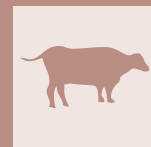


Effects of farm size and labour type on the welfare of dairy cattle according to the Welfare Quality® protocol



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SUMMARY

This study aimed to determine the welfare of 24 dairy cattle farms with the «Welfare Quality®» (WQ) protocol. Seven small farms (6-25 dairy cattle), 8 medium farms (26-100 dairy cattle), and 9 large farms (101+ dairy cattle) were used to determine the effects of labour resources on animal welfare, farms were divided into 3 subgroups: i) Family farms (n: 11), ii) Family farms with hired workers (n: 7), and iii) Large enterprises with exclusively hired workers (n: 6). Farm size and labour-type had no effect on the four main principles and total WQ scores of farms ($P>0.05$). All investigated farms were within the «acceptable» or «enhanced» welfare group according to the WQ protocol. However, family farms tend to have higher scores in some categories, indicating that having closer contact to animals helps for recognizing their needs.

It can be seen that housing conditions, managerial practises and the amount of labour per animal unit affect the welfare of the animals more than their operating capacity. The relatively small number of farms used in this study and the high variability between farms regarding the examined parameters were considered the most important limitations of the study. More detailed labour efficiency studies are needed to determine to what extent the welfare of animals are affected by the type and amount of labour.

KEY WORDS

Welfare Quality®; Labour type; On-farm welfare assessment; Dairy cattle.

INTRODUCTION

In European countries, consumers have begun to pay more attention to issues such as the conditions under which animals are raised on farms, how they are transported and slaughtered, and the effects of modern production techniques on animals. Therefore, the importance of the concept of «animal welfare» has gradually increased (Ekiz et al. 2022). The ability to develop a sustainable animal production strategy and ensure the production of quality animal products across the country is closely related to the welfare of the animals (Barry et al. 2023). Many studies have demonstrated that the husbandry practises applied on farms affect animal welfare (Hemsworth et al. 2002; Waiblinger et al. 2006). To evaluate farm level welfare, many evaluation systems (Animal Needs Index (ANI 35L/2000), the «TGI 200» and the «Welfare Quality®») have been developed that combine environmental and/or animal-based welfare indicators (Canali and Keeling 2009; Koçak et al. 2015).

Sixty percent of cattle farms in Türkiye have 14 head of cattle (İnan 2016). Also, there are many larger enterprises, especially after the significant investments in recent years. Although large farms mostly prefer the loose housing systems, small farms use

barns where they can tie up animals, especially during the winter months (İlgü and Güneş 2002). However, in small sized family farms, a mixed farming system (seasonally tethered or loose) throughout the year is commonly applied, depending on the climate and pasture opportunities in the region (Uzal and Uğurlu 2006). In temperate climates, breeders can benefit more from pasture resources, allowing animals to freely exhibit species-specific behaviours. Consequently, these animals experience better welfare compared to those that are continuously kept tethered (Hemsworth et al. 1995). Accordingly, different sized cattle farms face different welfare problems (Heath et al. 2014). Therefore, it is important to determine the efficiency of existing evaluation methods on farms of different sizes.

This study focuses on determining the effects of factors on the level and quality of human-animal interaction in dairy farms, such as labour type and FTE, on the principles of the WQ protocol and the total WQ score. The effect of farm size on WQ scores is also discussed.

MATERIAL AND METHODS

2.1. Animal materials

The trial protocol and procedures were approved by the Istanbul University-Cerrahpasa Local Ethics Committee for Animal Experiments (Approval Number: 2018/24).

The study was conducted at 24 loose-stall dairy cattle farms lo-

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cated in different districts of Kırklareli province between November 2018 and March 2019. To select the farms included in the study, cooperation was made with the Kırklareli Cattle Breeders Association, obtaining a list of farms suitable for data collection under the WQ protocol. To be included in the study, farm owners were explicitly informed that a) they had to be registered with the Kırklareli Cattle Breeders Association (in which case they were automatically required to have at least 6 dairy cattle) and b) they had to consent to farm visits and data collection during the study. In line with the preliminary investigations made before the study, the distribution of 1093 breeding dairy cattle farms in Kırklareli in the specified years according to the number of animals was examined. It was observed that the majority of farms in Kırklareli had 25 or fewer dairy cattle, so this number was chosen as the upper limit for small-sized farms. Because farms with more than 100 dairy cattle are generally considered large, lower and upper limits for the three subgroups were determined. Dairy cattle farms were divided into subgroups according to farm size and labour type to investigate the effects of these factors on farm level animal welfare, which presented in Table 1.

