Bhutan Journal of Animal Science (BJAS)
Volume 4, Issue 1, Page 105-111, 2020

Full length paper

ASSESSMENT OF MILK PRODUCTION AND INCOME FROM TRADITIONAL AND IMPROVED MANAGEMENT SYSTEM OF SMALL DAIRY FARMERS IN BHUTAN

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ABSTRACT: The study was conducted to compare and assess the productivity of dairy cattle and corresponding household income from traditional and improved dairy management system. The study area falling under four regions were randomly selected by selecting one Dzongkhag from each region. The study also documented major challenges encountered in enhancing productivity of dairy animals. The average daily milk yield and monthly household income for traditional and improved management system under small holder dairy farming were 1.63 l and 7.37 land Nu. 4,167.50/month and Nu. 19,586/month respectively. The average daily milk yield and corresponding household income adopting improve management system was significantly higher (p<0.001) than traditional system. The study also found that about 75 percent of the respondents adopting improved dairy management system meet their household expenses from income generated from dairy farming whereas only 35 percent of the respondents practicing traditional management system meet their household expenses through the sale of milk and milk products. The major challenges encountered in small holder system were lack of technology adoption such as AI services for breeding and fodder conservation, and marketing support. The study concluded that the dairy farming has contributed immensely in improving livelihoods of rural farming communities. Further, the improved dairy farming has enabled the farmers to earn income by four times higher than traditional dairy farming. Therefore, any form of support provided to the farmers in modernizing dairy farming and adopting better technologies will have positive impact on livelihoods of the farmers.

Keywords: Dairy farming; household income; improved farming; small holder; traditional farming.

1. INTRODUCTION

Bhutan is an agrarian country with more than 60 percent of the population depending on subsistence agriculture and livestock farming for their livelihood (Wangmo and Dorji 2017). Small holder dairy farming is widely practiced by Bhutanese farmers and is mainly reared for milk and milk products, draught power and manure. Sale of milk products is increasingly a main source of income to farming community.

About 48 percent of the household in the country rear 3,04,178 heads of cattle out of which 65.4% are local cattle and remaining 34.6% are exotic cross breeds (Livestock statictics 2017). Crossbreeding of local cattle with exotic dairy breeds started from 1985. Improved crossbred cows are stall-fed for increased milk production (Samdup et al. 2010). Milk production varies with the breed type, age, stage of lactation, nutritional status, pregnancy and water availability. High milk yield is the most important for higher economic returns. However, without proper nutrition and management, milk production of the dairy animals cannot be improved. Studies have proven that stall-fed cattle showed a significantly higher milk yield and better reproductive performance than the free range animals (Sultana et al. 2001). The regular earnings from the sale of milk and milk products have favorable effects on the cash flow to rural households and improve their livelihoods.

Despite potential contribution of dairy farming towards improved household livelihoods, farmers are yet to realize benefit of optimizing production. Majority of farmers failed to understand the connection between improved management practices and income. Therefore, the practice of feeding and management on milk production and income was carried out to assess productivity and household income from traditional and improved dairy management systems as well as identify major challenges under traditional and improved management systems.

2. MATERIAL AND METHODS

2.1Study area

The study covered four Dzongkhags (districts); Samtse, Dagana, Trongsa & Samdrup Jongkhar (one Dzongkhag from each region). Within the dzongkhag, two gewogs (sub-district) were selected; Tashichholing and Dumtoed Geogs in Samtse (western region); Goshi and Dorona Geogs in Dagana (West Central); Tangsebji & Langthel in Trongsa (East Central Region); and Deothang and Langchenphu in Samdrup Jongkhar (Eastern Region) (Figure 1)

2.2 Sampling design and sampling

Two gewogs from each dzongkhag were purposively selected; one for the traditional dairy farmers and another for improved dairy farmers based on the Livestock Statistics 2017. Farmers rearing indigenous breed (local cattle) managed under free-range system with forest grazing was defined as traditional dairy management/ traditional farming whereas farmers with cross-bred cattle of above 50 percent exotic blood level, reared under stall-feeding with minimal to zero forest grazing was considered as improved management system. Thirty percent of the villages in traditional dairy management system and 50 percent of the villages under improved dairy management system were selected in consultation with concerned Livestock officers of the selected Dzongkhags. From the selected Geogs, 43 households (20 household from traditional system and 23 from improved system) were selected for the study.

