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Performance of Buffalo (*Bubalusbubalis*) under Bhutanese conditions

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Abstract

The study was conducted to generate and document baseline data on the productive and reproductive performance of buffalo under Bhutanese conditions. The compositional milk quality of buffalo was also studied. The data were collected from 46 individual buffalo based on their history, reared by 34 farmers of Samtse and Tsirang districts using structured questionnaire. A data on daily milk production of individual buffalo was measured immediately after complete milking using weighing spring balance with a 10 g precision. Milk samples of 60 ml were collected in plastic vials, then stored in cool box and transported to place or areas with electricity facility for milk compositional analysis. The samples were analyzed within 2 hr time period after collection of samples using ultrasonic milkotester. The production and breeding parameters studied were average daily milk yield, average age of cows, lactation number, lactation record, age at first breeding, heat interval, gestation period, calving interval and days open.It was observed that the buffaloes are bred for the first time at an average age of 35.26 months. The average heat interval, number of services required per conception, gestation period, calving interval, and days open recorded in this study for the buffalo cow was 21.49 days, 1.97 numbers, 301.21 days, 507.6 days and 160.01 days respectively. The average % fat content , % SNF, density, freezing point, % Protein, % Lactose, % Ash and % added water of buffalo milk in Bhutan were 7.22, 9.26. 1.029, -.620, 3.35, 5.00, 0.70 and 0.00 respectively. The total solids estimated in buffalo milk was 17.18 %. Presently, owing to limited/inadequate government supports and interventions the buffalo farming are declining despite its high potential to improve rural livelihood and diversify income generation capacity of Bhutanese farmers. The sustenance of buffalo farming in future will entirely depend on enabling policy and appropriate extension services supports by government in the areas of improved management practices, breeding, feed and fodder and animal health aspects.

Keywords: Reproductive and productive performance, compositional milk quality, ultrasonic milkotester

INTRODUCTION

Buffaloes are reared for many years in Bhutan. In Bhutan, Buffalo farming is limited to sub- tropical belts around southern districts mainly in Samtse, Chukha, Sarpang, SamdrupJongkhar, Tsirang and Dagana. There were 740 buffalo comprising of 158 milch cows, 111 dry cows, 108 heifers, 17 breeding bull, 130 scrub bulls, 27 bullock and 189 calves (97 male and 82 female) (DoL, 2012). There are no exact records ofwhen it was introduced in the country. Buffalo farminghas immense contributions to improving rural livelihoods. The roles of buffalo are multi-functional, which are reared mainly for food, manure, hides and draught power. Beside it is also reared for religious purpose, gifts, social status and security. In the recent years it is used for the production of bio-fuel or energy (bio-gas). Buffalo farming has great socio-cultural importance - used as dowry during marriage, inheriting buffalo to children help maintains family cohesion, symbolized social status and serves as a social and financial security in times of need.

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Table 1: Household member size of buffalo rearing farmers by age categories

Age categories	M	F	Total
<18	0.90	1.55	2.40
>18<60	2.65	2.77	5.42
>60	0.39	0.48	0.87
Total	3.94	4.80	8.74

In Bhutan, buffalo farming had substantial contribution of 19.2% to the overall household income and 66.2% towards dairy income, which was found similar to the neighboring buffalo rearing countries in the region (Dhendup, 2011).

Buffalo is a hardy animal, resistant to diseases and known for efficient feed convertor. Thus, they can be reared by poor landless people under minimal management interventions. This gives an opportunity to switch over to buffalo farming in future particularly for the inhabitants in the southern foothills, in lieu of limited or small land holdings, susceptibility of productive cows to diseases and unavailability or difficulty in meeting a high demand of good quality cows. For the last many decades, there was limited government interventions and policy support for promotion of buffalo farming. The only support provided by the government in buffalo farming are supplying of few numbers of breeding bulls from India and rendering limited animal health related services. Thesesupports are inadequate considering the immense socio-cultural importance and substantial economic contributions buffalo farming has on rural household. Owing to these reasons, there is a drastic decline in Buffalo population in the country. The lack of empirical evidences to persuade policy makers, and their limited of knowledge on important role buffalo farming plays in improving rural livelihoods could have deter government policy supports.