The amount of labour per cow is crucial in determining the level of stockperson attention that can be provided to the animals. For this reason, the full-time equivalent (FTE) labour use value was calculated for all farms. One FTE denotes 50 h of work per week for a worker (Bewley et al. 2001). Since the employees share all work including animal care and feeding, agricultural activities, and shelter cleaning, labour use was calculated taking into account all animals on the farm.

2.2. Welfare assessment based on the WQ protocol

The WQ protocol, was used to determine the welfare of dairy cattle under farm conditions (Welfare Quality® Consortium 2009). This protocol has 4 main welfare principles, and those principles contain 11 welfare criteria, and there are 30 evaluation measures in total. Although all researchers were familiar with the WQ assessment method, each researcher evaluated the principles assigned to all farms included in the study, thus ensuring inter-observer reliability. Furthermore, preliminary assessments were conducted on two pilot farms before commencing visits to the farms participating in the study. However, in line with the information in the animal selection table

in the “selecting dairy cows for assessment” section of the WQ protocol, all animals in enterprises with less than 30 dairy cows were evaluated, and as the enterprise size increased, animal selection was made using the sampling method specified in the protocol.

Within the scope of the study, researchers collected data on these 30 criteria according to their past experience and expertise. In short, the principles of absence of prolonged hunger, ease of movement, absence of injuries, and good human-animal relationship determination were measured by a veterinary researcher. Evaluation of the principles of absence of prolonged thirst and absence of disease was carried out by a veterinarian specializing in cattle breeding. Lying comfort, social behaviour, other species specific behaviours, and positive emotional state were examined in two repetitions by two researchers who have studied farm animal behaviour for many years, in line with the WQ methodology. The section on absence of pain inducing management procedures was evaluated by an animal breeding expert, based on face-to-face interviews with breeders.

In the evaluation method, the welfare of the animals at farms are expressed using the total Welfare Quality score, which varies between 0-100. The data recorded on the farms were entered into the score calculation section on the Welfare Quality® Consortium website, and the total farm WQ score was obtained using the scores of four main principles (good feeding, good housing, good health, appropriate behaviour) for each farm (INRAE 2024).

Following the WQ protocol manual, cattle farms were divided into four welfare level, (Not classified, Acceptable, Enhanced, Excellent) based on the level of meeting the needs of the animals regarding four main evaluated principles (Welfare Quality® Consortium 2009).

2.3. Statistical analysis

A General Linear Model (GLM) procedure was applied to determine the effect of farm size and labour type on the scores of WQ principles and the total WQ score. FTE value was included in the model as a covariate. The GLM model was:

$$Y_{ijkl} = \mu + a_i + c_j + b_l X_k + e_{ijkl}$$

Y_{ijkl} : prediction result for any feature.

μ : Overall mean

a_i : Fixed effect of farm size (i: Small, Medium or Large)

Table 1 - The descriptions of study subgroups.

Groups	Description	N	Mean ± S.D	Min.	Max.
Farm Size					
Small Farms	Has 6 to 25 dairy cattle on their farms	7	14.00±4.76	6	25
Medium Farms	Has 26 dairy to 100 dairy cattle on their farms	8	28.63±8.90	26	88
Large Farms	Has 101 heads or more dairy cattle on their farms	9	282.44±332.13	101	1052
Labour Type					
Family farms	Use labour force of family members only	11	17.64±6.59	6	29
Family farms with hired workers	Rearing livestock with the help of permanent outside hired workers and family members	7	50.86±24.40	25	88
Large enterprises with exclusively hired workers	Livestock rearing is carried out only with the help of external hired labour on a permanent and/or periodic basis.	6	386.50±370.74	60	1052

S.D.: Standard deviation, Min.: Minimum, Max.: Maximum

Table 2 - Effect of farm size and labour type on welfare scores of dairy cattle farms according to the Welfare Quality protocol.

