Full length paper

Adoption of Improved Dairy Production Practices by Dairy and Non-Dairy Farmers' Groups

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ABSTRACT

A study was conducted to understand the farmers 'knowledge on adoption of dairy technologies, comparing dairy farmers groups [DFG] and non-dairy group members. Over 167 farmers were interviewed in three *Dzongkhags* in Low altitude [Sarpang], Mid-Altitude [Tsirang] and high altitude [Haa]. Ninety-seven were respondents of dairy farmers' groups and 70 were respondents of non-dairy farmers' group. The questionnaire sought information on farmers' knowledge on dairy technology, household profile, feeding practices, dairy husbandry practices, breeding practices and health practices.

Dairy farmers' group respondents had a high level of adoption in feeding practices with 84.92 percent, dairy husbandry practices with 80.15 percent and health care practices with 77.30 percent. However, the non-dairy farmers' group respondents had medium level of adoption of feeding practices with 69.20 percent, dairy husbandry practices with 54.92 respondent and health care practices with 69.87 percent. Breeding practice adoption among dairy farmers' group respondents was medium with 43 percent and non-dairy farmers group respondents with 28 percent. There is a big scope for strengthening the farmers' knowledge on dairy technology adoption among dairy and non-dairy farmers groups, particularly in breeding practices through awareness creation and training of farmers on emerging technologies.

1. INTRODUCTION

Livestock production makes a significant contribution to economic development, rural livelihoods, poverty alleviation and meeting the demand for animal protein in developing countries. In South and East Asia, smallholder dairying has become a good income-earning occupation for crop farmers in mixed farming systems. In a small Himalayan Kingdom of Bhutan, dairy farming is a traditional source of milk, draught power and manure.

Dairy development in Bhutan started in the early 1960s. Several projects and programs were initiated to improve dairy production, resulting in formation of dairy farmers' groups [DFG] across the country. The Royal Government of Bhutan continues to invest in crossbreeding programs, extension services, animal health care, prevention and control of animal diseases. Dairy farmers are provided subsidy for cattle purchase and shed construction with an aim to encourage them to upgrade from subsistence to market-oriented dairy enterprises. In developing countries, the modern animal breeding, feeding and animal health technologies are promoted to transform subsistence into market-oriented dairy farming [Duncan et al. 2013]. To increase production, it is essential to adopt modern dairy technologies and farming practices such as rearing improved breeds of dairy cattle, cross breeding animals through Artificial Insemination [AI] and use of superior breeding bulls, better housing to animals, improved feeding and animal health care. Adoption of new technologies, enhanced production performance of dairy cattle, and reduced cost of production have led to substantial gains in farmers' income (Challa, 2013). Adoption of dairy technologies improves livelihoods of farmers through higher yields, better household income, improved nutrition and availability of animal protein [Kebebe et al. 2017].

Most Bhutanese farmers are less aware of scientific animal management and improved dairy farming practices. Aulukh and Singh [2005] reported that in Asia, there is lack of awareness on economic aspect of milk production, due to majority of dairy farmers being smallholders and illiterate following traditional dairy farming. In traditional dairy farming, farmers rear local cattle breed as it is easy to manage and are resistant to diseases, despite its low productivity. Although many improved technologies were developed in the field of dairy sector, there has been little success in bringing desired socio-economic changes in dairy farmers [Kumar et al. 2011]. In Bhutan, the farmers' non-adoption of dairy technologies presents a formidable challenge in dairy development. It has resulted in poor production practices, making the dairy enterprise less profitable. As the world moves towards intensive dairy production systems, it is crucial that modern technologies are adopted to enhance production and contribute to food sufficiency and security. However, despite production being less impressive across the country, no major efforts are made to address this challenge. Thus, it is essential to initiate a study to generate baseline information on adoption of dairy technologies and understand issues hindering technology adoption by Bhutanese dairy farmers. The study findings could highlight some areas needing special attention and government interventions. Therefore, a study was conducted with the objectives to, understand the knowledge on existing dairy technology between the members of Dairy Farmers Group [DFG] and non-Dairy Farmers Group [non-DFG], and identify factors affecting dairy technology adoption.

