



Investigating current welfare status of the buffalo farms by ANI evaluation method

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Abstract

The Animal Needs Index (ANI) method is used in the study to determine the welfare levels of 58 buffalo farms in the Marmara region of Turkey. The enterprises were divided into 3 subgroups according to their size; (i) small-scale enterprises (n : 19), which have 5 to 19 buffalo cows, (ii) medium-scale enterprises (n : 20), which have 20 to 39 buffalo cows, and (iii) large-scale enterprises (n : 19), which have more than 40 buffalo cows. The farms were visited and evaluated in two seasons according to ANI system. Thirty criteria for locomotion, social interaction, flooring, light and air, and stockmanship categories were evaluated. Most of the farms were determined to be highly suitable for animal welfare according to the ANI method. Although many differences were observed among the enterprises during the visits, it was thought that the buffalo enterprises could not be evaluated with sufficient sensitivity with the help of the ANI method, since these differences cannot be revealed when the total ANI scores were compared. The enterprise scale had no direct effect on the investigated parameters in the study. Considering the deficiencies of the criteria in the study to evaluate the physical characteristics and needs of the buffaloes, it has been concluded that the evaluation methods to be developed to determine the welfare level of buffaloes should consider the species-specific characteristics of the buffaloes.

Keywords Water buffalo · On-farm welfare evaluation · Enterprise scale · Animal Needs Index

Introduction

Being resistant to many diseases compared to cattle creates a perception among consumers that buffalo products are healthier and safer and this situation increases the demand for buffalo milk and dairy products (Atasever and Erdem 2008). In the past decades, buffalo milk was used mostly in cream and yoghurt production in Turkey, in insignificant quantities. However, buffalo breeding becomes a growing field in Turkey because of the increased consumer demands for buffalo milk and special products such as milk cream, mozzarella, burrata, and ricotta cheese.

Buffalo production is traditionally conducted under extensive conditions all around the world because of their need for

water or mud for social contact and grooming. However, to increase milk yield to meet consumer demand, some farmers began preferring intensive rearing. However, the intensification of buffalo farms can have negative impacts on buffalo welfare in many different ways, like any other species (Kaplan et al. 2018). Although there is not yet a method developed for farm-level welfare assessment in buffaloes, many studies conducted on how effective it will be when parameters such as daily bedtime, body condition scores, various haematological parameters, qualitative behaviour assessment, and disease and health records were used in determining the welfare level of buffaloes (De Rosa et al. 2009; De la Cruz-Cruz et al. 2014). In addition, De Rosa et al. (2009) stated that in order to prevent health and welfare problems that may occur in buffaloes due to intensification, buffalo's social or abnormal behaviour and their relationships with humans should be closely monitored in the developed method.

Animal Needs Index (ANI) method was developed for the evaluation of on-farm welfare levels of dairy cattle by Bartussek et al. (2000). ANI method evaluates farm equipment and conditions (stall dimensions, floor quality, air

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quality, etc.), management practices (social structure of the herd, management of young animals, yard or pasture usage, etc.), and animal-based parameters (skin and hoof condition, cleanliness of animals, etc.) under 5 categories (Bartussek et al. 2000). ANI evaluation method adapted for organic poultry and sheep production after dairy cattle, but there were no studies for buffaloes.

In Turkey, buffalo breeding is mostly carried out in poorly built barns, since the buffaloes spent most of the year in yards or pasture under extensive conditions (Soysal 2009). However, with the increase in intensive buffalo breeding recently, buffaloes have also started to be raised under conditions similar to cattle. However, unlike cattle, there is no method developed to assess welfare at farm-level for buffaloes. Therefore, in this study, it was aimed to determine the welfare levels of buffaloes raised under intensive conditions in different sized enterprises with the ANI method.