Factor	n	Good Feeding	Good Housing	Good Health	Appropriate Behaviour	Total Welfare Quality Scores
Farm Size						
Small	7	42.77±20.97	52.16±6.68	26.55±6.73	15.56±2.50	137.03±25.51
Medium	8	56.95±14.60	62.91±4.65	38.50±4.69	18.79±1.74	177.14±17.77
Large	9	78.13±15.25	54.38±4.86	33.74±4.89	24.80±1.82	191.06±18.55
Labour Type						
Family Farm	11	70.92±14.72	61.78±4.69	42.70±4.72	23.52±1.75	198.92±17.91
Family + hired employees	7	61.18±14.29	49.98±4.55	27.93±4.59	19.05±1.70	158.14±17.39
Only hired employees	6	45.75±22.78	57.69±7.26	28.15±7.31	16.57±2.72	148.17±27.71
Overall Means		59.28±8.13	56.49±2.59	32.93±2.61	19.71±0.97	168.41±9.89

Higher scores indicate better welfare status of the animals, both for main categories and total WQ scores. n: number of farms; *FTE: Full-time equivalent labour utilization value

c_j: Fixed effect of labour type (j: Family, Family + hired worker, hired worker only)

X_k: FTE effect as covariance

b_j: Partial regression coefficient of the FTE effect

e_{ijkl}: Random error.

Chi-square analysis was conducted to compare the subgroups of farm size and labour type regarding the percentages of farms with «acceptable» and «enhanced» welfare levels (those were the only levels resulted in study). Pearson's correlation test was applied to determine the relationship between FTE scores and category-based and total WQ scores. All statistical analyses were performed using the SPSS 22.0 (IBM, USA) programme and the significance level was considered as P<0.05.

RESULTS

The WQ main principles and total WQ scores of the farms are presented in Table 2. The overall means for the «good feeding», «good housing», «good health», «appropriate behaviour» principles and total WQ scores were 59.28, 56.49, 32.93, 19.71 and 168.41, respectively. The farm size and labour type subgroups had similar points for the 4 main principles and total WQ score (P>0.05). The effect of full-time equivalent (FTE) labour use on the WQ main principles and total WQ scores was also not significant (P>0.05).

Regarding the WQ evaluation, farms are grouped considering the scores they receive for 4 main principles and total WQ score. All farms were fell in the «acceptable» or «enhanced» welfare group (Table 3). In other words, none of the farms whose welfare evaluation was performed according to the WQ protocol

provided a welfare condition at the «Not classified» or «Excellent» level. However, the effects of farm size and labour type on the distribution of welfare levels among farms were statistically insignificant.

When the relationships between FTE and the scores of WQ main principles and the total WQ score were examined, no significant correlation was observed. But, there was a moderately positive relationship (r=0.499, P<0.05) between good housing and good health (Table 4). Additionally, appropriate behaviour result had negative yet not significant correlations with total WQ scores (r=-0.048; P<0.05).

DISCUSSION

The WQ protocol is the most comprehensive system available for animal welfare assessment on farms, but it is not comprehensive enough to examine all aspects of a farming method in detail, regarding animal welfare (Wagner et al. 2021).

Although large enterprises received higher scores than other farm size groups in Good Feeding, Appropriate Behaviour, and Total WQ scores, the effect of farm size was not significant throughout the study. Similar to ours, Gieseke et al. (2018) reported that the effect of farm size on any of the WQ parameters was not significant, and they concluded that the WQ was not suitable for use when comparing differently sized farms. Only «Good Feeding» scores of our study was higher than previous studies, which investigated loose-type cattle farms (Popescu et al. 2014; Wagner et al. 2021; Barry et al. 2023). Additionally, the overall mean (19.71±0.97) determined for the «Appropriate behaviour» category from this study was much

Table 3 - Effects of farm size and labour type on animal welfare* at dairy cattle farms.

