Bhutan Journal of Animal Science (BJAS)
Special Issue, Page 27-34, October 2022

CATTLE FEED RESOURCES ASSESSMENT AND COPING STRATEGIES ADOPTED DURING FEED SCARCITY IN EASTERN BHUTAN

KEZANG WANGDI*, TASHI ZANGMO, KHANDU WANGCHUK AND NORBU

Regional Livestock Development Centre, Department of Livestock, Kanglung, Bhutan.

*Author for correspondence: *babukezang07@gmail.com*

ABSTRACT: The study was undertaken to identify and assess cattle feed resources, feeding practices, and coping strategies adopted during the feed scarcity among dairy farmer groups of six eastern districts in Bhutan from October 2021 to February 2022. A total of 405 dairy farmers were interviewed using a semi-structured questionnaire comprising both open and closed-ended questions. Descriptive statistics, one-way ANOVA, and Chi-square tests were administered to analyze the data. The study findings revealed improved pasture, fodder trees, non-conventional feeds, crop residues, natural grazing, and commercial concentrate feed as the major feed resources available in decreasing order. Amongst the feed resources, improved pasture is recorded as an important forage resource by the majority of respondents. The stall feeding and semi-grazing system dominated the dairy feeding system, and green grasses are the main basal diet of dairy cattle in eastern Bhutan. It is alarming to note that none of the dairy farmers have adopted TMR and UMMB technology even these days. However, most farmers conserved crop residues but maintaining their quality remains a challenge due to a lack of good storage facilities. Significant differences in feeding practices across different farm sizes were observed, $\chi 2$ (4, 405) =13.810, $p<.05$. About 76% of the respondents reported experiencing critical feed scarcity, especially during the dry season. Collection of forages from the forest was the most important strategy adopted by dairy farmers to mitigate against feed scarcity followed by roadside grazing. The study concluded that the pressing issues of feed scarcity particularly during the dry season can be alleviated through the adoption of improved forage technologies, effective feeding strategies, and building the capacity of farmers.

Keywords: Crop residues; coping strategies; dairy farmers group; feeding practices; feed resources; feed scarcity

1. INTRODUCTION

Dairy farming is an integral part of small-holder farming systems across the globe (Wangchuk et al. 2019). In South and East Asia, small-holder dairying has become a source of income earning for crop farmers in mixed farming systems (Thapa et al. 2019). Unlike other farming activities, dairy farming generates regular income for the farmers around the year (Wangchuk et al. 2019). Dairy farming is gaining momentum, and the number of dairy farmers' groups and cooperatives had seen significant growth in recent years in Bhutan (Wangchuk and Gyeltshen 2018). Feeding cattle with nutritionally balanced feed year-round is imperative (Bhujel et al. 2018). However, dairy farmers could not fully exploit the genetic potential of milking cows mainly due to poor feeding management and limited feed resource availability. Dairy farmers feed maize straw, rice straw, and grain products which are almost devoid of nutritional values and biomass (Gyaltshen 2002) during the lean period in Bhutan. Feed resources shortage usually occurs from January to April (Wangmo and Chetteri 2018), and available feed resources are of poor quality and not fed in the right amount (Wangchuk and Gyeltshen 2018) impacting the optimization of milk production (Namgay 2017). Commercial feed is not fed to animals by the majority of backyard dairy farmers due to high costs. Maintaining access to adequate quantity and quality of feed and fodder resources is crucial for dairy cattle to produce more milk. Despite considerable support provided for feed and fodder development by the Government, feed and fodder shortages remain a challenge,

particularly during the winter months. Therefore, there is a need to evaluate feed and fodder resource availability and management among dairy farmers to diagnose problems and suggests appropriate intervention measures to improve as well as enhance feed and fodder availability for dairy cattle. Likewise, there is a need to understand the coping strategies adopted by the farmers to develop targeted interventions to understand and resolve feed scarcity issues for dairy farming in the eastern districts.

2. MATERIALS AND METHODS

2.1. Study area

A cross-sectional study was conducted covering 31 Gewogs of six eastern districts, namely, Samdrup Jongkhar, Pema Gatshel, Tashigang, Tashi Yangtse, Mongar, and Lhuntshe.

