BHUTAN JOURNAL OF ANIMAL SCIENCE
Namgay (2017). Feed and fodder resources in Bumthang: availability and utilization by dairy farmers. Bhutan J. Anim. Sci. 1(1): 31-34.

Forage and Animal Nutrition

Feed and fodder resources in Bumthang: availability and utilization by dairy farmers

RINZIN NAMGAY

National Research Center for Animal Nutrition, Department of Livestock, Ministry of Agriculture and Forests, Bumthang, Bhutan
Email- rinzinnamja@gmail.com; ph: +975 17866132

ARTICLE HISTORY

Received: 12/10/16
Peer reviewed; 20-28/10/16
Received in revised form: 5/11/16
Accepted: 20/11/16

KEYWORDS

Animal unit
Dry matter
Feed resources
Fodder resources
Pasture

ABSTRACT

The availability and utilization of feed and fodder resources by farmers in Bumthang *dzongkhag* (district) were assessed with the objective to understand the current scenario and generate empirical information on feed and fodder status in the *dzongkhag*. A multi-stage simple random sampling technique was employed and a total of 120 households were selected (30 households each from four study sites). Primary data were collected by interviewing dairy farmers and secondary data were collected by reviewing literatures and reports. Feed resources available year-round were categorized and feed requirement gaps were determined based on cattle population. The major fodder resources found were improved and native pastures. The contribution of crop residues was 3.2%, indicating underutilization of this resource as livestock feed. The annual feed and fodder production exceeded the annual feed requirement for the entire population of dairy cattle in Bumthang *dzongkhag*. The scarcity of feed and fodder was acute during spring season after all conserved fodder resources were exhausted in winter. Farmers lacked good storage facilities and were not familiar with techniques to improve the quality of crop residues.

INTRODUCTION

Traditional farming system in Bhutan has evolved over the centuries with the integration of multi-composite farming system. Livestock is an integral part of farming system in Bhutan and plays an important role in supporting livelihood through provision of draft power, manure, milk, milk products, and meat, both for commercial and self-consumption (Wangdi 2003). Livestock contributes 24% to the Renewable Natural Resources Gross Domestic Product (DAMC 2013).

Livestock development in Bhutan faces many difficulties. Shortage of feed and fodder is one of the main constraints since ruminants are traditionally fed on natural community pastures, fallow lands, and straws (Ghebrehiwet et al. 1994). Inadequate feed and fodder coupled with poor resource management is the main reason for farmers not being able to achieve optimum livestock production. Large ruminants such as cattle, yak and to a lesser extent buffaloes are the most important livestock species that contribute to rural income generation.

Although considerable attempts were made by the Department of Livestock (DoL) to address feed and fodder shortages through introduction and promotion of advanced technologies, the technology adoption appears to be insignificant. Livestock farmers chose to revert back to traditional feeding system. However, in the 11th Five Year Plan, DoL has adopted a vision of self-reliance and commercialization of livestock product through commodity based program (DoL 2013), whereby the National Research Centre for Animal Nutrition (NRCAN) under DoL has been fully entrusted to develop strategies to meet the demand for feed and fodder resources in the country. Thus, to achieve the vision of DoL and sustain the rural livelihood by ensuring adequate livestock feed and fodder resources, it is imperative to assess the availability and utilization of feed and fodder resources in the country. Therefore, a study was conducted to understand the current scenario and generate empirical information on current status of feed and fodder resources in Bumthang *dzongkhag* (district).

MATERIALS AND METHOD

Study sites

The study was carried out in Bumthang *dzongkhag*, which falls under temperate ecological zone, where dairy farming is an important component of integrated farming system. The *dzongkhag* has four *gewogs* (block) namely Choekhor, Chumey, Tang, and Ura. These four *gewogs* were selected for the study. According to the statistical hand book (2013), there are 1,544 households and 96 villages in Bumthang. The *dzongkhag* has a total area of 2,667.76 sq km with an altitude ranging from 2400-6000 masl. The *dzongkhag* receives an average annual rainfall of 598.6 mm. The mean annual temperature of 11.75°C was recorded, with a highest of 23.7°C in the month of August and a lowest of – 4°C in January (NSB 2012).

Sampling and data collection

A multi-stage simple random sampling method was employed to select farm households from each *gewog*. Initially, from a total 1,544 households under Bumthang *dzongkhag* (Livestock sector quarterly report, Bumthang 2015), 1078 households with livestock were selected. Then from 1078 households, 120 households were sampled from four study *gewogs*.

Both primary and secondary data were used for the study. Primary data was collected through the interview of dairy farmers using structured questionnaire. Secondary data were collected through review of literatures and reports. The data were collected in March, 2016, assisted by staff from NRCAN who had professional knowledge on feed and fodder.