Buffalo is populated mostly in developing countries with meager resources, thus it remained neglected or underutilized in terms of quality research in the area of health, management, nutrition and reproduction (Gordon, 1996). The information on buffalo farming particularly in areas of reproductive and production performance are also limited in Bhutan. Thus, this study was proposed with following objectives:

- To generate and document empirical baseline information pertaining to production and reproductive performance in Bhutan
- To document the buffalo management practices in the country
- To understand and document the compositional milk quality of buffalo

RESULTS AND DISCUSSIONS

Materials and Methods

The farmers rearing buffaloes were selected purposively for the study. Data were gathered based on the individual animal history using structured questionnaire and open ended question during the month of October 2012 and April 2013.The data on production and reproduction parameters such as daily milk yield, lactation yield, gestation period, age at first breeding, heat interval, service per conception, calving interval, days open were gathered from 46 milking cows owned by 34 farmers of Tsirang and Samtse districts. The daily milk production of animal was weighed in actual immediately after complete milking using spring weighing balance (d=10g). Then milk in the containers was thoroughly mixed and samples of 60 ml were collected from each milking cow in a plastic vials for the compositional analysis. The samples collected were transported to areas with electricity facility for the analysis. The samples were analyzed for the compositional quality within two hours period after collection of milk samples using Ultrasonic Milk Analyzer (Master Eco, Indian made). The data were gathered and analyzed using descriptive statistics in SPSS (Version 21) (George and Mallery, 2014).

Demography and livelihoods

Table 1 shows total number of household members by age categories. The average family member size observed per household was 8.74, with majority of family members (62.01 %) falling within the productive age range between 18 and 60 years. It is followed by the younger generations below 18 years of age, which are mostly reported as students. The female population was found higher than the male at all age categories. Average male to female ratio of 1:1.22 was observed.

The livelihood of these farmers were mainly dependent on agriculture farming, i.e. cardamom, areca nut, orange, ginger and rice cultivation. Buffalo farming was found to be secondary activity; however, it was reported that it was an integral part of agricultural farming system. Migration of younger generation to urban areas and skilled farmers (carpentry and masonry) of productive age in search of jobs or off-farm activities to sustain and led easier way of life is of concern to the elderly people.

Land Holding

It was observed that all respondents in this study owned land. The average total land holdings was 4.68 acres per household. The average land holding of individual household by land categories were 1.62, 1.74, 0.19, 0.097, 0.732 and 0.30 acres of wetland, dry land,

Table 2: Average cattle breeds and buffalo holdings (no) by categories

Breed	Milch cows	Dry cows	Breeding bull	Bullock	Scrub bull	Heifer pregnant	Heifer Empty	Male Calf	Female Calf
Jersey X	1.40(10)			2 (1)		1.00 (2)	1.50(4)	1.33 (6)	1.25 (4)
Local	1.38(13)	1.11 (9)	1 (3)	2 (14)	1 (1)	1.25 (4)	1.40 (5)	1.50(14)	1.55 (11)
Mithun X	1.25 (4)	1.00 (1)	1.00 (2)			1.00 (2)		1.50 (2)	1.00 (1)
Buffalo	1.30(30)	1.00 (5)	1.00 (1)	2.30 (10)	1.00(1)	1.00 (6)	1.00 (6)	1.61(18)	1.82 (17)
Total	1.33(57)	1.07(15)	1.00 (4)	2.04 (27)	1.00(2)	1.07(14)	1.27 (15)	1.53 (40)	2.10 (9)

Table 3. Major feed and fodder resources for the buffalo

Feed Resources	% Respondent	Ranks
Forest Grazing	83.9	1st
Improved Pasture	11.4	5th
Crop residues	44.4	3rd
Alcohol Residue	16.6	4th
Hay/straws	58.3	2nd

improved pastureland, tsamdro, orchards and kitchen garden respectively.