2.3 Questionnaire design

The study was administered through field surveys, using the semi-structured questionnaires with open and closed-ended questions. The questionnaires were pre-tested during the mock interview prior to the actual survey and necessary changes were made to improve the questionnaire clarity. The questionnaire consisted of eight sections; socio- demographic characteristics, dairy housing types, milk production, dairy husbandry, technology management, feeding and breeding practices, and constraints in the farming.

2.4 Data collection

Data were collected from December 2018 to February 2019 by visiting households in the selected villages having at least one milking cow during the interview time. Head of the family or person above 18 years of age actively involved with day to day dairy activity was interviewed.

2.5 Data Analysis

Data coding, entry size and cleaning were carried out using Microsoft Excel and exported to SPSS.

The statistical software SPSS version 21 (IBM Corporation, 2015) was used to analyze the data. A nonparametric chi-square ($\chi 2$) test was performed to test significant difference between traditional dairy farming and improved dairy farming. The 95% confidence level ($p<0.05$) was applied for statistical decision.

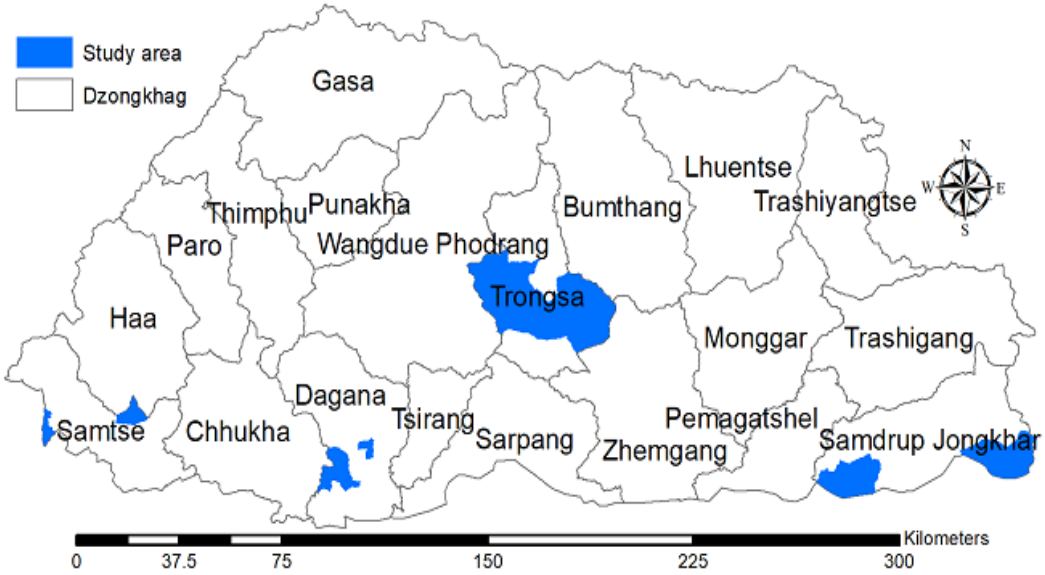

Figure 1: Map of Bhutan showing the study sites

3. RESULTS AND DISCUSSIONS

3.1. Socio demographic characteristics

3.1.1 Gender, age and size of family member

The socio-demographic characteristics of respondent were 58 percent male and 42 percent female. Although sex ratio in the country was 47 male to 53 female (NSB 2017) the finding indicates the females are less forth-