Calculation of Animal Unit (AU) and annual feed requirement
Animals have different intake capacities and forage requirements based on the body weight and milk production of the animal (Wangchuk and Dorji 2008). Animal unit (AU) conversion factors are numerical figures expressing the forage requirements of particular classes of animals (Ruyle and Ogden 1993). According to Ruyle and Ogden (1993), the AU is defined as one mature cow weighing approximately 450kg with a daily requirement of about 11.8kg forage dry matter. However, under Bhutanese condition, a standard AU is an adult cow weighing approximately 380kg (Dorji 1993) with a daily requirement of about 9kg forage dry matter (Wangchuk and Dorji 2008). The conversion factor was used for calculating total AUs of current population of dairy cattle (Table 1).

Table 1 AU for different categories of animals.

Animal category	Animal unit/conversion factor
Cow (milking and dry)	1.0
Heifer	0.7
Calf	0.5
Bulls and bullocks	1

Using the daily dry matter intake per AU as 9kg for a mature cow weighing 380kg (Dorji 1993), the annual requirement of major feeds was computed as follows:

Total dry matter (DM) requirement per day= Total AUs × 9kg DM AU^{-1}
Annual DM requirement =Total AUs × daily DM intake AU^{-1} × 365 days
Deficit/surplus (DM) = Total annual DM production (tons) – Annual DM requirement (tons)
Surplus = Annual dry matter production – Annual dry matter requirement

Data analysis
Data were processed in Microsoft Excel program and analyzed with Statistical Package for Social Sciences (SPSS) version 23. T-tests were performed to compare differences in means.

RESULTS AND DISCUSSION

Land holdings of respondents
The average land holding of respondents was 7.50 acres (ac) against the overall average national land holding of 2.50 ac (NSB 2012). The average land holding was reported to be 3.40 ac per rural household (RNR Statistics 2015). The total land reported for the study area was 2884 ha dry land, 25 ha wet land and 12 ha orchard (RNR Statistics 2015). The average land holding was 7.50±0.57 ac and the average pastureland holding was 2.40±0.22 ac.

Cattle production system
Cattle production system in Bumthang is multifaceted. The seasonal movement of cattle and yaks between winter and summer pastures is one of the important strategies to overcome feed shortage (Singh 2006). Herders take advantage of the variations in climate and vegetation as they migrate with animals according to seasons (Wangdi 2003). The study showed that 2.50% of livestock farmers practiced transhumant system, 94.2% sedentary system, and 3.30% both transhumant and sedentary systems. In sedentary system, animals were housed during night and let loose to graze during day. Cattle grazed in communal grazing land around the village, in the forests, on the cultivated land after harvest, and fallow land. Milking cows were supplemented with concentrate feed. Those who practiced both transhumant and sedentary system of cattle production also reared less number of high yielding or improved cattle near the village settlement.

Total AU and annual feed requirement
The total AUs in Bumthang *dzongkhag* were 11,964.3. The total DM requirement per day for the total AUs was 107.7t and the annual DM requirement was 39,302.7t. The surplus DM production was 2,900.8t.

Type of feed and fodder resources
The major feed and fodder resources available for livestock in Bumthang are presented in Table 2. There were seven types of feed resources available on small mixed farms. The major feed and fodder for livestock was contributed by improved pasture (75.8%), followed by natural grazing (20.8%). The minor fodder resources were fodder trees (1.40%) and crop by-products (3.2%) (Table 3).

Table 2 Feed resources available in study area.

Native pasture: Communal grazing area, fallow land, road side area, and forest grazing.
Improved pasture: Developed improved pasture
Crop residues: Paddy straw, Wheat, Barley and Buckwheat straw
By-product: Mustard oil cake, Rice bran, and Brewer grains (alcohol residues)
Fodder crops: Fodder oat, Turnip, Radish, Fodder pumpkin, Swede, and Fodder beet
Fodder trees: Willow trees
Concentrates: Karma feed (commercial), Buckwheat flour, and Wheat flour

Dry matter availability
The DM requirement for the entire livestock and its contribution by different fodder resources are presented in Table 3. The DM production by different fodder resources was 42,748.8t. The actual DM requirement for livestock units in the study area was 39,302.7t and there was excess DM production of 3,446.1t (calculated at 3.3t AU^{-1} of 11,964.3 AU). However, the actual quantity of DM produced by other feed resources could not be estimated as the respondents hardly maintained records.

Native pasture (Natural pasture)
Natural grazing was the main source of fodder in all seasons. Households reared cattle in sedentary system and depended fully on native pastures during day time. Similar finding was reported by Khan (2008). The green forage available from native resources accounted for a substantial portion in the overall availability of animal feed resources. However, it was difficult to quantify the availability of feed resources from the natural grazing area since forage productivity depends on several factors such as communal grazing area coverage, forest cover, fallow land cover, rainfall and grazing pressure. Majority of respondents in the study area were dependent on

native pastures as a source of forages for cattle production. About 56% respondents were fully dependent on natural pastures, 25% were partially dependent, and 19% were not dependent at all. Cattle were let loose to graze freely in natural grazing areas.

