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Effect of farm size on dairy farm feeding welfare scores in Karnataka

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Abstract
This study was undertaken to compare the influence of farm size on dairy farm feeding welfare scores in Karnataka, India. A total of 401 adult crossbred cattle in 60 dairy farms of Karnataka were considered. The farms were grouped into three different categories based on adult herd size i.e., small, medium and large as per the prevailing dairy cattle holding in the region. The mean scores of the welfare indicator 'Availability of quality feeds and fodder' and 'Feeding practices for different categories of animals' in small, medium and large dairy farms, out of total score of 10 each, was 5.78 ± 0.077, 5.93 ± 0.041 and 6.10 ± 0.118, and 4.65 ± 0.109, 4.90 ± 0.143 and 5.28 ± 0.106, respectively. The mean scores of the welfare indicator 'Availability of feeds and fodder storage/preservation space' and 'Colostrum and milk feeding to calves' in small, medium and large dairy farms, out of total score of 5 each, was 3.13 ± 0.114, 3.28 ± 0.106 and 3.53 ± 0.117, and 4.68 ± 0.055, 4.70 ± 0.056 and 4.63 ± 0.080, respectively. The mean welfare score of small, medium and large dairy farms, out of total score of 30, was 18.28 ± 0.213, 18.80 ± 0.197 and 19.53 ± 0.234, respectively, with an overall welfare score of 18.85 ± 0.140. Large dairy farms had significantly better welfare scores.

Keywords: Dairy cattle welfare, farm size, feeding, Karnataka

Introduction
According to the DAHDF (2019) [2], India has the largest dairy cattle population globally, comprising 193.46 million cattle and 109.85 million buffaloes. Dairying is viewed as a lucrative venture, offering year-round supplementary income, productive employment opportunities, and improved nutritional security for households (Sreedhar and Ranganadham, 2010) [8]. As a developing nation, India must strike a balance between supporting the livelihoods of livestock owners and ensuring the well-being of their animals. Enhancing animal welfare offers numerous benefits, including sustained productivity, alignment with international standards, and the ability to satisfy the growing expectations of informed consumers both domestically and globally.

Animal welfare refers to an animal's ability to adapt and function effectively in response to its physical, chemical, and social environment—covering physiological, behavioural, cognitive, and emotional aspects, as well as the animal's own perception of its well-being (Scott *et al.*, 2001) [7]. Growing consumer awareness about animal welfare has boosted the demand for livestock products sourced from farms that maintain high welfare standards, potentially leading to increased market value and profits. However, the absence of comprehensive data on the welfare status of dairy cattle in Karnataka poses a significant obstacle to developing effective animal welfare policies. Hence the present study was undertaken to study the effect of farm size on feeding welfare scores.

Materials and Methods
Karnataka ranks among the top agricultural states in India, characterized by a relatively high livestock density, with animal husbandry playing a vital role in the rural economy. For this study, the resource/environment-based indicators of animal welfare were assessed at 60 dairy farms, 30 from the peri-urban region of Bengaluru Rural district and 30 from rural region of Kolar district were consider. Relevant variables to study the management practices related to the

welfare status of dairy cattle and attitude of farmers to dairy cattle welfare formed the basis for developing the schedule of enquiry, and to assess the dairy cattle welfare. Assessment of the welfare status of dairy cattle was done by using the basic components of the welfare scale were developed by Calamari and Bertoni (2009) [3] based on Integrated Diagnostic System Welfare (IDSW), and the Dairy Cattle Welfare Scale developed by Kumar (2016) [4] with suitable modifications keeping in view the farming practices and local conditions of the study area. Based on the number of adult cattle, the farms were categorized into three groups: small (1-2 animals), medium (3-10 animals), and large (more than 10 animals), reflecting the typical herd sizes in the region.