Material and methods

In this study, breeding conditions of 58 buffalo farms in the Marmara region of Turkey were evaluated in terms of animal welfare with the Animal Needs Index (ANI) method (Bartussek et al. 2000). The chosen farms had at least 5 buffalo cows and were visited in both summer and winter. The farms were divided into 3 subgroups according to the number of buffalo cows:

- a) Small-scale enterprises (n : 24): These family-type enterprises had 5 to 19 buffalo cows (mean 13.08 buffalo cows). The labour on the farm is mainly covered by families.
- b) Medium-scale enterprises (n : 19): Relatively larger family enterprises, which had 20 to 39 buffalo cows (mean 29.58 buffalo cows), and wage labour were used occasionally for some of the jobs on the farm.
- c) Large-scale enterprises (n : 15): Modernised enterprises, where only paid labour is used, which had more than 40 buffalo cows (mean 150.20 buffalo cows).

ANI welfare assessment system has 30 criteria under five categories, which were presented in detail by Bartussek et al. (2000): (i) locomotion, (ii) social interaction, (iii) flooring, (iv) light and air, and (v) stockmanship. These 5 categories were allocated between researchers and each researcher evaluated the same category during the study for intra-observer reliability.

Many differences have been observed between enterprises in terms of breeding conditions. The housing type of farms was varied between seasons. Twenty-six farms used loose housing during summer, while 32 farms chose to use tether buffaloes, at least at night-time. In winter, more

farms preferred tethered systems (48) over loose (10) housing. Bedding and flooring type/conditions can affect welfare in many aspects; therefore, they are thoroughly investigated. The most frequent bedding type in the study was “concrete; metal or plastic grids” (50 farms in winter, 32 farms in summer) and followed by “soft rubber, < 30 mm straw, < 60 mm sand” (4 farms in winter, 7 farms in summer) and “3060 mm straw; \geq 60 mm sand” (0 farms in winter, 11 farms in summer), respectively. Most of the farms preferred to use natural floor (44 farms) in the yard or pasture flooring, which is the best choice for hoof and udder health. Yard and pasture usage of farms varied depending on farm utilities and geographical conditions. Most of the farms offered yard/pasture usage to the animals more than 230 days/year (43 farms), followed by 180 days/year (14 farms). For the evaluation of light and air category, air quality parameters had to be measured in each evaluation. The relative humidity (winter: 71,65%, summer: 56,71%), temperature (winter: 12,80 °C, summer: 29,45 °C), and CO₂ (winter: 1089,60 ppm, summer: 384,47 ppm) were measured with Testo 440 indoor air quality measuring instrument (Testo SE & Co. KGaA, Germany), while NH₃ (winter: 2,66 ppm, summer: 2,24 ppm) was measured using a portable NH₃ gas detector (Penta Automation and Industrial Products Limited Co., Turkey).

The evaluation of a farm in the ANI system was made according to the sum of all 5 categories' points, which is named as “ANI Scores”. The sum of all points can vary between 9 and +45.5 and higher scores reflect better welfare. ANI system has 6 welfare grades in it, divided as, (A) \geq 28; very suitable, (B) \geq 24–< 28; suitable, (C) \geq 21–< 24; fairly suitable, (D) \geq 16–< 21; partially suitable (mediocre), (E) \geq 11–< 16; scarcely suitable, and (F) < 11; unsuitable (Seo et al. 2007).

Statistics

One-way ANOVA analysis was performed to evaluate the effects of enterprise scale on Animal Need Index scores (both for 5 ANI categories and for the total ANI scores) in each season (SPSS Statistics version 21.0, IBM, New York, USA). Paired sample *t*-test was used to compare the scores given to enterprises in different seasons. Enterprises were divided into 6 welfare categories according to the total ANI scores they received. Frequencies of the enterprises in different welfare categories were compared in terms of season and enterprise scale, using the chi-square test.

Results

Summer points of small-scale enterprises were higher than winter scores for nearly every category and total ANI scores, except stockmanship category (Table 1). In medium

Table 1 Categories and total ANI scores of the buffalo enterprises from different enterprise scale