Table 1: Socio demographic characteristics for traditional and improved dairy farming

Variables	Categories	Traditional farming (n=80)	Improved farming(n=92)	Total	p value
Gender	Male	45 (56)	55 (60)	100 (58)	0.64
	Female	35 (44)	37 (40)	72 (42)	
Age	18 - 35 years	16 (20)	17 (18)	33 (19)	
	35 - 55 years	42 (53)	50 (54)	92 (54)	0.96
	Above 56 years	22 (27)	25 (27)	47 (27)	
Education	No Education	62 (77)	61 (66)	123 (71.5)	
	Primary	15 (19)	15 (17)	30 (17.4)	
	Secondary	2 (2.5)	12 (13)	14 (8.1)	0.043
	Higher Secondary above	1 (1.3)	4 (4)	5 (2.9)	
Total land	0 - 2 acres	26 (32.5)	35 (38)	61 (35.5)	
	2.1- 5 acres	49 (61.3)	41 (44.6)	90 (52.3)	0.03
	Above 5 acres	5 (6.3)	16 (17.4)	21 (12.2)	
Pasture Land	Improved pasture (Yes)	59 (73.6)	84 (93)	143 (83)	0
	Improved pasture (No)	21 (26.3)	6 (6.5)	27 (16)	
Herd Size	Till 4 animals	17 (21)	18 (20)	35 (20)	0.85
	Above 4 animals	63 (79)	74 (80.4)	137 (80)	
Family member	Less than 6	44 (55)	74 (80)	118 (69)	0
	6 and above 6	36 (45)	18 (20)	54 (31)	

Note: *The figure in the bracket represent percentage, Chi Square p value test, Family members (mean = 5.86) categorized less than 6 and 6 and above. Livestock herd size (mean 5.16) categorized less than 6 and above 6*

Table 2: Milk production and income under traditional and improved management system

Parameters	Improved cattle	Local Cattle	*p-value*
Average milk yield (litres/day)	7.00 ± 3.60	1.63 ± 0.69	0.00
✓ Trongsa	7.37 ± 3.22	1.33 ± 0.68	0.01
✓ Samtse	5.46 ± 2.60	1.49 ± 0.87	0.01
✓ SamdrupJongkhar	7.06 ± 3.18	1.62 ± 0.32	0.01
✓ Dagana	8.10 ± 4.74	2.07 ± 0.59	0.01
Average milking animal (no)	2.03 ±1.043	1.79 ±0.931	NS
Lactation length (months)	9.92 ± 2.50	9.34 ± 3.34	NS
Monthly Income (Nu)	19,586.96 ±10457.30	4,167.50 ±2248.87	0.00
Milk production reduction in summer and winter (%)	27.29 ± 6.60	24.50 ± 4.47	NS

Note: The figure in the bracket represent percentage, Chi Square p value test

coming in dairy activities. Fifty four percent of the respondents were in the middle age group (36 to 56 years), 27 percent old age above 56 years and 19 percent were young age group below 35 years, indicating that not many youths are taking up dairy farming activity. Almost 70 percent of the households in the study area has less than 6 members in the family living in village. This could be because of more educated people are moving in the urban town and some serving in government offices elsewhere.

However, in socio-demographic characteristics significant difference ($p<0.05$) was observed only in education level; Secondary and higher secondary and above and land holdings that propelled farmers in traditional and improved farming system (Table 1).

3.1.2 Literacy

Majority (71.5%) of respondents in this study were illiterate though the literacy rate is 71 percent literacy rate (PHCB, 2018). Majority of dairy farmers in rural areas who practice traditional dairy farming are mostly illiterate and not aware of improved dairy farming. The findings from the study revealed that more educated respondents in the study area are taking up the improved dairy farming and earn better income (Table 2).