2.2. Data collection

A total of 405 respondents were selected using a simple random sampling method from a registered dairy farmers group in the region. The respondents were stratified based on the number of cattle owned into three groups - categorized as small farms (1 – 3 animals), medium farms (4 – 6 animals), and large farms (more than 7 animals). A semi-structured questionnaire containing both open and closed-ended questions was adopted to gather data from October 2021 to February 2022. Data on the socio-economic characteristics of the respondents, feed resources, feeding management practices, fodder conservation practices, and coping strategies adopted during feed shortages were collected.

2.3. Statistical analysis

The data obtained were segregated into qualitative and quantitative data. Descriptive statistics and a One-way ANOVA test was used to analyze quantitative data. The qualitative data were analyzed using Pearson Chi-square ($\chi 2$) test to determine the association among three categories of farms. All statistical tests were carried out at a 95% confidence level. The statistical software Statistical Packages for Social Sciences (version 20) was used to analyze the data.

3. RESULTS AND DISCUSSION

3.1. Socio-economic characteristics

Table 1 presents the socio-economic characteristics of the respondents in this study. The results showed more male respondents (61.7%) than females (38.3%) contrasting with the findings of Wangchuk et al. (2019) where more female engagement in dairy farming than their male counterparts was reported. The overall mean age and the family size of the respondents were 47.14 years and 4.33 years, respectively. More than half of the respondents (51.6%) interviewed were literate which indicates that there is a good scope and opportunity for easy acceptance and adoption of new available livestock technologies. Mulugeta (2005) reported that the low education level of farmers can have a positive influence on the transfer of improved agricultural technologies and their participation in development. Overall, about ninety-four percent of the respondents were married while 5.90 % are single.

Table 1. Socio-economic characteristics of DFG in the eastern region

Parameter	Category of farms			Total
	Small (n=104)	Medium (n=184)	Large (n=117)	
Gender (%)				
Male	14.6	27.7	19.5	61.7
Female	11.1	17.8	9.4	38.3
Marital status (%)				
Married	23.7	42.7	27.7	94.1
Unmarried	2.0	2.7	1.2	5.9
Literacy level (%)				
Illiterate	14.1	21.5	12.8	48.4
Literate	11.6	23.9	16.0	51.6
Mean				
Age	46.1	46.8	48.5	47.1
Family size	3.61	4.5	4.5	4.3

3.2. Source of income

The study revealed livestock farming as the major livelihood occupation for most of the respondents in the region. Of all the households (HHs) surveyed, 57% of respondents reported livestock; particularly dairy farming, as their major source of income, followed by agriculture farming (28.6%) such as potatoes, oranges, and vegetables. Husen et al. (2016) and Tshering (2018) reported that livestock production has multiple contributions to the source of income and survival of rural farmers. The other sources of household income reported were engagement in off-farm activities such as business, contact work, weaving, and remittance from family members and relatives.

3.3. Major feed resources

The study recorded six major feed resources, namely cultivated or improved pastures accounting for about 20.6%, followed by fodder trees (18.9%), crop residues (16%), non-conventional feeds (15.7%), natural grazing (14.6%), and concentrate feeds (13.9%). Findings agree with Namgay (2017), who reported that the major feed resources in Bumthang were improved pastures, crop residues, fodder trees, natural grazing, by-products, and concentrate feeds. Most of the respondents (20.63%) owned improved pastures developed from the seeds supplied on subsidy by the government. The result is in line with the findings of Thapa et al. (2019) who reported that a vast majority of DFG members had significantly greater established improved pastures. Fodder trees are the second major feed resource adopted in feeding cattle during the autumn months. Ficus (Ficus roxborghii) was the most commonly planted fodder tree, and most farmers preferred to feed its leaves as fresh fodder, and some conserved it for winter feeding. A few farmers also reported feeding willow trees (*Salix babylonica*) and other local fodder trees such as Baynangshing (*Quercus dilatata*), Betsanangshing (*Quercus spp*), and Pinshing (*Bassia butaraceae*). Those farmers who do not have fodder trees relied heavily on forest and roadside grazing. In this study, the utilization of crop residues and non-conventional feeds was found similar. The conventional practice of forest grazing is declining due to the formation of dairy groups and the adoption of exotic dairy cows to enhance milk production.