Parameters	Small enterprises	Medium enterprises	Large enterprises	P-values
<i>Locomotion</i>				
Summer	7.33 ± 2.16	6.40 ± 2.25	6.50 ± 1.41	0.262
Winter	5.54 ± 1.71	5.55 ± 1.44	5.93 ± 1.32	0.703
P-values	0.001	0.050	0.204	
<i>Social interaction</i>				
Summer	6.19 ± 1.51	5.71 ± 1.88	6.30 ± 1.18	0.489
Winter	5.02 ± 1.45	5.11 ± 1.58	5.27 ± 1.15	0.871
P-values	0.001	0.059	0.006	
<i>Flooring</i>				
Summer	3.92 ^a ± 1.46	2.92 ^b ± 1.67	2.63 ^b ± 1.04	0.017
Winter	2.98 ± 0.68	2.84 ± 0.88	3.13 ± 1.22	0.652
P-values	< 0.001	0.800	0.192	
<i>Light and air</i>				
Summer	7.17 ± 1.08	6.92 ± 1.25	7.33 ± 0.79	0.532
Winter	5.38 ± 1.13	5.26 ± 1.22	5.60 ± 1.17	0.690
P-values	< 0.001	< 0.001	< 0.001	
<i>Stockmanship</i>				
Summer	5.83 ± 1.02	5.21 ± 1.02	5.43 ± 0.50	0.086
Winter	6.02 ± 0.31	6.05 ± 0.55	6.20 ± 0.65	0.534
P-values	0.396	0.001	0.001	
<i>Total ANI Scores</i>				
Summer	30.44 ± 5.74	27.16 ± 5.38	28.20 ± 3.15	0.105
Winter	24.94 ± 3.99	24.82 ± 4.24	26.13 ± 3.92	0.590
P-values	< 0.001	0.008	0.055	

^{a, b}Different letters in the same row show statistical differences between enterprise scales
Significant values are shown in bold

enterprises, locomotion, light and air, and total ANI scores were higher in summer ($P > 0.05$); however, for the stockmanship category, winter scores were better. Large-scale enterprises had higher scores in summer for social interaction and light and air categories, while they had lower scores in summer for stockmanship category.

The effect of the enterprise scale was only significant in summer evaluation of flooring category, and small-scale enterprises had higher scores for this category. In this category, type, quality, and cleanliness of flooring material were evaluated, and for the medium and large-scale enterprises, summer and winter conditions of these criteria were similar, yet for the small-scale enterprises, buffaloes spent more time in pasture than medium or large enterprises; therefore, the farmers can keep the farm cleaner and tidier than medium or large enterprises.

None of the enterprises had a total ANI score lower than 16.5 in both winter and summer, which reflects that all enterprises had partially suitable welfare conditions for buffaloes according to the ANI evaluation system (Table 2). Small-scale farms had higher points in summer than winter. More small-scale farms had total ANI scores more than 28 points in summer than winter (54.2% vs. 12.5%), while in

the 21.524 points category, there were more farms in winter than summer (41.7% vs. 8.3%). Meanwhile, for medium and large enterprises, similar distribution of welfare status was observed in both seasons, due to their similar management practices during the year. On the other hand, the only significant difference between groups was on 21.524 points welfare status in summer, since small enterprises have the lowest percentage for this score category.

Discussion

ANI is a system developed to evaluate the level of housing and breeding conditions of the enterprises meeting the basic needs of the animals. Therefore, emphasis has been placed on management practices and housing conditions instead of animal-based parameters (Popescu et al. 2009). However, many studies conducted with the ANI method, and it has been determined that ANI is a sensitive and reliable method for farm-level welfare assessment (Amon et al. 2001; Ofner et al. 2003).

Locomotion category determines the extent to which animals can exhibit their natural behaviour in farm conditions.

Table 2 Welfare status of the enterprises according to the ANI evaluation system (%)

Parameters	Small enterprises	Medium enterprises	Large enterprises	P-values
<i>16.5–21 points</i>				
Summer	0	5.3	0	0.352
Winter	8.3	10.5	6.7	0.922
P-values	0.489	1.000	1.000	
<i>21.5–24 points</i>				
Summer	8.3 ^b	36.8 ^a	13.3 ^a	0.049
Winter	41.7	52.6	33.3	0.520
P-values	0.017	0.515	0.390	
<i>24.5–28 points</i>				
Summer	37.5	31.6	40.0	0.866
Winter	37.5	21.1	33.3	0.499
P-values	1.000	0.714	1.000	
<i>> 28 points</i>				
Summer	54.2	26.3	46.7	0.177
Winter	12.5	15.8	26.7	0.512
P-values	0.005	0.693	0.450	