2. MATERIAL AND METHODS

2.1 Study area

The *Dzongkhags* [districts] of Sarpang representing Low altitude, Tsirang Mid-Altitude and Haa high altitude were selected randomly from four regions. The sub districts of Gelephu and Shompangka from Sarpang, Kikorthang and Patshaling from Tsirang and Bji and Katsho from Haa were selected for the study [Figure 1]. Sub districts were purposely selected from the selected districts based on the maximum and active DFG and non-DFG members available during the study time.

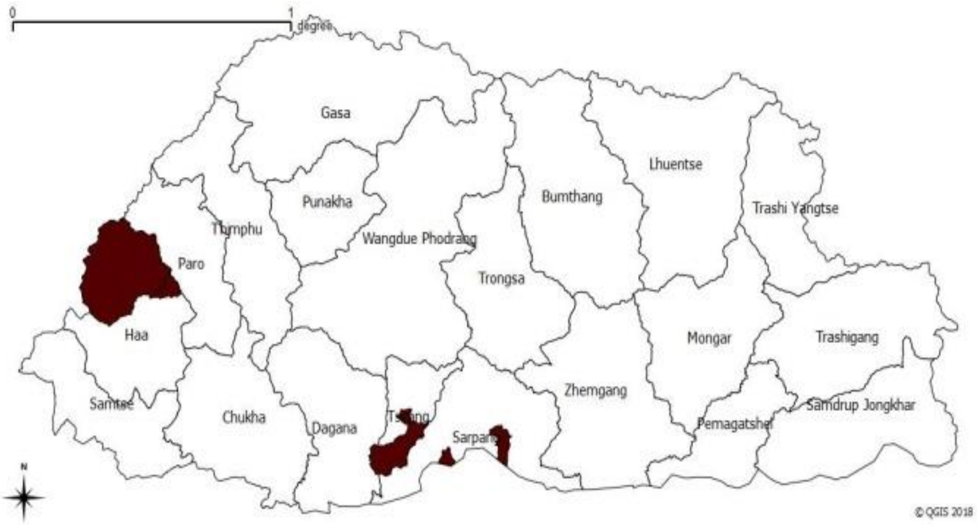

Figure 1: Map of study area

2.2 Sampling design

A multistage and purposive sampling was used to select the region, districts and sub districts. The total number of households sampled was 167, which were divided into DFG and non-DFG. Out of total samples, 97 were DFG households and 70 were non-DFG households. The selected dairy farmers owned more than one milking cow at the time of interview. Farmers above 18 years of age were selected for the interview. The household list maintained by sub district Extension staff was used during selection. DFG members were located near head quarter, towns and other important office, and non-DFG members were located away from head offices.

2.3 Questionnaire design and field interview

A questionnaire was designed for this study, consisting of five parts: Household characteristics [gender, age, educational level, farm location, type of farms, landholding, access to information, extension, credit, knowledge and institutional support received], feeding practices, Dairy husbandry practices, Breeding & AI practices and animal health care practices. Age was categorized into young age [18–35 years], middle age [36–55 years] and old age [56–86 years]. The questionnaire was pre-tested with 10 farmers, prior to the actual survey. Where needed, the changes were included and the questionnaire was revised. The survey was administered through face-to-face interview in local and national languages. The same questionnaire was used for both DFG and non-DFG members. Data was collected from December 2018 to February 2019.

A modified knowledge test [Sah 2005] was used to measure the knowledge and to categorize the knowledge/adoption level. Respondents were presented with dichotomous statements under each broad category of technology adoption and open-ended questionnaires. Responses were given scores [1 for Yes and 0 for No]. Knowledge index was calculated with the formula presented below. Index below 40 percent was considered low, 40 to 70 percent as medium and above 70 percent as high.

$$\text{Knowledge Index} = \frac{\text{Score obtained by respondents}}{\text{Maximum obtainable score}} \times 100$$

2.4 Data analysis

Data were coded, entered and arranged in Microsoft Excel program. The data were analyzed with a statistical software SPSS version 21. Descriptive statistics such as frequency, descriptive statistics, crosstabs, Chi squire Pearson's correlation coefficient were used. Differences were considered significant when p values were less than 0.05.