3.2 Average land holdings & Pasture development

The overall average land holding in the study area was 3.69 acres with 3.3 acres for households in traditional management system and 4.03 acres in improved management system. The average household landholding in study area was higher than the national average land holdings of 2.16 (PHCB 2018). Study also found that 93 percent of households with improved management system and 73.6 percent of household with traditional management system have improved pasture land with average of 0.62 acres.

The average improved pasture with traditional management system and improved management system was 0.23 acre and 0.95 acres respectively. Owing to small land holdings, only small portion of the agriculture land is devoted for pasture development and rest are used for agriculture purpose. The finding is consistent with Maleko et al. (2018), who reported that farmers devote about 87 percent of the land to grow crops and only small portion is reserved for pasture development.

3.3 Herd Size

Average milking animals reared by traditional farmers was 1.79 heads and improved farmers was 2.03 heads. Majority (80%) of the respondents kept more than four animals and rest had a herd size of less than 4 animals (Table 1). There was no difference between traditional dairy farmers and improved dairy farmers on herd size.

3.4 Milk production, household income and contribution

3.4.1 Milk production

Recall and milk record data were used to record daily milk yield of dairy cattle managed under traditional and improved management systems. Average daily milk yield was 1.6 litres and 7.0 litres for the traditional and improved management systems respectively. The average daily milk yield under improve management system was found significantly higher ($p<0.001$) than those reared under traditional management system, which could be due to low genetic potential of local breed, poor feeding and husbandry practices, compared to higher exotic blood level cows under improved management system with better feeding and management. The result is consistent with Samdup et al. (2010) who reported milk yield of 2.4 - 4.6 times higher for crossbred/ improved cattle than in local cattle.

Milk production in winter was reduced by more than 27 percent in improved management compared to about 25 percent in traditional management. The reduction in milk production in winter was attributed mainly to fodder shortage and was substantiated by the findings of Wangchuk et al. (2019) that fodder shortage as an impediments to increasing milk production.

The average monthly household income of dairy cattle reared under traditional and improved management systems were Nu. 4,167.50 (range Nu.1000 – 12000) and Nu 19,586.96 (range Nu. 4500 – 45000) respectively. The average household income was highly significant ($p<0.001$) to improved management system for higher milk yield owing to feeding of concentrate feeds, more improved pasture and engagement of more educated people in it compared to traditional management system (Table 2). Hence, if the traditional farmers take up improved dairy management system, the average income is likely to multiply by more than four times.

3.4.2 Contribution from dairy farming to household income

The study found that about 75 percent of the respondents adopting improved dairy cattle management system meet their household expenses from sale of milk and milk products whereas only 35 percent of the respondent under traditional management system meet their expenses through sale of milk and milk products, and rest from sale of cash crops and other activities (Figure 2).

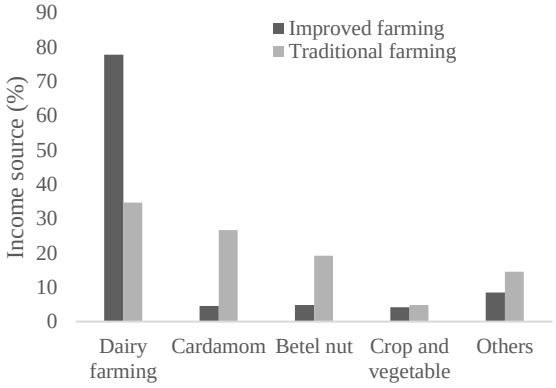

Figure 2: Source of income by traditional and improved dairy farming

Findings from this study suggest that irrespective of management types, dairy has contributed immensely (above 95 %) in meeting the household expenditure, Schooling of their children and grandchildren, buying feed and household food items thereby improving livelihoods of farming community (Table 3).