^{a, b}Different letters in the same row show statistical differences between enterprise scales

Significant values are shown in bold

Due to their nature, farms can restrain animal behaviours involuntarily, and this continuous situation can cause chronic stress, behavioural disorders, and health problems in animals (Fisher et al. 1997). Besides, there is no regulation by the European Union stating the optimum stall, barn, or yard standards for buffaloes. However, the optimum stall area, drinker and feeder dimensions for various livestock, was determined by the Bureau of Indian Standards, and it was reported that the stall dimensions for adult buffaloes should be 4 m² per animal and for the open areas, it should be 8 m² per animal (Anonymous 2020). It was observed that 18 of 58 enterprises in the study did not meet the specified dimensions (not presented in the tables).

Small- and medium-sized enterprises in the study had the opportunity to take the buffaloes to the pasture during the summer months; for this reason, there is a significant difference between the summer and winter evaluations in the locomotion category. Large-scale enterprises tend to offer similar resources to animals in all seasons, such as using yards for outdoor activity, instead of pasture, because of the difficulty of herd management due to the large number of animals. This situation might be the possible reason for the similar total ANI scores.

Locomotion scores obtained in the study (6.40 for summer, 5.54 for winter) were found to be higher than the points obtained by Koçak et al. (2015) for the fattening enterprises with tethered system and the mean score of 24 dairy

enterprises (3.48) in the tethered system from the study by Popescu et al. (2009). Considering that most farms use tethered systems for winter, it has been observed that breeders have created a farm structure that allows more movement for buffaloes than cattle, although some enterprises do not meet the criteria set by the Indian Standards Bureau in line with the needs of the buffaloes (Anonymous 2020).

The interaction of the offspring with their parents, the situation of young animals in the herd, meeting the needs such as movement, personal hygiene and the rest of the animals raised in tethered systems as long as the chain allows, the opportunity to exhibit species-specific behaviours in open areas is essential for the animals to socialise and to understand the structure of the herd (Rousing and Wemelsfelder 2006; Sosa et al. 2018). The effect of enterprise scale was not found significant for both seasons in social interaction category.

Social interaction scores obtained in the study (5.71 for summer, 5.02 for winter) were found to be higher than those of Popescu et al. (2009) for the mean score of 24 tethered dairy enterprises (2.94). Considering that most buffalo farms use tethered systems in winter, the difference between the studies is possibly due to buffalo breeders' tendency to use their own heifers and purchase young animals less frequently and allow more open space usage due to the needs of the buffaloes.

The materials used on the floor surfaces, such as bedding, passageways, and yards, where animals are exposed every day should be selected from easily cleanable materials that will not adversely affect the health of animals (Telezhenko and Bergsten 2005; Schütz and Cox 2014). Otherwise, many health problems, especially the skin, hoof, and udder diseases, become a constant problem due to the failure of providing hygiene; the welfare of the animals will be negatively affected and this situation usually results in yield losses (Schütz and Cox 2014).

It has been observed that in small-scale enterprises, due to the usage of yards/pastures in summer, more frequently than other groups, enterprise hygiene can be provided better, while no significant difference was observed in other groups depending on the season since they offer similar yard or pasture utility to animals throughout the year. It was determined that the lowest score (2.63 for summer, 2.84 for winter) was in the flooring category. In the study, flooring score was lower than that of Popescu et al. (2009) (3.52) in both seasons. Since cattle are more susceptible to hygiene-related diseases than buffaloes, it suggests that cattle breeders pay more attention to hygiene conditions of their enterprises.

The light and air category evaluates the climatic conditions in the barn, in which daylight in animal house, air quality, draught in lying area, and noise vary depending on the seasonal conditions. Therefore, the difference between the summer and winter scores of all enterprises for this category

was significant. However, the minimum scores of enterprises for both seasons (6.92 for summer, 5.26 for winter) were higher than the obtained points of Popescu et al. (2009) and Koçak et al. (2015). It is inappropriate to compare the studies since the indoor climatic conditions are directly related to the geographical conditions of the farms and the variation that can be observed between the enterprises is high.