3. RESULTS AND DISCUSSION

3.1 Respondents' profile

Fifty-seven percent of DFG members were literate, ranging from primary to above secondary level education [Table 1]. More educated respondents interviewed were from Tsirang, followed by Sarpang and Haa districts. The mean age of respondents was 48.04 years. About 54 percent of DFG members were female. Maximum female respondents were from Haa with 59 percent, followed by Tsirang and Sarpang with 21 and 19 percent, respectively.

The biggest proportion of respondents in this study was in middle age, followed by old age and young age group [Figure 2]. This is in contrast to the findings of Mane et al. [2016] where young age group was found biggest, working in dairy farming. Middle and old age groups continued their dairy farming practice. Similar to the suggestion of He et al. [2007], the government interventions are needed to attract educated Bhutanese to dairy farming at large scale by making improved technologies more accessible and user friendly.

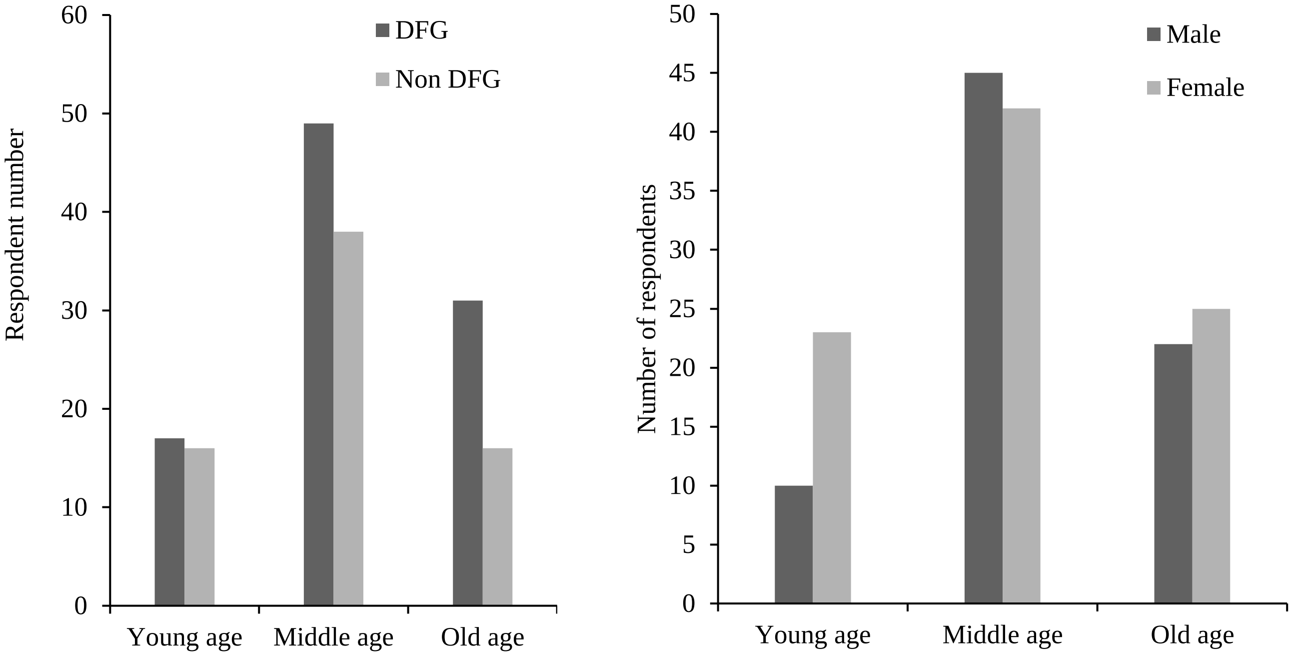

Figure 2: Age of the respondent between DFG and non DFG and between Male and female.