3.4.2 Milk marketing

Milk marketing due to lack of adequate infrastructure and road connectivity among rural farmers was a major problem. About 75 percent of respondents of the traditional and 64 percent of respondent of the improved dairy farmer respondent process daily

Table 3: Contribution of household income from traditional and improved farming

Variables	Categories	Traditional farming (n=80)	Improved farming (n=92)	Total
Household expenses	Yes	80 (100)	92 (100)	172 (100)
	No	0	0	0
Schooling	Yes	77 (96)	91 (98.9)	168 (98)
	No	1 (1.3)	1 (1.1)	2 (1.2)
Feed purchase	Yes	2(2.2)	91 (99)	93 (54)
	No	72 (90)	1 (1.1)	73 (42.4)

The figure in the bracket represents percentage, Chi Square p value test

produced milk into butter and cheese. However, it is reported to be labour intensive and time consuming. Therefore, the need to adopt improved technology for product processing is warranted to ease the problem.

3.5 Dairy management system

Housing is important to ensure proper and easy management of dairy cows. The study recorded about 85 percent of farmers rearing improved cattle constructed permanent dairy shed, followed by 13 percent and 2 percent with semi-permanent/temporary sheds respectively (Figure 3).

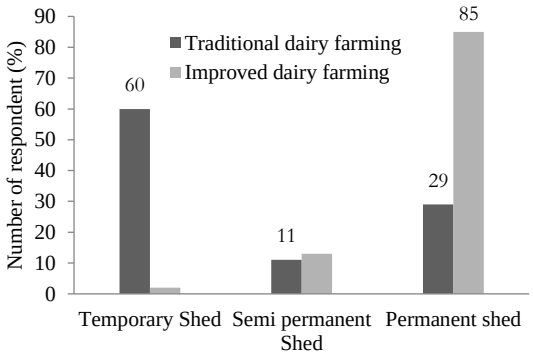

Figure 3: Dairy Sheds in traditional and improved dairy farmers

3.6 Feeding management

3.6.1 Traditional management system

Adequate/ balanced feeding is considered as one of the important components for optimum production. Finding from the study indicates that 100 percent of the traditional management system feed crop residue as primary feed to their milking animals which ranged from 2 to 25 kg per day (Table 4).

The finding from the present study indicated that about 30 percent of the traditional dairy farmers feed 5 – 10 kg of paddy straw as an alternative feeding during winter owing to non-availability of green fodders. However, no concentrate feeds were given under traditional management system due to non-availability of feed agent and high feed price in the area (Table 5). More than 97 percent of the traditional management system tethered their dairy cows in their private land or near the forest which is the main source of fodder.

Table 4: Feeds and feeding trend

	Cattle type	
	Improved(N=9)	Local(N=80)
Crop residue (kg)	5-30	2-25
Concentrate (kg)	2-3	0
Fodder (kg)	5-18	5 - 10
Water (l)	20–30	15–20

Table 5: Different feeding and fodder availability in traditional & improved dairy farming

Variables	Categories	Traditional dairy farming (n=80)	Improved dairy farming (n=92)	Total	*p* value
Feeding Concentrates to the milking cows	Yes	4 (4.7)	82 (95.3)	86 (50)	0.00
	No	76 (88.4)	10 (11.6)	86 (50)	
Tether milking cow in field for grazing	Yes	78 (97.5)	41 (44.6)	119 (69.2)	0.00
	No	2 (2.5)	51 (55.4)	53 (30.8)	
Feed crop residue	Yes	80 (100)	92 (100)	172 (100))	NS
	No	0	0	0	
Feed paddy straw	Yes	24 (30)	63 (68.5)	87 (50.6)	0.00
	No	56 (70)	29 (31.5)	85 (49.4)	
Have feed agent to buy	Yes	0	82 (89)	82 (48)	0.00
	No	80 (100)	10 (11)	90 (52)	

The figure in the bracket represent percentage. Chi Square p value test

On the contrary, only 29 percent of traditional dairy farmers had permanent shed followed by 11 percent and 60 percent in semi-permanent and temporary shed respectively. The type of dairy shed and shed floor significantly affect the milk production in traditional and improved dairy farming ($p<0.001$). The result shows that the current types of sheds are influenced by the availability of financial resources. In many places cattle were kept in confined area and floor was made from mud without drainage system to protect from cold. Most of the traditional system do not have dairy sheds as their animals are migrated to their orchards for manuring purpose and also in search of green grass in different seasons. Clean milking practice such as washing of hands, udder and milking utensil before milking were practiced by both traditional and improved dairy farming equally.