The cleaning of animals in the stockmanship category is considered an important criterion because ANI is a cattle-oriented assessment system. However, due to reasons such as having less sebaceous and sweat glands in buffalo skin, having a thicker skin, and having less hair follicles, it is essential for buffaloes to become muddy in terms of sun protection and balancing the body temperature (thermoregulation). While a body covered with mud or dirt is accepted as an indicator of low welfare in cattle, this situation is considered normal in water buffaloes due to the reasons stated above (De Rosa et al. 2005).

Similar to the stated reasons above, skin integrity, hoof condition, technopathies, and animal health categories do not reflect the real situation in terms of buffaloes, due to the species-specific physiological characteristics of buffaloes (such as thick skin, resistance to diseases, need of covering in mud). This part of the ANI evaluation system cannot fully determine how and at what level the buffaloes are affected by the current farm conditions, since the specified criteria constitute most of the stockmanship category. However, the scores for this category were higher than the scores of Popescu et al. (2009) and Koçak et al. (2015) possibly due to the above-mentioned characteristics of the buffaloes.

The lowest total ANI scores (20.5 for summer, 18.5 for winter) were found higher for both summer and winter periods from the points determined by Seo et al. (2007), Popescu et al. (2009), and Ofner et al. (2003) (6; 10.5 and 11.5, respectively); while the highest total scores (41 for summer; 37.5 for winter) were higher than the scores of Popescu et al. (2009) and Seo et al. (2007) (22 and 40, respectively), but Ofner et al. (2003) observed higher total ANI score (43.8) than the current study. It is thought that this situation was shaped by the fact that all three studies were conducted on cattle and the buffaloes need more activity in open areas, such as yard/pasture due to their physiological needs. Buffalo farms obtaining higher scores than the other studies conducted with cattle were an expected outcome since ANI is a system that allows the enterprises to get more points when they have better outdoor areas and they allow animals longer durations of outdoor usage.

Most of the 58 enterprises were determined to be highly suitable for animal welfare according to the ANI method (91% for summer; 98% for winter). However, it was observed that the effect of the enterprise scale on the welfare levels of the buffalo enterprises was significant only in the flooring

category in summer. It was determined that the difference was caused by various management practices that change depending on the season, and it was concluded that the enterprise scale did not have a direct effect.

In order to evaluate buffaloes more precisely with ANI, some adaptations are needed, especially in the stockmanship category. The study results showed that the most important need for change in locomotion and social interaction categories was in the “space allowance for loose housing systems” criterion. This criterion can be adapted according to the suggestions of the Bureau of Indian Standards for space allowance for buffaloes (4 m²/animal for indoor, 8 m²/animal for outdoor). The rest of the criteria is quite similar between dairy cattle and buffaloes. Therefore, these can be used unchanged in buffalo evaluation. During this study, researchers observed that flooring and air quality conditions in buffalo farms are similar to dairy cattle, and the criterion in these categories is highly objective. Therefore, these criteria can be used unchanged in the evaluation of buffalo welfare. In the stockmanship category, only “cleanliness of pens/feeding areas”, “technical condition of equipment”, and “tecnopathies” criteria can be used unchanged for buffaloes. However, “condition of integument”, “cleanliness of animals”, “condition of hooves”, and “animal health” criteria are needed to be adapted according to water buffaloes’ special needs.

Although many differences were observed in terms of herd structure and management among the enterprises during the visits, it is thought that the buffalo enterprises could not be evaluated with sufficient sensitivity with the help of the ANI evaluation system, since these differences could not be revealed when the total ANI scores were compared. Additionally, considering the deficiencies of the criteria in some categories to evaluate the various physical characteristics and needs of the buffaloes compared to cattle, it has been concluded that the evaluation methods to be developed in order to determine the welfare level of buffaloes should consider the characteristics of buffaloes that are different from cattle.

Author contribution PDK, HY, and OK designed the experiment. All authors collected the data. PDK and OK performed the statistical analysis. PDK wrote the paper. OK supervised all the procedures. All authors reviewed and approved the submitted paper.

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Declarations

Ethics approval The study was conducted with approval from the Istanbul University Ethics Committee (approval number 2018 / 106758).

Consent to participate (include appropriate statements) Not applicable.

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