More than 80 percent of DFG respondents interviewed received training on dairy management and feeding, compared to 18 percent by non-DFG respondents [Table 1]. More than 58 percent of DFG members had one to three acres of land, which included both agricultural and pasture lands. Table 1 shows that more than 66 percent of DFGs respondents practiced tethering and feeding crop residues and concentrates, followed by stall feeding. In contrast, 33 percent of non-DFG respondents practiced tethering and feeding crop residues and concentrates, followed by free grazing and migration.

About 37 percent of information on improved dairy technology was received from livestock staffs, followed by family and friends with 30 percent and radio and television 24 percent. Discussion of information at different level will have positive impact on knowledge of dairy farmers to improve dairy farming activities as suggested by Sharma et al. [2007].

3.2 Farmer's knowledge on modern dairy farming technology

3.2.1 Adoption of feeding practices

Table 2 shows the results of adoption of feeding practices by DFG and non-DFG. Proper feeding is one of the pre requisites for successful dairy farming and helps in enhancing milk production. Dairy farms should have high yielding animals and provisions for feeding concentrates and energy rich feeds. Both DFG and non-DFG members had high level of adoption of good feeding practices, such as feeding of colostrum to calves within 8 hours of calving, feeding concentrated feed to milking cows, and providing clean drinking water. A vast majority of DFG members had significantly greater established pastures. However, the proportions of respondents having fodder trees in their field were about 59% and 63% for DFG and non-DFG, respectively. The proportion of respondents, who adopted technology of feeding concentrates, was significantly higher in DFG.

Fifty-seven percent of DFG respondents interviewed were educated, adopted the feeding technology and feasible and viable practices [Figure 3]. Other reasons for higher level of technology adoption could be due to all dairy group members residing in the periphery of the districts and sub district headquarters where technical supports from livestock staffs and other stakeholders are regular and timely. This is in agreement with the findings of Quddus [2012] where DFG members have greater proportion of literate members and plays important role in making themselves aware of the technologies and government supports. The reason for low adoption of technologies by non-DFG respondents could be due to less number of educated members, limited awareness, lack of commercial feeds, lack of training, less support in input supply, poor road network and less support from government, which is similar to the findings of Mekonnen et al. [2009].

Table 1: Socio-economic characteristics of DFG and non DFG respondents.

	Dairy Farmers Group			Non-dairy Farmer Group		
	Haa	Sarpang	Tsirang	Haa	Sarpang	Tsirang
Illiterate	26	11	8	18	14	13
Literate	9	20	23	5	9	11
Male	4	21	20	4	16	12
Female	31	10	11	19	7	12
Training	32	26	29	10	7	4
No training	3	5	2	12	15	20
Land [less than 1 acre]	2	2	9	10	2	6
Land [1-3 acre]	23	16	8	10	6	13
Land [3-5 acre]	8	10	9	3	8	3
Land [more than 5 acres]	2	3	5	0	7	1
Free Grazing	0	1	0	0	13	8
Migratory	0	1	0	0	2	4
Tethering and Feeding	35	24	22	23	8	10
Fully Stalled fed	0	5	9	0	0	2
Age [18-35]	6	5	6	6	4	6
Age [36-55]	15	20	14	9	14	15
Age [56-87]	14	6	11	8	5	3

3.3 Dairy husbandry practices

3.3.1 Milking practices and clean milk production

Table 3 presents the results of comparisons between DFG and non-DFG on milking practices and clean milk production. The overall technology adoption on dairy farming practices, particularly in milking practice and clean milk production, was high in DFG respondents with 84.48 percent, compared to medium in non-DFG with 67.67 percent [Table 3]. The adoption of clean milk production practices like cleaning of hands and udder before milking was 100 percent in both groups. Similar result on clean milk production was reported (Aulakh & Singh, 2012).

The practice of milk let down with the help of calves is still high in both groups. The practice of weaning calves after four months should be encouraged for high yielding animals for good and hygienic milking practices. Guidelines on this should be developed and awareness made to the dairy farmers by extension staffs.

Table 2: Adoption level on feeding practices of DFG and non DFG respondents.