3.6.2 Improved management system

Finding from the study indicates that 100 percent of the improved management system feed crop residue as one the major feed component to their milking animals and were given in the range of 5 to 30 kg daily (Table 4).

Crop residue ingredients include paddy straw, leftover vegetables, sorghum, pumpkin, banana stem, mustard cake etc. Beside this, fodder grasses were also fed to the dairy animals in the range of 5 – 20 kg. More than 95 percent of the improved management system feed commercial feeds to their milking cows during morning and evening before milking and were given in the range of 2 to 3 kg (Table 4 & 5). The findings from the present study indicated that about 69.5 percent of the improved dairy farmers fed paddy straw as an alternative feed during winter owing to non-availability of green fodders.

These crop residues and fodder fed to milking cows have low level of nutrients and can meet only 35 to 45 percent of the feed demand of the ruminant (Maleko et al. 2018). Crop residue have low palatability and digestibility due to high fibre contents which is less than 18 percent. Thus, treatment with urea molasses of high fibre crops was recommended for better performance and more milk production. Efforts to reduce the problem of dry season over fodder shortage by hay making technologies were introduced. However, the technology did not pick up in the farmer's field although it was effective and successful elsewhere. Low adoption of this technology could be due to limited practice of fodder conservation, low level of awareness/ extension support, and labour and land shortages as the similar situation was reported by Maleko et al. (2018). Findings from the study area revealed that concentrate feeding among improved management system was 2 to 3 kg and no concentrate was fed in traditional management system.

3.7 Water

The result from the study revealed that farmers provided 15 to 20 litters of water/day to local cattle compared to 20 to 30 litters of water per day to improved cattle (Table 4). The finding is in consistent to the findings of Smith et al. (2017) which provided 20 to 40 litters of water daily to crossbred milking cows. However, water consumption is found to be proportionate to milk production and different seasons of the year.

3.8 Breeding

About 70 percent of the traditional dairy farmer respondents use local breeding bull to breed their cows compared to one percent by the improved dairy farmer respondents (Figure 4).

Similarly, 23.8 percent of the farmers in traditional system use community Jersey bull to breed their cattle compared to 33.7 percent of the farmers in improved system, indicating that the farmers in improved system have preference for sires with higher exotic blood level than those in traditional system. There was significant difference in milk production ($p<0.001$) resulting from different breeding types; artificial insemination (AI) and different breed of breeding bulls. None of the traditional dairy farmer used AI to breed their dairy cows compared to 56.5 percent of the farmers in improved farming. Ninety nine percent of the traditional farmers did not avail AI services due to lack of facility compared to 98 percent of improved dairy farmers who availed AI facility as available in the Geog. More awareness on benefit of AI over natural service and AI facilities need to be provided with adequate logistic support in villages to encourage breed improvement for higher milk production and income.

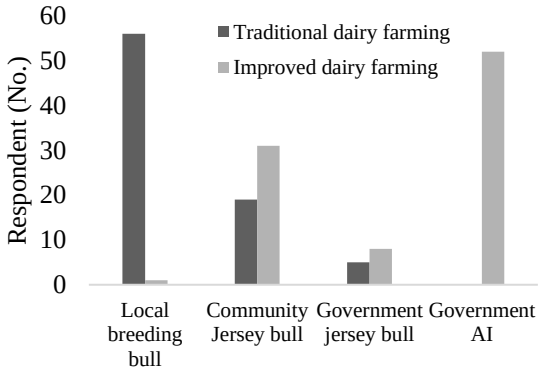

Figure 4: Different types of breeding practiced by traditional and improved dairy farming