The assessment of feed and fodder availability was carried out using various parameters, including the quality and quantity of green fodder, dry fodder, silage, concentrate feed, and feed supplements. In addition, physical measurements were taken to evaluate the storage infrastructure, which included space allocated for storing dry fodder, silage, and concentrate feed, as well as the presence of facilities for mixing feed ingredients and the cleanliness of the storage areas. Feeding practices for various categories of animals were evaluated through direct measurement of green fodder/silage, dry fodder, and concentrate mixtures provided to the animals on the day of the visit. The assessment also included factors such as grazing practices, chopping of roughage, fodder enrichment, use of Total Mixed Ration (TMR), pre-calving feeding (steaming up), special post-calving feeding, summer feeding strategies, concentrate feeding based on milk yield, feeding frequency, and the use of UMMB blocks or salt licks. Colostrum and milk feeding practices for calves, such as timing, frequency, and quantity of colostrum and milk provided based on body weight, were documented through farmer interviews.

Results and Discussion

The overall mean scores of the welfare indicator ‘Feeds and feeding practices’ in dairy farms of sizes are presented in Table 1 with detailed breakup in Table 2. The mean welfare score in small, medium and large dairy farms, out of total score of 30, was 18.28 ± 0.213, 18.80 ± 0.197 and 19.53 ± 0.234, respectively, with an overall welfare score of 18.85 ± 0.140. Large dairy farms had significantly ($P<0.05$) higher welfare scores than small and medium farms**.** This was likely due to due to better availability of feeds and fodder, better feeding practices and better storage of feeds and fodder. Similar colostrum and milk feeding practices were recorded in farms of all sizes. Higher overall scores were reported by Kumar (2016) [4] (20.30 ± 1.12, 20.70 ± 1.12 and 23.40 ± 1.18) and Mahla (2018) [5] (21.90 ± 1.23, 26.65 ± 0.74 and 27.40 ± 0.29), while lower overall scores were reported by Rajpoot (2019) [6] (11.28 ± 0.40, 11.38 ± 0.48, 14.00 ± 0.42) and Adhikari (2021) [1] (13.40 ± 0.30, 13.34 ± 0.12, 17.78 ± 0.22), all of whom found significantly better scores in large dairy farms.

Availability of feeds and fodder: The mean welfare score in small, medium and large dairy farms, out of total score of 10, was 5.78 ± 0.077, 5.93 ± 0.041 and 6.10 ± 0.118, respectively, with an overall welfare score of 5.93 ± 0.051. Large dairy farms were significantly ($P<0.05$) better than the small dairy farms in this indicator. This might be due to better availability of dry fodder, silage, concentrate feed and feed supplements in large farms, and only better green fodder quality in small farms. Similar findings were reported by Rajpoot (2019) [6] (4.18 ± 0.33, 4.25 ± 0.40 and 5.76 ± 0.23) and Adhikari (2021) [1] (4.26 ± 0.41, 4.87 ± 0.39 and 6.25 ± 0.57) with lower scores, and Kumar (2016) [4] (7.15 ± 0.36, 7.15 ± 0.30 and 8.40 ± 0.40) and Mahla (2018) [5] (7.10 ± 0.34, 7.70 ± 0.16 and 7.90 ± 0.10), with higher scores. None of the farms studied met the freedom from hunger criteria due to limited quantity and quality of feed provided to the animal. There was also a lack of awareness among the farmers about scientific feeding practices and silage feeding.

Feeding practices for different categories of animals: The mean welfare score in small, medium and large dairy farms, out of total score of 10, was 4.65 ± 0.109, 4.90 ± 0.143 and 5.28 ± 0.106, respectively, with an overall welfare score of 4.94 ± 0.076. Large dairy farms had significantly better feeding practices as compared to small and medium farms due to greater adoption of chaffing of fodder, steaming up, summer feeding schedule and concentrate feeding as per milk yield. However small dairy farmers practiced grazing in greater numbers. The findings in the present study were in corroboration with Rajpoot (2019) [6] (3.80 ± 0.12). In contrast, Mahla (2018) [5] (8.83 ± 0.27) and Kumar (2016) [4] (7.05 ± 0.13) reported higher scores. The significant difference between large and small farms is in agreement with Rajpoot (2019) [6], Mahla (2018) [5] and Adhikari (2021) [1]. Majority of the farms practiced steaming up, special feeding after calving, summer feeding schedule and concentrate feeding as per milk yield.