Parameters	DFG [n =97]		Non DFG [n= 70]		p value
	Frequency	%	Frequency	%	
Feed Colostrum to calves within 8 hours	96	98.97	69	98.57	NS
Feed crop residue/concentrates to milking cows	97	100.00	65	92.86	NS
Provide clean drinking water	97	100.00	68	97.14	NS
Do you have established pasture	88	90.72	49	70.00	0.001
Have fodder trees in your field	57	58.76	44	62.86	NS
Feed calves with concentrates	77	79.38	30	42.86	0.000
Feed Heifer with concentrates	76	78.35	29	41.43	0.000
Feed Pregnant cows with concentrates	79	81.44	30	42.86	0.000

3.3.2 Improved cattle shed

Table 4 presents the results of adoption of improved cattle shed by DFG and non-DFG respondents. Over 82 percent of DFG respondents had adopted improved cattle shed. The improved shed had facilities like enough sunlight, water tap near the cowshed, enough ventilation and floor made of concrete materials. In contrast, over 44 percent of non-DFG respondents had medium level improved cattle sheds. Generally, there was a significant difference in the adoption of improved cattle shed technology between DFG and non DFG [Table 4]. The better housing provided by DFG members was because of government supports. DFG members were supported with basic construction materials. The reason for low adoption by non-DFG members could be due to remote location, poor road network and small land holding.

