Bordi A (2004): Influence of space restriction on welfare of weaned buffalo calves (*Bubalus bubalis*). *Livestock Production Science*, 86:117–124.
25. Pasha TN, Hayat Z (2012): Present situation and future perspective of buffalo production in Asia. *The Journal of Animal and Plant Sciences*, 22(3): 250-256.
26. Perišić P, Bogdanović V, Mekić C, Ružić-Muslić D, Stanojević D, Popovac M, Stepić S (2015): The importance of buffalo in milk production and buffalo population in Serbia. *Biotechnology in Animal Husbandry*, 31 (2):255-263.
27. Rashid MA, Pasha TN, Jabbar MA, Ijaz A, Rehman H, Yousaf MS (2013): Influence of weaning regimen on intake, growth characteristics and plasma blood metabolites in male buffalo calves. *Animal*, 7(9):1472-1478.
28. RSPCA (2018): Welfare standards for dairy cattle, Assurewel dairy cattle assessment protocol, West Sussex, UK. (<https://www.ber-spcaassured.org.uk/media/1283/rspca-welfare-standards-dairy-cattle-jan-2018.pdf>.)
29. Saltalamacchia F, Tripaldi C, Castellani A, Napolitano F, De Rose G (2007): Human and animal behaviour in dairy buffalo at milking. *Animal Welfare*, 16: 139-142.
30. Salzano A, Spagnuolo MS, Lombardi P, Vecchio D, Limone A, Censi SB, Balestrieri A, Pelagalli A, Neglia G (2017): Influences of different space allowance on reproductive performances in buffalo. *Anim. Reprod.*, 14(2):429-436.
31. Tekerli M, Küçükkebabçi M, Akalin NH, Kocak S (2001): Effects of environmental factors on some milk production traits, persistency and calving interval of Anatolian buffaloes, *Livestock Animal Science*, 68: 275-281.
32. TÜİK (2017). Hayvansal Üretim İstatistikleri, 2017. Haber Bülteni, Sayı: 27704, 07 Şubat 2018.
33. Warriach HM, McGill DM, Bush RD, Wynn PC, Chohan KR (2015): A review of recent developments in buffalo reproduction - A Review. *Asian Australas. J. Anim. Sci.* 28(3):451-455.
34. Welfare Quality®2009 (2009): Welfare Quality® assessment protocol for cattle. Welfare Quality® Consortium, Lelystad, The Netherlands.
35. Yang B, Zeng XLQ, Qin J, Yang C (2007): Dairy buffalo breeding in countryside of China. *Italian J Anim Sci.*,6(2):25–29.
36. Zava AM, Sansinena M (2017). Buffalo milk characteristics and by-products. In: Edit by Presicce GA (2017): *The Buffalo (Bubalus bubalis) - Production and Research*. Bentham Science Publishers. Sharjah, UAE.
37. Zicarelli F, Campanile G, Gasparini B, Di Palo R, Zicarelli L (2005): Influence of the period and of the space on the milk production and on the consumption of dry matter in the Italian Mediterranean Buffalo. In: *Proceedings of the 3rd Congresso Nazionale sull' Allevamento del Bufalo; 1st Buffalo Symposium Europe and the Americas, Paestum, SA, Italy*. Paestum, SA, Italy: CNAB. pp. 75-76.