3.4. Feeding practices

The study observed three types of feeding systems – stall feeding, semi-grazing, and tethered in eastern Bhutan (Table 2). Stall feeding is predominately practiced on small (52.9%) and medium farms (46.2%), whereas semi-grazing is widely practiced on large farms (55.6%). Further, the Chi-square test of associations indicates a significant difference between feeding systems across farm sizes, $\chi 2$ (4, 405) =13.810, $p<.05$). Such differences may be attributed to the availability of improved fodder grasses and the rearing of high-yielding exotic dairy cattle. On the other hand, constrained by a labour shortage in the household, few farmers have resorted to rearing cattle by tethering in the cropped land and along the roadside. Overall, 97 % of the respondents reported feeding green grasses year-round, and the proportion of feeding green fodder grasses was similar across the farms. When asked about the chopping of fodder, about 72.6% of the respondents stated they chopped the fodder of which 81.2% were from a large farm, 70.1% from a medium farm, and 67.3% from a small farm. The fodder was chaffed mostly using chaff cutter machines(52.8%) and the rest by using locally made knives and sickles. Unfortunately, few farmers were not aware of the importance of providing proper feeding troughs resulting in trampling and inefficient utilization of feed. Hence the study suggests that there is a need to encourage dairy farmers to construct proper feeding troughs for efficient utilization of the feeds.

3.5. Feed and minerals supplementation

Table 3 presents the frequency of HHs providing cattle with supplementary feed. More than half of the respondents (52.8%) reported feeding concentrate feeds. As anticipated, the practice of feeding concentrates increases with farm sizes. For instance, 65% of respondents in large farm sizes fed concentrate feeds to their cattle. However, there was no significant difference ($p>.05$) in feeding concentrate across farm sizes studied. Overall, 81.5% of the respondents reported feeding lactating cows with commercial concentrate feed ($p>.05$) to maximize milk production. Jarial et al. (2015) and Kumar et al. (2017) reported that feeding commercial concentrate feeds on regular milking cows will enhance milk production.

Table 2: Feeding practices (%) as reported by DFG in the eastern region

Parameter	Category of farms			Total	P-Value
	Small	Medium	Large		
Feed system					0.008
Stall feeding	52.9	46.2	35	44.7	
Semi grazing	32.7	38.6	55.6	42	
Tether grazing	14.1	15.2	9.4	13.3	
Types of fodder fed mostly in a year					0.939
Green fodder	97.1	97.3	96.6	97.0	
Dry fodder	2.9	2.7	3.4	3.0	
Chaff the fodder while feeding, yes	67.3	70.1	81.2	72.6	0.041
Own chaff cutter, yes	36.5	54.3	65.0	52.8	0.001

The respondent also reported feeding commercial concentrate feed to other categories of animals, such as dry cows (21.2%), heifers (25.4%), and calves (30.9%). Adequate and proper utilization of commercial concentrate feed is challenged by the lack of capital, high cost, transportation issues, and lack of storage facilities. The study also recorded respondents providing other feed supplements such as maize flour, rice husk, alcohol waste, and mustard oil cake. In this study, none of the farmers reported feeding UMMB. However, a vast majority (82.%) of respondents reported providing all classes of cattle with common salt as a mineral supplement. Haile et al. (2012) observed the same in their study.

3.6. Cultivation of improved fodder grasses

Improved fodder was cultivated by most (83%) respondents for cattle feeding (Table 4). Farmers' preference for hybrid cattle and their inability to adapt to the topography demands them to switch to improved fodder cultivation. Similarly, the Chi-square test of associations indicates a highly significant difference between farm size and fodder cultivation, $\chi 2$ (2, 405) = 14.695, $p<.05$. The larger the farm is more likely to practice improved fodder cultivation. On the contrary, a few respondents said they still practiced forest/roadside grazing due to limited land holdings (13.3%) and labour constraints (6.9%). Farmers are well aware of the improved fodder grasses such as napier, pakchong, gautemala, ruzi, molasses, and oat used for cattle feeding. Most of the farmers preferred pakchong napier and guatemala grasses as they are well adapted to the local climate, yield high biomass, and require a small land area for propagation. The majority of the farmers, however, appeared unaware of the need to apply fertilizer in the pasture field. Interestingly, 17% of the interviewees reported having no idea about the application of fertilizer in the pasture field. Therefore, given the above facts, there is a need to create awareness about manure application to enhance forage production and maximize milk production.