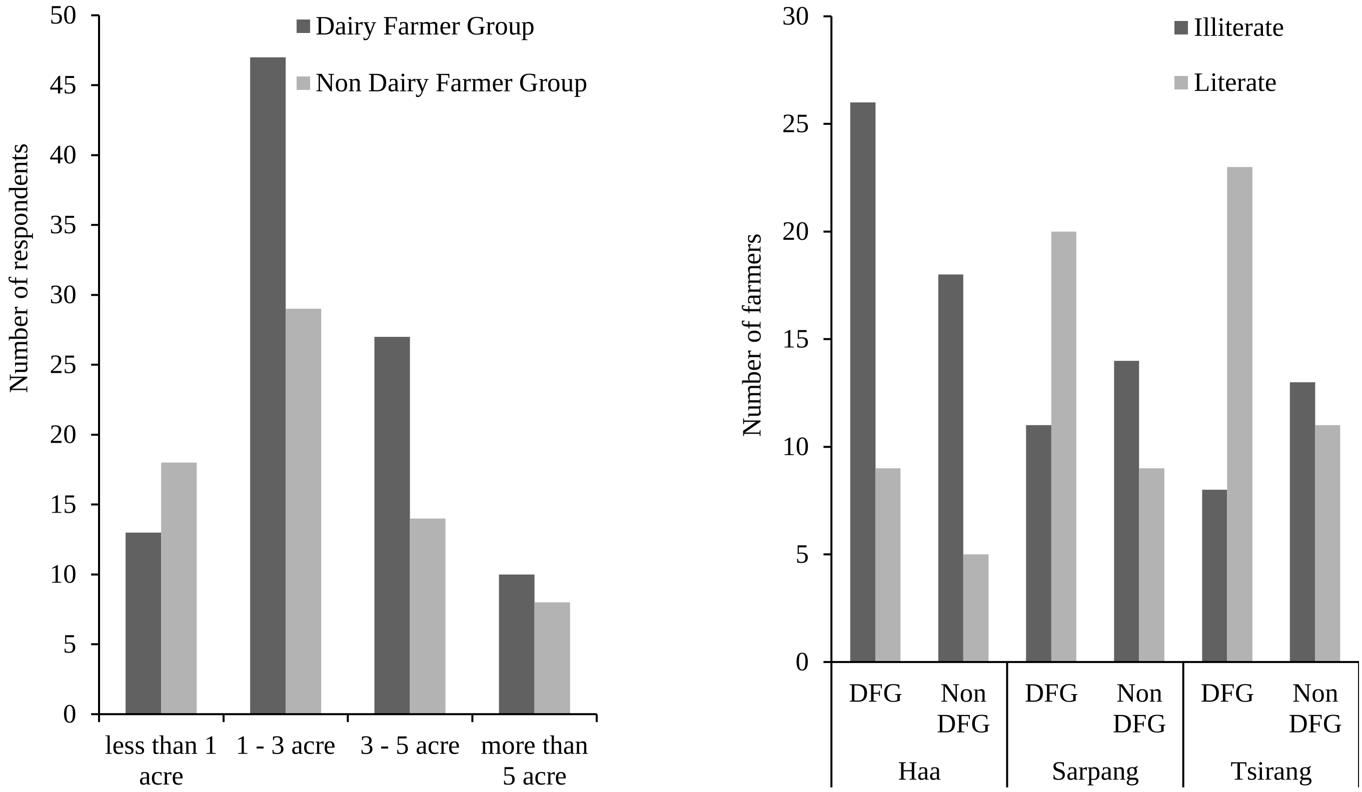

Figure 3: Education level and land holding of the respondent between DFG and non DFG members.

Table 3: Comparison of DFG members and non DFG respondents on dairy husbandry practices.

	DFG [n =97]		Non DFG [n= 70]		p
Parameter	Frequency	%	Frequency	%	Value
Wash hand before milking	96	96.77	70	100.00	0.581
Wash udder before milking	97	100.00	70	100.00	ns
Wash dairy shed regularly	66	96.77	22	31.43	0.000
Clean milking animals regularly	25	28.90	10	14.08	0.018
Let the calf take milk for milk let own	97	100.00	65	92.86	0.012
Overall technology adoption	387	84.48	237	67.67	

Table 4: Adoption level on cattle shed of DFG and non DFG respondents.

	DFG [n =97]		Non DFG [n= 70]		p
Parameter	Frequency	%	Frequency	%	Value
Cattle shed receive enough sunlight	86	88.65	43	61.42	0.000
Have improved cattle shed	80	82.47	27	38.57	0.000
Water tap near the shed	82	84.53	29	41.42	0.000
Cattle shed have enough ventilation	83	85.56	37	52.85	0.000
Cattle shed have concrete floor	68	70.10	19	27.14	0.000
Overall technology adoption	399	82.25	155	44.28	

3.4 Animal breeding practices

The breeding practices of DFG and non-DFG are presented in Table 5. The overall adoption of animal breeding practices, including Artificial Insemination by DFG, was medium with 56.21 percent compared to non-DFG with 39.15 percent. Almost 100 percent of DFG respondents reared improved dairy cow compared to 87 percent by non-DFG.

3.4.1 Breeding methods

About 77 percent of DFG respondents reported the availability and adoption of AI technology, compared to 44 percent of non-DFG members [Table 5]. Poor adoption of AI technology by non-DFG could be due to distant location of AI centres, ignorance of farmers on estrus signs and not knowing the right time to take animals for insemination. There was a significance difference in the use of government AI facility between DFG and non-DFG respondents. Similar findings have been reported by Letha [2013]. About 35 percent of DFG respondents used government supplied breeding bull and 55 percent used community bull when the AI services are inaccessible or when AI service fails. On the other hand, non-DFG respondents used 30 percent government supplied breeding bull, 28 percent community breeding bull and 25 percent local bull.

Table 5: Comparison of DFG members and non DFG respondents on breeding practices.

Parameters	DFG [n =97]		Non DFG [n= 70]		p
	Frequency	%	Frequency	%	Value
Have government breeding bull in village	34	35.05	21	30.00	NS
Have community breeding Bull	53	54.64	20	28.57	0.001
Have household local breeding bull	5	5.15	18	25.71	0.000
Practice mating after 12 to 18 months of age	29	33.33	8	11.43	0.000
Have AI Service facility from Government	75	77.32	33	47.14	0.000
Practice AI in animals in correct heat time	71	73.20	31	44.29	0.001
Present cow to breeding bull in correct time	55	56.70	32	45.71	NS
Service cow within 60 to 90 days calving	38	39.18	9	12.86	0.004
Know estrus cycle of 19 to 22 days	c	27.84	10	14.29	0.012
Maintain 60 to 75% cross breed animals	78	80.41	36	51.43	0.000
Maintain replacement stock	89	91.75	50	71.42	NS
Rearing of improved breed	97	100.00	61	87.00	NS
Overall technology adoption	651	56.21	329	39.15	