Factor	n	Acceptable (%)	Enhanced (%)
Farm Size			
Small	7	85.7	14.3
Medium	8	75.0	25.0
Large	9	88.9	11.1
Labour Type			
Family Farm	11	72.7	27.3
Family + hired employees	7	100	0
Only hired employees	6	85.7	14.3

n: number of farms; *Evaluation based on Total Welfare Quality® Score

Table 4 - Correlation coefficients between FTE score and Welfare Quality® principal scores and total Welfare Quality® score.

	FTE	Good Feeding	Good Housing	Good Health	Appropriate Behaviour	Total Welfare Quality Scores
FTE	1	0.178	-0.063	0.224	0.120	0.202
Good Feeding		1	0.104	0.231	-0.065	0.876***
Good Housing			1	0.499*	-0.142	0.496*
Good Health				1	-0.202	0.600**
Appropriate Behaviour					1	-0.048
Total Welfare Quality Scores						1

FTE: Full-time equivalent labour utilization value

*P<0.05, ** P<0.01, *** P<0.00

lower than that of previous studies (Popescu et al. 2014; Wagner et al. 2021). This result indicates that the opportunities provided for cows to exhibit species-specific behaviours (expression of social behaviours, expression of other behaviours, human-animal relationship and positive emotional state) in dairy cattle farms in the region might be inadequate.

Although the farms provided better nutrition than those reported in previous studies conducted in various countries (all farms received a perfect score of 100 because they did not experience long-term hunger), only eight of the farms were determined to provide sufficient and unlimited access to clean water (not presented in the tables). This result indicates that breeders are not sufficiently informed or do not aware the necessity of providing animals with unlimited access to fresh and clean water to protect their health and welfare. Research shows that 1.24 to 1.30 L of drinking water are required for every 1 kg of milk production. (Popescu et al. 2014), and the daily water intake requirements of dairy cattle are 23.5 and 143.3 L (Singh et al. 2022). However, long-term dehydration or limited water intake not only affects milk yield/quality but can also slow growth, decrease welfare and be resulted with more aggressive behaviour (Little et al. 1980).

Even though the effect of labour-type was not significant, family farms had higher mean scores in all categories, which represents most of the dairy sector in Türkiye. This result may be related to the fact that the small number of animals per worker, allowing close contact between owners and their animals in family businesses, helps them better understand their needs. The farms with only hired employees received the lowest scores, especially regarding good feeding and appropriate behaviour principles. Similarly, O'Donovan et al. (2008) found that as herd size increases, the time workers spent per animal decreases, particularly the time allocated for cow care, cleaning, and management. Additionally, Deming et al. (2018) reported that 17.3 hours were allocated per animal per year for cattle herds of 250 head or more, while this value varied between 23.3 and 23.8 hours for herds smaller than 250 head. Furthermore, the same study found that the time allocated for cow care decreased as herd size increased. Weary et al. (2019) stated that when farms reach a certain number of animals, there is a decrease in the standard of care provided to animals due to the decrease in worker interest per unit of animals and management practises that contribute to welfare. In such situations, management practices that contribute greatly to welfare, especially access to outdoor opportunities such as courtyards/pastures, become impractical and pave the way for chronic welfare problems.

Even though, the effect of FTE did not affect farms WQ scores, it had a positive effect on animal health ($P=0.054$), and when breeders' interest in animals' increases, the general health status of the animals (in terms of absence of injuries and diseases and providing adequate mobility) improves. However, both Robbins et al. (2016) and Beggs et al. (2015) reported that as enterprise size increases, welfare risks in some areas increase, but enterprise make more efforts to develop strategies to prevent this phenomenon. However, a more detailed labour productivity study is required to determine to what extent the welfare of animals is affected by the type and amount of labour used.