Livestock holding dynamics

Table 2 shows the average livestock holding of different categories. All respondents in this study owned livestock. Livestock reared are cattle jersey crosses, local cattle, mithun and mithun crosses and buffalo. Other livestock such as goats, pigs and poultry are also reared by most of these farmers as a source of food and income.

It was observed that besides buffalo, other cattle breeds like jersey X, local and mithun are reared by respondent farmers. The average total livestock holdings by categories were 1.33, 1.07, 1, 2.04, 1, 1.07, 1.27, 1.53 and 2.09 head of milch cows, dry cows, breeding bull, bullock, scrub bull, pregnant heifer, empty heifer, male calf and female calf respectively. A large proportion of buffalo bullock (2.30 head per household) was maintained by 33.33% of respondent. This indicates the importance of buffalo in agriculture system particularly as the source for draught power.

Buffaloes in Bhutan

FAOSTAT reported buffalo as the second most important dairy species in the world (cited in Dendup, 2011). The world population of domestic buffaloes has been estimated to be more than 150 million or one-eighth of the cattle population, with the numbers steadily increasing (Bhat, 1992). In comparison, the buffalo's population in Bhutan is insignificant, which was recorded 740 head (DoL, 2012). It is mostly concentrated in the southern foothill districts, and the population was reported to be declining at the rate of 6 % per annum starting year 1984 (Dhendup, 2011).

The study observed two major Indian buffalo breeds (Murrah and Surti) and local buffalo known as *kagay* are reared by the Bhutanese farmers. Dendup (2011) described *kagay* as a black type of buffalo and other buffalo types found and reported in Bhutan are *Hyakhulae* (buffalo type with light grey strips) and *Dobla* (buffalo crossbred between local and Indian Surti breed). The records or history of this local buffalo origin are not available nor have studies been conducted to establish it so far. However, looking into the existence of two Indian buffalo breeds in the country and in the immediate border Indian states (Assam, West Bengal), probably we could conclude local buffalo as the crosses of either of the two Indian buffalo breeds found in Bhutan.

Feed and water resources

Table 3 shows the major feed and fodder resources for buffalo in Bhutan. The major feed and fodder resources

Table 4: Avergage production and reproduction performance of buffaloes in Bhutan

Parameters	N	Average	Ranges	Remarks
Average milk yield (Kg)	46	2.81	0.5-8	Reported by farmers
Avg. milk yield (Kg)	46	2.37	0.25-4.5	Measured
Average age of cows (years)	46	7.83		
Average lactation number (no)	46	3.1	1-11	
Age at First service (months)	46	35.26	18 - 50	
Heat interval (no)	46	21.49	18 - 23	
Service per conception (no)	46	1.97	1 – 4	
Gestation period (months)	46	10.07	9 - 11	
Calving interval (months)	46	16.92	14 - 25	
Days open (days)	46	160.01	60-365	

for the buffalo are forest grazing, crop residues, alcohol residues, improve pasture, hay/straws and local concentrates. In this study, majority of respondent (83.90%) reported forest grazing as the major sources of buffalo's feed and fodder, followed by hays/straws (58.3%), other crop residues (44.4%), alcohol residues (16.6%), improved pasture (11.4%) and local feed mixtures. The low contribution from improved pasture could be attributed to small improve pastureland holdings of 0.19 acres per household.

In the winter months, animals are let loose in the agricultural field after harvesting of crops for grazing. It was observed that only 16.13 % of the respondents provided their animals with supplement concentrate feed in this study. The supplement feeds are provided to only milch cows and calves during winter months. The quantity of concentrate feed supplement fed ranges from 0.5 to 1.0 kg per animal. All animals are reported to have adequate and free access to drinking water all times.

Housing

Almost every respondent had shelter for their animals; however, the shelter type differs. This study observed that 87.10% of respondent had semi-permanent shed- made out of locally available materials (timber, bamboos, and stones), and CGI sheets are used for roofing.It was observed that 35.48 % of the respondent provided year round shelter; 51.61 % and 6.45 % of respondent provided shelter during summer and winter months respectively, and 6.45% of respondent did not provide shelter to their animals. The shelters were provided to protect animals from incessant rains during summer and extreme cold during winter months, and also for the easier management. In contrast some of the respondent (6.45%) reported that the buffaloes are hardy animals and can thrive on extreme climates; thus, shelters are not at all required for the buffaloes.