3.4.2 Reproduction parameters

Table 5 presents the level of adoption of reproduction parameters. Mating heifers at 18 months of age and below for DFG and non DFG respondent were 33 percent and 11 percent, respectively, indicating poor reproduction technology adoption. The result highlights that both DFG and non-DFG respondents have low level of knowledge on the estrus cycle of dairy cows within 19 to 22 days with 27.84 percent and 14.29 percent, respectively. About 39 percent of DFG respondents adopted the technology of serving cow within 60 to 90 days after calving, compared to 13 percent by non-DFG respondents. This finding is in agreement with that of Kumer et al. [2016] who observed reproduction and breeding performance as medium to low level in DFG and non DFG respondents.

Proper and better breeding practices help to develop good dairy population. The main reasons behind heifer not coming to heat even after 18 months of age could be due to poor management, feeding and breeding practices. Majority of farmers may not have adequate knowledge on management and proper feeding of animals with balanced ration to heifers and milking cows. This problem could be further aggravated by high price of concentrates feeds, which many farmers cannot afford to buy. Similar finding on under feeding due to high price was reported by Kumar et al. [2011]. The respondents' lack of knowledge on the estrus cycle could be due to low level of awareness and training and not many young and educated farmers are taking up this business who could adopt new technology (Quddus, 2012).

3.5 Animal Health Practices

3.5.1 Disease preventives measures

The overall adoption of animal health practices by DFG was over 77 percent, compared to non-DFG with 69.87 percent [Table 6]. Proportions of members who vaccinated against major livestock diseases were 98 percent and 100 percent for DFG and non-DFG, respectively. However, Both DFGs and non DFG had low level of knowledge on zoonotic diseases. DFG respondents had a high level of knowledge with 75.26 percent on disease control and eradication program, compared to non-DFG members with 57 percent [Table 6].

The level of deworming practices was medium with 49 percent for DFG and low with 31 percent for non-DFG. The medium level of adoption on deworming practices to animals could be due to rise in backyard and semi-commercial farms. Government developed a policy of deworming only those animals found positive with minimum threshold of parasitic loan on laboratory examination for rationale use of deworming drugs.

3.5.2 Disease curatives practices

Disease outbreak incidence was slightly higher for non DFG with 77.14 percent, compared to 73.20 percent for DFG [Table 6]. Prompt reporting during disease outbreak in DFG was 100 percent, compared to 93 percent for non DFG. Over 90 percent of DFG and non-DFG members isolated the sick animals from normal animals during disease outbreaks. Similarly, over 85 percent of DFG respondents took extra care and availed extension services during disease outbreak while only 68 percent of non-DFG respondents availed extension services during disease outbreak. Both Dairy groups had a high level of awareness on availing disease surveillance for early warning and for prompt disease control.

3.6 Factors affecting technology adoption by DFG and Non-DFG farmers

Findings from the study indicated that, over 95 percent of DFG and non-DFG members had problem with the availability of pasture to feed their animals [Table 7]. The main problem with pasture is lack of irrigation, less land and very cold weather in some selected study areas. Other important hindering factors for technology adoption were unavailability of people/labour working in the farms, lack of training and awareness. Old and illiterate people work in the field, which could have contributed to low technology adoption. Majority of dairy farmers still live in remote villages and the improved dairy technology adoption has not taken place due to poor network facility. There was a significance difference in the dairy technology adoption between DFG and non DFG members [$p<0.05$], which suggests that more attention should be given to farmers of non-DFG members.

Table 6: Comparison of DFG members and non DFG respondents on health care practices.