Improved pasture

According to respondents, about 282 ac land were planted with improved pasture. However, the total acreage under improved pasture in Bumthang *dzongkhag* was 3,920.87 ac (Livestock sector quarterly report, Bumthang 2015. In view of increasing shortage of feed, improved pasture production was seen as an important component in the mixed farming systems in the study area. Majority of respondents (91.7%) had improved pasture and only 8.3% of respondents did not have improved pasture due to inadequate land holding and labour shortage. A similar study conducted by Tebeje (2012) in the highlands of Ethiopia also found that the shortage of land is a major constraint to pasture development. Improved pasture was developed on the private land (77.5%), hired land (2%), and both private land and hired land (12.5%). About 8% of respondents were without improved pasture. Lack of private land was the main reason for hiring land for improved pasture development. The results indicated that the improved pasture holdings were directly proportional to the land holding size.

Crop residues

Crop residue was a major feed resource during winter for the majority of respondents. This finding is in line with the report of Lukuyu et al. (2011) who observed similar trend in Kenya. About 2,778t DM crop residues were produced. About 49% of respondents fed their cattle with paddy and buckwheat straw and about 50% did not provide these feeds. Over 77% of respondents fed crop residues to cattle and over 23% never used crop residues. Crop residues were mostly stored in the open area without proper conservation. Tebeje (2012) reported that 91% of Ethiopian farmers stored crop residues outdoor. Farmers conserved straw as hay and fed directly to cattle without enriching with mineral supplements.

Winter fodder crops and feeding practices

Winter fodder crops were cultivated mainly for feeding livestock in winter. The crops included root crops such as swede, fodder beet, turnip, and radish. Other crops as fodder included oats, fodder maize, and fodder pumpkin. About 83% of respondents cultivated fodder crops as feed and 17% did not cultivate. Generally, it was observed that the cultivated fodder crops were conserved to be fed during the lean season. Cattle were fed with chopped root crops mixed with concentrates at various ratios and were provided in gruel form.

Fodder trees and feeding practices

Fodder trees were an important source of feed for the cattle during autumn season. Willow (*Salix babylonica*) was the only common fodder tree found in the study area and contributed 1.40% to the total fodder mass. The annual DM production of willow trees was about 590t out of 17,578 number of trees. Majority of respondents (69.2%) had willow trees planted on private land. Those respondents (30.8%) who did not have willow trees relied heavily on improved pasture.

About 83 respondents had fodder trees and about 64% of them utilized forage effectively. A total of 1956 willow trees were owned by 83 respondents and each household owned about 24 willow trees. About 4% of respondents used willow partially and about 2% did not use willow for feeding. About 30% of respondents did not have willow trees in the study area. Majority of respondents fed willow leaves as fresh fodder and few conserved it as hay and bag silage for winter feeding.

Table 3 Estimated DM production and requirement.

Fodder Resources	Area (ac)	DM production (t)	Contribution (%)
Improved pasture	3,920.87	23,525.2	55.0
Fodder crops	304.16	348.1	0.8
Crop residues	1,389[a]	1,372.3	3.2
Native Pasture	70,833.81[b]	16,912.6	39.6
Fodder Trees	17,578	590.6	1.4
Total DM Production		42,748.8	
Total DM Requirement		39,302.7	

Source: Progress report of Bumthang Dzongkhag (2015) and Dorji (1993)
[a] Crop residues used for livestock feeding is only 49 %,
[b] Estimated native pasture used for grazing is only 50%

Crop by-product

Utilization and sources of by-products are presented in Table 4. Over 88% of households used crop by-product to feed cattle and about 12% had never fed by-products. Crop by-products were fed as and when available. The major forms of crop by-product available were brewer's grain, mustard oilcake and rice bran. About 101 respondents fed brewer's grains produced at home, which was estimated to be about 34.2t. However, other respondents purchased from the neighbors and brewery plants. Mustard oilcake was the second commonly used by-product with an average annual consumption of 5.78t. About 60% of respondents purchased these by-products from other sources. About 24 respondents fed rice bran. The annual production of rice bran was 7.62t. About 83% produced rice bran on their own.

Table 4 Utilization and sources of by-product.