Milking Practices

Animals are usually milked in open space or inside the dairy shed. Most respondent washed the udder/milk teats of the milch cows with clean water prior to milking. It was reported that a complete milking was never practiced at the earlier stage of the calf growth. It was observed that the farmers leave at least one or two teats completely without milking for the calves to suckle starting from the time of calving until calf attained age of 5-6 months.Thereafter, they switch over to complete milking gradually considering the status of the calves' health. In this study it was observed that only 25.81 % of the respondent had practiced complete milking and the rest of 74.19 % respondent milked two to three milk teats, leaving the rest for the calves to suckle. This indicates that about 25 % of calves born had attained age of 5-6 months or more and the remaining 75 % were below 5-6 months of age during the study period.

Milking frequency and time

Buffalo cows are milked daily in general. However, the frequency of milking differs based on the stage of lactation and seasons. Buffaloes in the early and later phase of the lactations were milk only once irrespective of the seasons to ensure enough milk for the calves to suckle for the growth andin the mid stages of lactations (during the peak production period) the cows were milked twice. In general, it was also reported that the cows were milked only once during winter months and twice during the summer months. It was observed that 74.20% of respondent milked their animal twice, and 25.80% of respondent milked their animals once a day in this study. The average milking time required per animal starting udder preparation (washing of udder, calf suckling) until complete milking was about 9.61 minutes, with milking time reported ranging from 5 to 12.5 minutes, in this study.

Breeding bull and preference for breeding services

The government had supplied improved breeding bulls to upgrade the local buffalo population in the recent years. In absence of the supports, farmers managed or select their breeding bulls from their own herd. Some of the selection criteria adopted for selection of breeding bulls is that the animal should be sturdy (strong and healthy), should have long tail, large and uniform testis, dam should be of high milk yielding, and should be disease free. In general, it was reported that the breeding bull are replaced every 5-6 years to avoid inbreeding in the herd,but then some respondent reported that owing to difficulty of non- availability of quality breeding bulls,they could replace

the breeding bulls only after 9-10 years Most of the respondent (95%) preferred to have breeding bull than AI services as the bull services was reported to have higher conception rate, and also might be attributed to lack of awareness on AI technology on buffalo. The remaining 5% of respondent preferred to have both services, as it provides them with choice.

Mortality

The calf mortality was observed highest with 68.42%. It was reported that mortality usually occurs during autumn and winter months. The major reasons reported are off-feeds, followed by diseases, i.e. calf scour, and paralysis. A death resulted from predation by wild animals and blood suckling leeches, and sudden death of animals suspected to be of plant poisoning as the causes of mortality was also reported.

Production and Reproduction parameters of Buffalo in Bhutan

Table 4 shows the average production and reproduction performance of buffaloes reared by rural farmers in Bhutan.

The production and breeding parameters studied are average daily milk yield, average age of cows, lactation number, lactation record, age at first breeding, heat interval, gestation period, calving interval and days open.It was observed that the buffaloes are bred for the first time at an average age of 35.26 months. The average heat interval, number of services required per conception, gestation period, calving interval, and days open recorded in this study for the buffalo cow was 21.49 days, 1.97 numbers, 301.21 days, 507.6 days and 160.01 days respectively. Most of this findings are either similar or falls within the range reported by other authors. It could be due to the fact thatbuffaloes are reported to have relatively poor reproductive efficiency that varies little with location throughout the world (Gordon, 1996). He also reported that buffalo exhibit many of the known reproductive disorders and have delayed onset of puberty, poor oestrus expression, longer post-partum ovarian quiescence, and most importantly lowered conception rates particularly when bred artificially.