The farm size and labour type did not have significant influence on the welfare of dairy cattle farms according to the WQ protocol, which is consistent with previous studies (Lindena and Hess 2022; Gieseke et al. 2018). However, the proportion of farms with «Enhanced» welfare was numerically higher in medium farms than in other groups. The fact that none of the 24 farms examined had an «Excellent» level of welfare according to the WQ protocol is similar to many previous studies conducted in different countries. (Keeling 2009; de Vries et al. 2011). Wagner et al. (2021) reported that there was an «Excellent» welfare level of 7%, a «Enhanced» welfare level of 64%, and an «Acceptable» welfare level of 36%, however, 46 of the farms examined in their study were engaged in organic cultivation and received higher scores than farms with conventional systems. In addition, Popescu et al. (2014), found that 70% of free-stall enterprises were at a «Enhanced» level of welfare and 30% were at an «Acceptable» welfare level, and that there were no enterprises with an «Excellent» or «Not acceptable» welfare level, similar to ours.

Although the effect of labour type on the welfare scores of farms were not significant, the proportion of farms defined as «Enhanced» welfare was higher in enterprises using only family labour than in enterprises that use family and hired employees together. However, all enterprises where family members and hired employees work together have an «Acceptable» welfare level.

When the correlations of FTE with WQ main principles and total score were examined, no significant relationship was found. However, there was a positive and significant correlation between the criteria of «Good feeding» and «Good health». Beggs et al. (2015) stated that as the size of a farm increases, farmers pay more attention to nutrition and milking hygiene, and that the welfare problems experienced in other areas can remain balanced thanks to improvements in the mentioned areas.

One of the most important shortcomings of welfare evaluation protocols is that assigning excessive weight to certain parameters may prevent the true situation from being fully revealed. Barry et al. (2023) stated that while animals not having sufficient and unlimited access to water may cause very low scores in terms of the «Good feeding» criterion, the general health status of the animals had little effect on the total score. This hypersensitivity focused on some criteria can lead breeders to care about improving areas that will bring more points, rather than focusing on improving truly important welfare problems (de Vries et al. 2013). However, the insufficient inter-observer reliability of one-time measurements such as QBA evaluation, cleanliness and injury scores, and avoidance distance is one of the points that should be taken into account when comparing WQ results of different studies (Heath et al. 2014; de Graaf et al. 2017; Gieseke et al., 2018).

CONCLUSION

Study results indicated that, farm size and labour type have no significant effect on WQ principles and the total scores. Even though large enterprises received higher scores than other farm size groups in Good Feeding, Appropriate Behaviour, and Total WQ scores, the farms uses family labours tend to have higher scores in some categories, indicating that having closer contact to animals helps for recognizing their needs.

It can be seen that housing conditions, managerial practises and the amount of labour per animal unit affect the welfare of the animals more than their operating capacity. The relatively small number of farms used in this study and the high variability between farms regarding the examined parameters were considered the most important limitations of the study. More detailed labour efficiency studies are needed to determine to what extent the welfare of animals are affected by the type and amount of labour.

Statements and Declarations

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Competing Interests

The authors have no relevant financial or non-financial interests to disclose.

Author Contributions

Alper Yilmaz, Bulent Ekiz and Pembe Dilara Kecici contributed to the study conception and design. Material preparation and data collection were performed by Hulya Yalcintan, Nursen Ozturk, Pembe Dilara Kecici, Alper Yilmaz and Bulent Ekiz. Data analysis was performed by Pembe Dilara Kecici and Bulent Ekiz. The first draft of the manuscript was written by Pembe Dilara Kecici and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Data availability

The datasets of the current study are available from the corresponding author on reasonable request, except for the public display.

Ethics approval

The trial protocol and procedures were approved by the Istanbul University-Cerrahpa Local Ethics Committee for Animal Experiments (Approval Number: 2018/118480).