Table 3. The practice of feed supplementation (%) as reported by DFG in the eastern region

Parameter	Category of farms			Total	p-value
	Small	Medium	Large		
The practice of concentrated feeding					0.223
Yes	36.5	54.3	65.0	52.8	
No	63.5	45.7	35.0	47.2	
Type of feed supplements					0.026
Concentrate feed	68.3	76.5	76.9	74.5	
Mustard oil cake	37.5	47.5	31.6	40.3	
Maize flour, rice husk, grains	57.7	51.4	47.9	52	
Common salt	86.5	78.8	82.9	82	
The class of animals supplemented					0.127
Milking cow	77.9	85.3	78.6	81.5	
Dry cow	20.2	25.5	15.4	21.2	
Heifer	22.1	29.3	22.2	25.4	
Calves	36.5	31.5	24.8	30.9	

3.7. Fodder conservation practices

Conserved fodder is crucial for feeding dairy cows particularly in the dry season. Conserving fooder as hay and silage are two popular methods adopted. A very small number of respondents had adopted silage feeding as it is expensive and labour intensive to construct silo pits (Table 5). Nonetheless, most farmers declared conserving silage in plastic bags is simple, cheap, and convenient compared to silo pits. Maize straw is the principal crop residue used for silage-making. A few respondents have reported making silage from green fodder grasses, including pakchong naiper, gautemala, and oats. Total Mixed Ration (TMR) and haymaking are not practiced in the study area.

Table 4. Cultivation of improved fodder grasses (%) as reported by DFG in the eastern region

Parameter	Category of farms			Total	p-value
	Small	Medium	Large		
Improved fodder cultivation					.001
Yes	72.1	83.7	91.5	83.0	
No	27.9	16.3	8.5	17.0	
Reason for not growing fodder					.066
Land scarcity	21.2	13.0	6.8	13.3	
Labour shortage	8.7	7.6	4.3	6.9	
Financial shortage	1.9	0.0	0.0	0.5	
Lack of awareness & inputs	2.9	1.6	0.0	1.5	
Application of fertilizer					.003
Yes	30.8	33.2	32.5	32.4	
No	41.3	50.5	59.0	50.6	
No idea	27.9	16.0	8.5	17.0	

3.8. The Practice of storing crop residues

Storage of crop residues is essential as it promotes efficient utilization by livestock. Table 5 represents the practice of storing crop residues in the study area. There was a significant difference ($p<.05$) in the total amount of crop residues stored across farm sizes studied, which may be attributed to the area of cropland and types of crops cultivated by farmers. Overall, about 73.1% of the respondents reported storing crop residues, of which 82.1% were from the large farm, 71.7% from the medium farm, and 65.4% from the small farm. Maize (57.3%) and paddy straws (42.7%) were the principal crop residues produced as they are cultivated on a large scale as annual crops. However, not all crop residues were effectively used for animal feeding. The inefficient use of crop residues was attributed to labour shortage for collection, transportation, lack of storage facilities, and proper technologies. Methods of crop residue storage did not differ ($p>.05$) across farm sizes. On average, 51.6% of the farmers, 42.5% from small, 50.0% from medium, and 59.8% from large farms stored crop residues over a cow shed. About 18.8% of the farmers in total - 15.4% from small, 17.9% from medium, and 23.1% from large farms stored crop residues over tree branches leading to substantial loss and decline in nutrient content over time due to exposure to rain and sunlight. Similar findings were reported from Kenya that hanging crop residues on tree branches results in quality deterioration due to rain and direct sunlight (Njarui et al. 2011). Gunny bags were found to be adopted by about 24.9% of the respondents in storing maize flour, rice husk, and other cereal grains residues.