Daily milk yield

In this study the average age and lactation number of milch cow observed was 7.83 years and 3.1 number respectively. The average daily milk yield reported by farmers was 2.81 kg per buffalo cow. The actual daily milk yield measured was 2.37±1.07 Kg per cows in this study. The average milk yield observed and measured in this study falls within the range reported *by* Tamang et al. (2009) of 2-5kg per cow per day. It was reported as well as found in this study that a good buffalo milked twice daily produced milk as high as 8 kg depending on the level of management.

Lactation record and yield

The average lactation record or period observed was 324.3 days in this study. The lactation length was observed similar to Surti breed, which was 330 daysagainst 324.3 days. The lactation length reported for Murrah and Nili-Ravi buffalo breed was reported 300 days (ILRI, 1999). The average lactation length of buffaloes ranging from 252 to 270 days was reported (Ganguli, 1981; Sastry, 1983), which was observed comparatively low from this study.

Thelactation yield estimated in this study for buffalo in Bhutan based on the survey and actual measurement was 911.28 kg and 768.59 kg respectively. The lactation yield estimated in this study was low as compared to findings of Tamang et al. (2009). He reported about 1260 litres for annual calvers and 2970 litres for the delayed calvers against the estimated lactation yield of 911.28 kg and 768.59 kg. In general, the lactation yield of buffaloes in Bhutan was found low as compared to Indian buffaloes breed, but at the same time, it was also observed comparable to some Indian buffalo breeds, i.e. Surti. The lactation milk yield recorded for Nili-ravi and Surti breed ranges from 1500 to 2300 kg and 900 to 1300 kg respectively.

Contribution of buffalo to the total annual milk production

There were 158 milch cows of the 740 buffaloes in the country (DoL, 2012). It was recorded that buffalo under conventional management practices produces about 2.37 kg of milk/day in average, accounting to lactation yield of about 768.59 kg/cow. With this information, it was estimated that the buffaloes produces about 118.36 MT of milk annually, accounting to about 0.40% milk to the total annual milk production in Bhutan.

Calving Interval

The average calving interval observed was 507.6 days (ranging from 420-750 days) for buffaloes in Bhutan. Although the ranges were wide, the average calving interval observed was found close to calving interval reported for different buffalo breeds in neighbouring countries. The calving interval ranges reported for Indian and Pakistani buffaloes were from 15 to 18 months (Wahid 1973). The calving interval reported for Murrah, Nili-ravi, Surti, Badawari, Kundi, Mehsana, Egyptian and Iraqi were 451, 509, 528, 413-592, 492, 415-650 and 408 days respectively (ILRI, 1999).

Calving seasonsand services per conception

In this study, it was observed that most of the calves were calved in the month of August through March. Ahmad *et al., (*1981) reported that most of the calving in buffalo takes place during July-September and very few calving occurs during February-June. Buffalo is thought to be seasonal breeder; however, it has been reported that they can breed throughout the year if the reproduction management is good (Rao and Nagarcenkar, 1977; Sastry&Tripathi, 1998).

The average number of services per conception required was 1.97, ranging from 1-4 services per conception for buffalo in Bhutan, which falls within the conception ranges reported for Indian buffaloes of 1.5 to 3.00 (ILRI, 1999).

Age at first service

It was observed that the buffalo in Bhutan are bred for the first time at the age of 35.26 months, ranging from 30-48 months which falls within the acceptable age of <48 months (Falvey and Chantalakhana,1999). A large variation in age at first calving across the buffalo breeds in general was noted. However, the age at first service observed in this study falls within the ranges reported by different authors for different buffalo breeds.

Table 5: Average milk composition of buffalo milk's in Bhutan

Parameters	Mean	±SD
Fat (%)	7.22	0.78
SNF (%)	9.26	0.65
Density (mass/volume)	28.85	3.28
Freezing point (degree Celsius)	0.62	0.06
Protein (%)	3.35	0.29
Lactose (%)	5.00	0.58
Other solids (%)	0.70	0.07
Added water (%)	0.00	0.00

On the whole, buffaloes are reported to calve for the first time at around 40 to 60 months (Ganguli, 1981). The averages of age at first calving reported in Murrah, Nili-Ravi, Egyptian and Pandharpuri buffalo were between 38 and 44 months while that in Surti and Bhadawari buffalo was reported between 46 and 54 months(Falvey and Chantalakhana,1999).