Availability of feeds and fodder storage/ preservation space: The mean welfare score in small, medium and large dairy farms, out of total score of 5, was 3.13 ± 0.114, 3.28 ± 0.106 and 3.53 ± 0.117, respectively, with an overall welfare score of 3.31 ± 0.067. Large farms had a significantly higher score than small farms in the availability of feeds and fodder storage/preservation space due to better availability of storage space for dry fodder, silage, concentrate feed, facility for mixing ingredients and better hygiene of feed storage area. The findings were agreement with Kumar (2016) [4] (2.90 ± 0.23, 2.75 ± 0.41 and 3.70 ± 0.52) in Haryana, whereas Mahla (2018) [5] (3.10 ± 0.0.34, 4.05 ± 0.34 and 4.80 ± 0.14) reported higher scores in Punjab. In contrast, Rajpoot (2019) [6] (2.56 ± 0.13, 2.38 ± 0.18 and 2.76 ± 0.16) reported no significant differences. The low welfare scores of medium and small dairy farms in this indicator may be attributed to the common practice of preservation of dry fodders only, with very few farmers taking up silage, hay preparation or other form of preservation.

Colostrum and milk feeding: The mean welfare score in small, medium and large dairy farms, out of total score of 5, was 4.68 ± 0.055, 4.70 ± 0.056 and 4.63 ± 0.080, respectively, with an overall welfare score of 4.67 ± 0.037. The mean welfare score of this indicator had no significant difference between the groups. Slightly higher scores were observed in small and medium farms due to better colostrum feeding and time of colostrum feeding. Similar findings were reported by Mahla (2018) [5], Kumar (2016) [4] and Adhikari (2021) [1], with higher scores as compared to the present study, whereas Rajpoot (2019) [6] reported much lower scores (1.00). In the study area, most farms practiced feeding colostrum within 1-2 hours after calving with 2-3 frequencies as per calf body weight. None of the farms practiced natural suckling. Instead, they all used bottle feeding because they believed that day-old weaning is good in case of crossbred calves and may increase milk yield. Welfare was compromised due to this practice because of lack of awareness about scientific merits of natural suckling.

Table 1: Mean welfare score of 'feeds and feeding practices' component in dairy farms of different size

Welfare indicator	Max Score	Farm size			Overall	P-value
		Small	Medium	Large		
Availability of feeds and fodder	10	5.78[a] ± 0.077	5.93[ab] ± 0.041	6.10[b] ± 0.118	**5.93 ± 0.051**	0.031
Feeding practices for different categories of animals	10	4.65[a] ± 0.109	4.90[a] ± 0.143	5.28[b] ± 0.106	**4.94 ± 0.076**	0.002
Availability of feeds and fodder storage/ preservation space	5	3.13[a] ± 0.114	3.28[ab] ± 0.106	3.53[b] ± 0.117	**3.31 ± 0.067**	0.047
Colostrum and milk feeding	5	4.68 ± 0.055	4.70 ± 0.056	4.63 ± 0.080	**4.67 ± 0.037**	0.707
Total score	30	18.28[a] ± 0.213	18.80[a] ± 0.197	19.53[b] ± 0.234	18.85 ± 0.140	0.000

Note: Means within a row bearing different superscripts differ significantly (P<0.05).

Table 2: Mean welfare score of sub-components of 'feeds and feeding practices' in dairy farms of different sizes and regions