3.9. Coping strategy during feed scarcity

Farmers' coping strategies during feed scarcity in the study area are presented in Table 6. Feed and forage shortage during the dry season is a common phenomenon and is responsible for low milk production Wangchuk et al. (2019). Overall, about 75.8% of the farms reported that they experienced critical feed scarcity during the dry season. There was no significant difference ($p>.05$) in coping strategies adopted across farm sizes studied. In decreasing order of importance, collection of fodder from forest (58.0%), natural/roadside grazing (43.7%), storing of crop residues (42.3%), purchased of concentrate (38.8%), silage preparation (18.3%), and reducing herd size (4.9%) were the main coping strategies adopted by farmers during feed scarcity. Due to the availability of abundant forest resources, a vast majority of the farmers

Table 5. Adoption of fodder conservation technology and storage of crop residues (%) by DFG

Parameter	Category of farms (%)			Total	p-value
	Small	Medium	Large		
Do you have a silage structure?					
Yes	26.0	33.2	29.1	30.1	.423
No	74.0	66.8	70.9	69.9	
Do you store crop residues?					
Yes	65.4	71.7	82.1	73.1	.018
No	34.6	28.3	17.9	26.9	
Types of crops stored					
Maize straw	50.0	57.1	64.1	57.3	.301
Paddy straw	38.5	37.0	55.6	42.7	
Storage methods practiced					
Over cow shed	45.2	50.0	59.8	51.6	.137
Tree branches	15.4	17.9	23.1	18.8	
Gunny bags	25.0	27.7	20.5	24.9	

Table 6. Practices of coping mechanisms (%) as reported by DFG in the eastern region

Parameters	Category of farms			Total	p-value
	Small	Medium	Large		
Experienced feed shortage					.442
Yes	76.0	78.3	71.8	75.8	
No	24.0	21.7	28.2	24.2	
Coping strategy adopted					.213
Collect from forest	57.7	63.0	50.4	58.0	
Natural/roadside grazing	41.3	44.6	44.4	43.7	
Conserving crop residues	36.5	43.8	45.3	42.4	
Purchased concentrate feed	35.6	40.2	39.3	38.8	
Prepare silage	13.5	21.2	17.9	18.3	
Reduce herd size	1.2	2	1.7	4.9	

have opted to collect fodder from the forest during feed scarcity, which agrees with the findings of Namgay (2017) who reported that most of the farmers in Bumthang collect natural pasture as the main source of fodder during fodder shortage.

The feed scarcity during dry seasons according to respondents is a major problem to increase milk production. Therefore, the study suggests the need for appropriate research and development interventions to help dairy farmers' groups develop appropriate coping strategies to overcome forage scarcity during the dry season.

4. CONCLUSIONS & RECOMMENDATION

Improved pastures, fodder trees, natural/roadside grasses, crop residues, concentrate feeds and non-conventional feeds are the essential feed resources in eastern Bhutan. Feed scarcity during dry seasons was identified as the most limiting factor for increasing milk production. To mitigate feed scarcity issues, farmers adopted various coping strategies such as the collection of fodder from forests, roadside grazing, conserving crop residues, purchasing concentrate feed, silage production, and reducing herd size. Feeding practices were dominated by the stall feeding and semi-grazing system. Inadequate land holdings and farm labour constraints were the reasons for not cultivating improved fodder by the farmers. Only a few farmers practice silage feeding as it is expensive and labour intensive. The effective utilization of commercial feed is challenged by the lack of capital, transportation, and storage facilities. Most farmers conserved crop residues for dry season feeding but do not take the initiative to improve the quality of crop residues. The present study concludes that the feeding management system adopted despite availability of excess feed

resources is not appropriate in general. Appropriate and effective feeding strategies need to be identified and promoted amongst dairy farmers to enhance milk production, especially during dry seasons. Further, to ensure sustainable feed supply farmers should be encouraged to conserve feed, adopt improved forage technologies (enrichment of fodder crops, TMR, feed block) and use of available local feed resources effectively.

Acknowledgment

The authors would like to express sincere gratitude to the CARLEP office for granting financial assistance to conduct this research. We are very much grateful to sample farmers for their cooperation and for providing relevant information. We are also indebted to Gewog Livestock Extension Officers for their support during the field survey.