				Source	
By-product	N	(n)	%	Own (%)	Purchase (%)
MOC				40	60
Rice bran				83.3	14.7
Brewer grain	120	101	84.2	82.2	17.8

Concentrate feed

Respondents understood the importance of concentrate as animal feed. Feeding concentrates to cattle was not a regular practice, therefore, it was difficult to quantify the exact quantities of concentrates fed. It was observed that the concentrate feeds were fed regularly to the milking cows in winter and rarely during summer. Major concentrate feeds comprised of commercial feed (Karma feed), buckwheat flour, wheat flour, and maize gluten, which were fed as supplement feed. About 47% of respondents used commercial feed since it was expensive. Lukuyu et al. (2011) reported that the commercial feeds are not used intensively as it is expensive and of unreliable quality. About 68% of respondents were highly inclined to feeding buckwheat and wheat flour. Majority of respondents (93.9%) said that the concentrate feeds are readily available at their homes.

CONCLUSIONS

The major feed resources in Bumthang are native and improved pastures, crop residues, fodder crops, by-products, fodder trees, and concentrate feeds. Improved pasture contributes highest to the total feed base. The total annual DM production exceeds the total feed requirement of existing livestock population in Bumthang *dzongkhag*. Despite excess feed availability, most

farmers face feed shortage. Feed shortage is acute in spring. Available feed resources are conserved but are exhausted early. Hay making is the main fodder conservation technique. Only few farmers practice silage making. Most farmers conserve crop residues and fodder crops for dry season. Farmers do not take initiatives to improve the quality of crop residues. Feeding management practices are generally poor.

ACKNOWLEDGEMENTS

The author would like to immensely thank Dr. Thubten Sonam, College of Natural Resources, Royal University of Bhutan, for his valuable advice, guidance and direction. The author would also like to thank Mr. Jigme Wangdi, Principle Livestock Health Officer, for his continued support and advise. The author expresses his sincere appreciation to the Program Director and staff of NRCAN for their continued support during the entire study period.

REFERENCES

Bhutan RNR Statistics (2015). Policy and Planning Division, Ministry of Agriculture and Forests, Thimphu.

Dorji J (1993). Estimation of Animal Feed and Requirements in the Kingdom of Bhutan. Department of Animal Husbandry, Thimphu, Bhutan.

DAMC (2013). Agricultural Marketing Policy of Bhutan. Ministry of Agriculture and Forests, Royal Government of Bhutan, Thimphu, Bhutan :1-30.

Dzongkhag Livestock sector, Bumthang (2015). Quarterly Report financial year, Jakar: Bumthang, Bhutan.

Ghebrehiwet T, Wangdi P, and Ibrahim, MNM (1994). Feeding Rice Straw Supplemented with Urea-Molasses Lick Block to Lactation Cows in Bhutan. Department of Animal Husbandry. Training, Research and Extension Division, Thimphu, Bhutan.

Ibrahim M (2007). Feeds and Feeding Strategies for Bhutan. Support of the Livestock Sector in Bhutan, Volume 2. RGoB, Bhutan.

Khan MJ, Drochner D, Steingass Hand Islam, KMS. (2008). Nutritive evaluation of some tree leaves from Bangladesh for feeding ruminant animals. *The Indian Journal of Animal Science*, 14: 57-64.

Department of Livestock (2013). 11th Five Year Plan. National Livestock Commodity Development Program. Ministry of Agriculture and Forest (MoAF). Thimphu: Bhutan.

DoL (2014). Livestock statistics 2014. Department of Livestock, Ministry of Agriculture and Forest, Thimphu, Bhutan.

Lukuyu B, Franzel S, Ongadi PM, and Duncan AJ (2011). Current production and management practices in central and northern rift valley provinces of Kenya. Livestock Feed Resources. International Livestock Research Institute. World Agroforestry Centre (ICRAF). Nairobi, Kenya.

National Statistics Bureau (NSB), 2012. Statistical Year Book of Bhutan. Royal Government of Bhutan, Thimphu, Bhutan.

Ruyle G and Ogden P (1193). Range Management. The University of Arizona, US.

Singh SB (2006). Feeds and feeding strategies for livestock in Bhutan: *A consultancy report on animal nutrition of EU livestock project.* Department of livestock, Thimphu, Bhutan.

Statistics (2013). Statistical Handbook of Bumthang. Dzongkhag Administration, Jakar: Bumthang.

Tebeje BE (2012). Study of smallholder farms livestock feed sourcing and feeding strategies and their implication on livestock water productivity in mixed crop-livestock systems in the highlands of the Blue Nile Basin, Haramaya University, Ethiopia.

Wangchuk K and Dorji T (2008). Animal feed production and management in Bhutan. Best practices in SAARC countries, SAARC Agriculture Centre. Dhaka-1215, Bangladesh: BARC Complex.

Wangdi K (2003). Fodder resources of Bhutan. *Proceedings of Rangeland workshop* held at RNR-RC, Jakar, 25 - 28 May, 2003.