Parameters	DFG [n =97]		Non DFG [n= 70]		p
	Frequency	%	Frequency	%	Value
Vaccinate cow against notifiable disease	96	98.97	70	100.0	NS
Know zoonotic disease	36	37.11	12	17.14	0.006
Encountered incidence of disease outbreak	71	73.20	54	77.14	NS
Prompt reporting of disease outbreaks	97	100.00	65	92.86	0.074
Isolation of sick animals	95	97.94	66	94.29	NS
Disease control and eradication program	73	75.26	40	57.14	NS
Avail animal health extension services	87	89.69	55	78.57	NS
Practice deworming of animals	48	49.48	22	31.43	NS
Give extra care when sick	82	85.42	48	68.57	NS
Avail service for Disease surveillance	91	83.49	66	94.29	0.029

4. Conclusions

The study concluded that, in general, overall technology adoption rate is higher in DFG than non-DFG. DFG respondents have high level adoption in practices of feeding, dairy husbandry and health care. Breeding practice adoption DFG are medium and non-DFG is low. Adoption of improved dairy technologies is influenced by many factors. Among others, level of education, awareness on available technologies and willingness of farmers to adopt technologies are major ones.

There is a good scope for strengthening the adoption of technologies in DFG and non-DFG. Extension services should be strengthened and training of farmers on improved technology and technical support should continue. There is a large gap in technology adoption on breeding practices, which should be filled by improving the knowledge of both groups. Government should intervene with subsidy and other financial incentives to attract youths and educated lots to replace the old people looking after dairy farming in remote villages.

Table 7: Comparison of DFG and non DFG respondents on overall technology adoption.

	DFG [n=97]	%	Non DFG [n=70]	%
Pasture unavailability	92	94.85	69	98.57
Irrigation	57	58.76	37	52.86
Land	36	37.11	29	41.43
Labor	39	40.21	41	58.57
Cold weather	17	17.53	18	25.71
AI and Breeding	28	28.87	16	22.86
Non educated farmers	45	46	45	64
Training attended	87	90	21	21

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References

Aulakh GS and Singh R [2012]. Adoption of recommended management practices by the buffalo owners. Indian Journal Dairy Science: 431- 434.

Aulukh GS and Singh R [2015]. Socio-economic characteristics of farmers and status of buffalo health care practices. Indian Journal of Animal Sciences, 85[12]: 1396–1398.

Challa M [2013]. Determining Factors and Impacts of Modern Agricultural Technology Adoption in West Wollega. GRIN Publishing.

Duncan AJ, Teufel N, Mekonnen K, Singh VK, Bitew A and Gebremedhin B [2013]. Dairy intensification in developing countries: effects of market quality on farm-level feeding and breeding practices. The International Journal of Animal Biosciences, 7 [12]: 2054–2062.

He XF, CaO H and Li FM [2007]. Econometric analysis of the determinants of adoption of rainwater harvesting and supplementary irrigation technology in the semiarid Loess Plateau of China. Agricultural Water Management: 243-250.

Kebebe EG, Oosting SJ, Baltenweck I and Duncan AJ [2017]. Characterization of adopters and non-adopters of dairy technologies in Ethiopia and Kenya. Tropical Animal Health Production, 23:123-126.

Kumar J, Kumar B and Kumar S [2011]. Constraints perceived by farmers in adopting scientific dairy farming practices in Msdhu districts of Bihar. Research Journal Agriculture Science: 142-145.

Ahirwaar MK et al. [2016]. Knowledge Level of Dairy Farmer about Improved Dairy Farming Practices in Rewa District of Madhya Pradesh. International Journal of Agriculture Sciences, 8 [45]: 1909-1911.

Letha DG [2013]. Adoption of Dairy Farming Technologies by Livestock Farmers. Indian Research Journal Extension Education: 57-61.

Mekonnen H, Dehninet G and Kelay B [2009]. Dairy technology adoption in smallholder farm in Dejen district, Ethiopia. Tropical Animal Health and Production, 23: 213-218.

Quddus M [2012]. Adoption of dairy farming technologies by small farm holders: practices and Constraints. Bangladesh Journal of Animal Sciences: 124-135.

Sah A [2005]. Entreneurship among Milk producers in Northern Region of India. Animal Science: 1-6.

Sharma P, Pandey S, Meena BS and Singh NP [2007]. Knowledge and adoption of livestock feeding practices in Jhansi district of Bundelkhand. Indian Journal of Dairy Science: 63-67.