Sl. No.	Welfare indicator	Max Score	Farm size			Overall
			Small farms	Medium farms	Large farms	
1	Availability of feeds and fodder	10	5.78 ± 0.077	5.93 ± 0.041	6.10 ± 0.118	5.93 ± 0.051
	Green fodder quality	1	0.93 ± 0.041	0.98 ± 0.025	0.88 ± 0.05	0.93 ± 0.023
	Green fodder quantity	1	0.50± 0.000	0.50 ± 0.000	0.50 ± 0.000	0.50 ± 0.000
	Dry fodder quality	1	0.93 ± 0.041	0.95 ± 0.034	0.98 ± 0.025	0.95 ± 0.020
	Dry fodder quantity	1	0.50 ± 0.000	0.50 ± 0.000	0.53 ± 0.025	0.51 ± 0.008
	Silage quality	1	0 ± 0	0 ± 0	0.05 ± 0.034	0.02 ± 0.012
	Silage quantity	1	0 ± 0	0 ± 0	0.10 ± 0.058	0.03 ± 0.02
	Concentrate feed quality	1	0.98 ± 0.025	1.00 ± 0.000	1.00 ± 0.000	0.99 ± 0.008
	Concentrate feed quantity	1	0.50 ± 0.000	0.50 ± 0.000	0.53 ± 0.025	0.51 ± 0.008
	Feed supplements quality	1	1.00 ± 0.000	1.00 ± 0.000	0.98 ± 0.025	0.99 ± 0.008
	Feed supplements quantity	1	0.45 ± 0.034	0.50 ± 0.000	0.58 ± 0.041	0.51 ± 0.019
2	Feeding practices	10	4.65 ± 0.109	4.90 ± 0.143	5.28 ± 0.106	4.94 ± 0.076
	Grazing practiced	1	0.28 ± 0.057	0.10 ± 0.046	0.03 ± 0.025	0.13 ± 0.029
	Chaff cutting of roughages	1	0.23 ± 0.085	0.40 ± 0.106	0.75 ± 0.077	0.46 ± 0.059
	Fodder enrichment	1	0 ± 0	0 ± 0	0 ± 0	0 ± 0
	Use of TMR	1	0 ± 0	0 ± 0	0 ± 0	0 ± 0
	Steaming up	1	0.95 ± 0.05	1.00 ± 0.000	1.00 ± 0.000	0.98 ± 0.017
	Special feeding after calving	1	1.00 ± 0.000	1.00 ± 0.000	1.00 ± 0.000	1.00 ± 0.000
	Summer feeding schedule	1	0.25 ± 0.057	0.4 ± 0.069	0.5 ± 0.073	0.38 ± 0.04
	Concentrate feeding as per MY	1	0.95 ± 0.034	1.00 ± 0.000	1.00 ± 0.000	0.98 ± 0.012
	Concentrate feeding frequency	1	1.00 ± 0.000	1.00 ± 0.000	1.00 ± 0.000	1.00 ± 0.000
	Use of UMMB/salt licks	1	0 ± 0	0 ± 0	0 ± 0	0 ± 0
3	Availability of storage/preservation space	5	3.13 ± 0.114	3.28 ± 0.106	3.53 ± 0.117	3.31 ± 0.067
	Dry fodder storage space	1	1.00 ± 0.000	0.85 ± 0.053	0.90 ± 0.046	0.92 ± 0.024
	Silage storage space	1	0 ± 0	0 ± 0	0.05 ± 0.034	0.02 ± 0.012
	Concentrate feed storage space	1	0.75 ± 0.057	0.95 ± 0.034	0.98 ± 0.025	0.89 ± 0.027
	Facility for mixing ingredients	1	0.45 ± 0.050	0.58 ± 0.041	0.65 ± 0.073	0.56 ± 0.034
	Hygiene of feed storage area	1	0.93 ± 0.041	0.90 ± 0.046	0.95 ± 0.034	0.93 ± 0.023
4	Colostrum and milk feeding	5	4.68 ± 0.055	4.70± 0.056	4.63 ± 0.080	4.67 ± 0.037
	Colostrum feeding	2	2.00 ± 0.000	2.00 ± 0.000	2.00 ± 0.000	2.00 ± 0.000
	Time of colostrum feeding	1	0.98 ± 0.025	0.93 ± 0.041	0.90 ± 0.058	0.93 ± 0.025
	Colostrum feeding frequency	1	0.70 ± 0.056	0.78 ± 0.057	0.73 ± 0.057	0.73 ± 0.032
	Milk feeding as per body weight	1	1.00 ± 0.000	1.00 ± 0.000	1.00 ± 0.000	1.00 ± 0.000
	Total score	30	18.23 ± 0.213	18.8 ± 0.197	19.53 ± 0.234	18.85 ± 0.14

Conclusion

The study reveals that large dairy farms in Karnataka scored significantly higher in feeding-related welfare indicators compared to small and medium farms, mainly due to better availability, storage, and scientific feeding practices. Despite this, none of the farms met the "freedom from hunger" criterion, highlighting widespread inadequacies in feed quality and quantity. While colostrum feeding practices were consistent across farm sizes, the absence of natural suckling and limited awareness of scientific feeding reduced overall welfare. Comparatively, scores in Karnataka were lower than some previous studies, indicating scope for improvement, especially in smaller farms, through better education and resource availability.

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