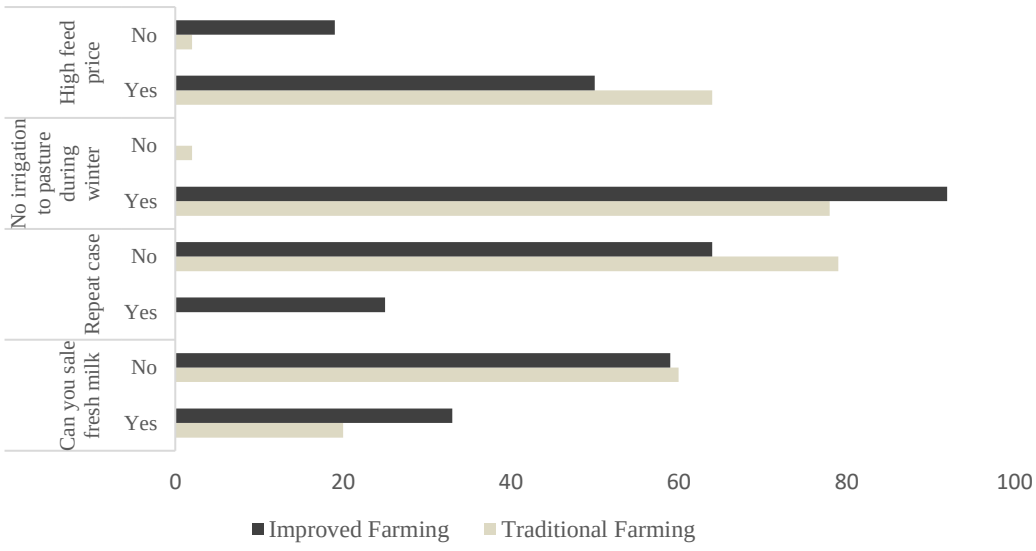

Figure 5: Challenges faced by farmers in traditional & improved management system

3.9 Animal Health

All respondents (100 percent) vaccinated their cattle against Foot & Mouth Disease (FMD) under improved management system compared to 90 percent under the traditional system. Similarly, 95 percent of the farmers in traditional management and 91 percent of the farmers in improved dairy management have not encountered management related disease such as Mastitis. About 9 percent and 5 percent management related disease especially mastitis was reported by improved and traditional management system respectively.

3.10 Constraints

Dairy management skills particularly for breeding and artificial insemination technology were lacking in farmers of both traditional and improved dairy management systems. The cases of repeat breeding were eminent in both the management systems. About 26 percent of farmers in traditional farmers reported wildlife depredation as other constraint compared to 5 percent in improved system. The reason for higher depredation under traditional management system could be attributed to animals being left in forest for open grazing most of the time.

Besides, the study revealed lack of irrigation facility for pasture development particularly in winter as another constraint in dairy farming system (Figure 5)

4. CONCLUSIONS

Improved dairy management system contributed four times higher household income as compared to traditional dairy farming system in the study area. More educated people are taking up improved dairy farming as a regular and attractive source of income adopting improved management technology. With farmers adopting improved dairy management system the milk production had increased and adverse impact on environment had reduced. The study revealed that the milk production in winter is reduced by more than 25 percent due to limited landholding for fodder production. The fodder shortage was further compounded by farmers' inability to conserve hay and silage when available in abundance during the summer season. Since little can be done on land scarcity, building farmers' capacity on fodder production and conservation technologies need to be emphasized.

Given different agro- ecological zones and climatic conditions in the country the farmers should adopt suitable dairy shed design for better health and production. Government should also provide more supports on capacity building to adopt improve management practices and technology to enhance milk production, household income and improve rural livelihood henceforth. More awareness on benefit of AI over natural service and AI facilities need to be provided with adequate logistic support in villages to encourage breed improvement.

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