References

- Barry, C., Ellingsen-Dalskau, K., Garmo, R.T., Kischel, S.G., Winckler, C., Kielland, C. 2023. Obtaining an animal welfare status in Norwegian dairy herds-A mountain to climb. *Front. Vet. Sci.*, 10: 1125860. <https://doi.org/10.3389/fvets.2023.1125860>.
- Beggs, D.S., Fisher, A.D., Jongman, E.C., Hemsworth, P.H. 2015. A survey of Australian dairy farmers to investigate animal welfare risks associated with increasing scale of production. *J. Dairy Sci.*, 98: 5330-5338. <https://doi.org/10.3168/jds.2014-9239>.
- Bewley, J., Palmer, R.W., Jackson-Smith, D.B. 2001. A comparison of free-stall barns used by modernized Wisconsin dairies. *J. Dairy Sci.*, 84: 528-541. [https://doi.org/10.3168/jds.S0022-0302\(01\)74504-3](https://doi.org/10.3168/jds.S0022-0302(01)74504-3).
- Canali, E., Keeling, L. 2009. Welfare Quality Project: from scientific research to on-farm assessment of animal welfare. *Ital. J. Anim. Sci.* 8(2): 900-903. <http://dx.doi.org/10.4081/ijas.2009.s2.900>.
- de Graaf, S., Ampe, B., Winckler, C., Radeski, M., Mounier, L., Kirchner, M.K., Haskell, M.J., van Eerdenburg, F.J.C.M., de Boyer des Roches, A., Andreassen, S.N., Bijttebier, J., Lauwers, L., Verbeke, W., Tuytens, F.A.M. 2017. Trained-user opinion about Welfare Quality measures and integrated scoring of dairy cattle welfare. *J. Dairy Sci.*, 100: 6376-6388. <https://doi.org/10.3168/jds.2016-12255>.
- Deming, J., Gleeson, D., O'Dwyer T., Kinsella, J., O'Brien, B. 2018. Measuring labor input on pasture-based dairy farms using a smartphone. *J. Dairy Sci.*, 101: 9527-9543. <https://doi.org/10.3168/jds.2017-14288>.
- de Vries, M., Bokkers, E.A.M., Dijkstra, T., van Schaik, G., de Boer, I.J.M. 2011. Associations between variables of routine herd data and dairy cattle welfare indicators. *J. Dairy Sci.*, 94: 3213-3228. <https://doi.org/10.3168/jds.2011-4169>.
- de Vries, M., Bokkers, E.A.M., van Schaik, G., Botreau, R., Engel, B., Dijkstra, T., de Boer, I.J.M. 2013. Evaluating results of the Welfare Quality multi-criteria evaluation model for classification of dairy cattle welfare at the herd level. *J. Dairy Sci.*, 96: 6264-6273. <https://doi.org/10.3168/jds.2012-6129>.
- Ekiz, B., Kecici, P.D., Ekiz, E.E., Ozturk, N., Kocak, O., Arslan, M., Yilmaz, A. 2022. The effects of accustoming to handling during the finishing period and weaning status on stress responses to transport, and carcass and meat quality in Kivircik lambs. *Small Rumin. Res.*, 206: 106587. <https://doi.org/10.1016/j.smallrumres.2021.106587>.
- Gieseke, D., Lambert, C., Gauly, M. 2018. Relationship between herd size and measures of animal welfare on dairy cattle farms with freestall housing in Germany. *J. Dairy Sci.*, 101: 7397-7411. <https://doi.org/10.3168/jds.2017-14232>.
- Heath, C.A.E., Browne, W.J., Mullan, S., Main, D.C.J. 2014. Navigating the iceberg: Reducing the number of parameters within the Welfare Quality® Assessment protocol for dairy cows. *Animal*, 8: 1978-1986. <https://doi.org/10.1017/S1751731114002018>.
- Hemsworth, P.H., Barnett, J.L., Beveridge, L., Matthews, L.R. 1995. The welfare of extensively managed dairy cattle: A review. *Appl. Anim. Behav. Sci.*, 42,161-182.
- Hemsworth, P.H., Coleman, G.J., Barnett, J.L., Borg, S., Dowling, S. 2002. The effects of cognitive-behavioral intervention on the attitude and behavior of stockpersons and the behavior and productivity of commercial dairy cows. *J. Dairy Sci.*, 80: 68-78. <https://doi.org/10.2527/2002.80168x>.
- İlgü, E., Güneş, H. 2009. Studies on the feed-lot performance of male Holstein-Friesian cattle under private farm conditions. *J. Fac. Vet. Med. Istanbul Univ.*, 28(2): 313-335.
- İnan, İ.H., 2016. Agricultural economics and management. İdeal Culture and Publishing, İstanbul, Türkiye.
- INRAE (The French National Research Institute for Agriculture, Food and Environment) 2024. *Welfare Quality® Result Simulator*. <https://www1.clermont.inrae.fr/wq/?simu=on>. (Accessed 26 June 2025).
- Keeling, L., 2009. An overview of the development of the Welfare Quality® Assessment Systems. Welfare Quality Reports N: 12.