Competing interests

The authors declare no competing interest in conducting this study.

REFERENCES

Bhujel AK, Namgyal U and Rai BD. (2018). Dry matter content of fodder resources used by dairy farmer's in West-Central Bhutan. Bhutan Journal of Animal Science, 2(1): 107-111.

Duguma B and Janssens GPJ. (2021). (PDF) Assessment of Livestock Feed Resources and Coping Strategies with Dry Season Feed Scarcity in Mixed Crop-Livestock Farming Systems around the Gilgel Gibe Catchment, Southwest Ethiopia (researchgate.net). Accessed on 29 October 2021.

Gyaltshen T. (2002). Experiences with oats (Avena sativa) at temperate and high elevations in Bhutan. Proceedings of the fifth meeting of the Temperate Asia Pasture and Fodder Network (TAPAFON). Renewable Natural Resources Research Centre, Bajo, Bhutan.

Haile W, Zelalem Y and Yosef T. (2012) Challenges and opportunities of milk production under different urban dairy farm sizes in Hawassa City, Southern Ethiopia. Af J Agric Res 7(26):3860–3866.

Jarial S, Kumar A and Padmakumar V. (2015). Assessment of feeding practices, nutritional status, and gap for dairy buffaloes in hilly districts Tehri Garhwal and Pithoragarh of Uttarakhand, India. Indian Journal of Animal Science. 83(9): 960-963.

Kumar S, Subash S and Jangir R. (2017). (PDF) Feeding and Milking Management Practices Adopted by Indigenous Cattle Farmers in Thar Desert of Rajasthan (researchgate.net). Accessed on 10 August 2021.

Mulugeta A. (2005). (PDF) Characterization of Dairy Production Systems of Yerer watershed in Ada Liben Wereda, Oromia Region, Ethiopia. Master's Thesis, Alemaya University, Dire Dawa, Ethiopia, 2005 (researchgate.net). Accessed on 28th October 2021.

Namgay R. (2017). Feed and fodder resources in Bumthang: availability and utilization by dairy farmers. Bhutan Journal of Animal Science, 1(1): 31-34.

Njarui DMG and Mureithi JG (2006). (PDF) Enhancing maize and fodder production by use of legumes in the semiarid region of eastern Kenya. In: Mureithi J G, Gachene C K K and Wamuongo J W (eds) Enhancing agricultural productivity in East Africa. Development and up-scaling of green manure legume technologies in Kenya. pp. 203-234. ISBN 9966-879-71-4 (researchgate.net). Accessed on 1st February 2021.

Njarui DMG, Gatheru M, Wambua JM, Nguluu SN, Wangi DMM and Keya GA. (2011). (PDF) Feeding management for dairy cattle in smallholder farming systems of semi-arid tropical Kenya. https://www.researchgate.net/publication/291778832_Feeding_management_for_dairy_cattle_in_smallholder_farming_systems_of_semi-arid_tropical_Kenya(researchgate.net). Accessed on 23 July 2021.

Thapa, Choden D and Tamang NB. (2019). Adoption of improved dairy production practices by dairy and non-dairy farmers groups. Bhutan Journal of Animal Science, 3(1): 14-21.

Tshering G. (2018). Dairy farming enhances household income in peri-urban and rural areas of Choekor in Bumthang. Bhutan Journal of Animal Science, 2(1): 107-111.

Wangmo R and Chhetri R. (2018). Herbage yield and nutrient content of stampede oat under different irrigation intervals. Bhutan Journal of Animal Science, 2(1): 66-69.

Wangchuk, Rizal, GM, Gyeltshen J, Rinzin C and Rinchen D. (2022). Effect of feeding

gliricidia and stylo meal on the milk yield and composition of dairy cows. Bhutan Journal of Animal Science, 6(1): 40-45.

Wangchuk K, Dorji T, Wangdi J, Wurzinger M and Zollisch W. (2019). Caught in the middle: Reasons for hindered growth among dairy groups of Haa districts in western Bhutan. https://www.longdom.org/open-access/caught-in-the-middle-reasons-for-hindered-growth-among-dairy-groups-of-haa-district-in-western-bhutan-44060.html. Accessed on 10 January 2022.