- http://www.cardiff.ac.uk/cplan/sites/default/files/WQReport-12_0.pdf. (accessed 27 June 2025).
- Koçak, Ö., Akın, P.D., Yalçın, H., Ekiz, B. 2015. Assessment of Animal Welfare in Different Beef Cattle Housing Systems by ANI 35 L/2000 Method. *Kafkas Univ. Vet. Fak. Derg.* 21(4): 575-583. <https://doi.org/10.9775/kvfd.2015.12975>.
- Lindena, T., Hess, S. 2022. Is animal welfare better on smaller dairy farms? Evidence from 3,085 dairy farms in Germany. *J. Anim. Sci.*, 105: 8924-8945. <https://doi.org/10.3168/jds.2022-21906>.
- Little, W., Collis, K.A., Gleed, P.T., Sansom, B.F., Allen, W.M., Quick, A.J. 1980. Effect of reduced water intake by lactating dairy cows on behavior, milk yield, and blood composition. *Vet. Rec.*, 106: 547-551.
- O'Donovan, K., O'Brien, B., Ruane, D.J., Kinsella, J., Gleeson, D. 2008. Labour input on Irish dairy farms and the effect of scale and seasonality. *J. Farm Manag.*, 13: 38-53.
- Popescu, S., Borda, C., Diugan, E.A., Niculae, M., Stefan, R., Sandru, C.D. 2014. The effect of the housing system on the welfare quality of dairy cows. *Ital. J. Anim. Sci.*, 13: 2940. <https://doi.org/10.4081/ijas.2014.2940>.
- Robbins, J.A., von Keyserlingk, M.A.G., Fraser, D., Weary, D.M. 2016. Farm size and animal welfare. *J. Anim. Sci.*, 94(12): 5439-5455. <https://doi.org/10.2527/jas.2016-0805>.
- Singh, A.K., Bhakat, C., Singh, P. 2022. A review on water intake in dairy cattle: associated factors, management practices, and corresponding effects. *Trop. Anim. Health Prod.* 54: 154. <https://doi.org/10.1007/s11250-022-03154-2>.
- Uzal, S., Uğurlu, N. 2006. The contractual analyse of beef cattle production farms in Konya. *Selcuk J. Agri. Food Sci.*, 20 (40): 131-139.
- Wagner, K., Brinkmann, J., Bergschmidt, A., Renziehausen, C., March, S. 2021. The effects of farming systems (organic vs. conventional) on dairy cow welfare, based on the Welfare Quality® protocol. *Animal*. 15(8): 100301. <https://doi.org/10.1016/j.animal.2021.100301>.
- Waiblinger, S., Boivin, X., Pedersen, V., Tosi, M.V., Janczak, A.M., Visser, E., Bryan, K., Jones, R. 2006. Assessing the human-animal relationship in farmed species: a critical review. *Appl. Anim. Behav. Sci.*, 101: 185-242. <https://doi.org/10.1016/j.applanim.2006.02.001>.
- Weary, D.M., Robbins, J., Fraser, D., von Keyserlingk, M.A.G. 2019. Is Animal Welfare Better on Smaller Farms? in *Animal Welfare: From Science to Law*. Pages 133-139. Hild, S., Schweitzer, L. (Eds). <https://www.fondation-droit-animal.org/proceedings-aw/is-animal-welfare-better-on-smaller-farms/>
- Welfare Quality. 2009. In *Welfare Quality® Assessment Protocol for Cattle*. Welfare Quality® Consortium, Lelystad, Netherlands. ISBN: 9789078240044.