Dry period

The average dry period observed was 160.01 days for buffaloes in Bhutan. The dry period observed for the buffalo in Bhutan are close to many Indian buffalo breeds- Surti, Mehsani, Jaffarabadi, Pandhapuri, Marathwadi, Nagpuri, Dharwari, which was recorded 150 days. The dry period recorded for Bhadawari, Murrah, Nili-Ravi and Non-descript buffalo breeds was 180 days and 210 days respectively (ILRI, 1999).However, in this study, the ranges (60-730 days) of dry period observed was vast as compared to other studies, which could be attributed to poor management and recording. The dry period for the Nili-Ravi and Murrah breeds of Pakistan was reported to be 90 to 150 days and from 60 to 200 days respectively (Wahid, 1973).

Heat Interval

It was reported that buffalo comes to heat regularly in all months but the proportion was higher from October to January and lower from April to July (ILRI, 1999). The average heat interval observed for the buffalo in Bhutan was 21.49 days ranging from 18-30 days. From a management point of view, it would be advantageous to take opportunity of this situation and provide breeding services during these months so that the calf drop is expected during the summer months when the feed and fodder is abundantly available.

Composition of Buffalo Milk

Table 5 shows the average components of buffalo milk in Bhutan. The average % fat content , % SNF, density, freezing point, % Protein, % Lactose, % Ash and % added water of buffalo milk in Bhutan were 7.22, 9.26. 1.029, -.620, 3.35, 5.00, 0.70 and 0.00 respectively. The total solids estimated in buffalo milk was 17.18 %.

The compositional quality of buffalo milk in Bhutan was found close to milk of Murrah buffalo in India. The milk components of Murrah buffalo reported was 7.38 % fat, 3.6 % protein, 5.68 % lactose and 17.24 % total solids(Falvey and Chantalakhana, 1999). The average % fat content of Murrah, Nili-ravi, Badawari, Kundi, Mehsana, Egyptian and Iraqi buffalo breeds are 6.1-8.3, 6.5, 8, 7, 7.4, 6.1-7.4 and 7.5-9 respectively. The milk constituents in buffalo are higher than cows: milk fat 6.5-8.0 % versus 3.5-4.0% and solids-not- fat 9.0 – 10.5% vs 7.5 – 8.5% (Gordon, 1992)

Problems faced in rearing buffalo

There are many problems faced in rearing buffaloes in Bhutan. Some of the major problems encountered as reported by majority of respondents in this study are:

1. Inadequate grazing land resulted from increasing forest covers, and conversion of suitable grazing land to pursue other productive agricultural activities i.e. coffee plantation.
2. Feed and fodder shortages as the bottleneck for buffalo farming resulted from small land holdings
3. Labor shortages- with youth migrating to urban areas, and skilled human resources of productive age moves out of villages in search of off-farm activities or jobs seeking for easier way of life
4. Unavailability of quality breeding bull/semen for genetic up- gradation of existing population
5. Drying-up of wallowing pond (water pools) due to change in land use system
6. The government policy supports were not adequate to further buffalo farming, beside its importance and high potential to alleviate rural livelihoods.
7. The present veterinary services rendered are not efficient resulting to high mortality of animals

Future prospects of buffalo farming

In this study, 90.32 % of respondent had reported to continue with the buffalo farming as in the past, mainly because buffalo farming was and will always remain as an integral part of their agriculture farming system. There is great potential to diversify utility of buffaloes to bring greater benefits to the rural communities such as draft,

dairy products (Mozzarella cheese) and dried carabeef. Through genetic up- gradation and improved management practices, it is expected to enhance milk production and thereby substantially contribute in meeting 11th FYP milk production target

However, they remain optimistic that the government will one time recognize the importance of buffalo farming in alleviating rural livelihoods and accordingly give impetus on buffalo farming like any other livestock commodities. The remaining 9.68 % of respondent had reported to give-up buffalo faming and switch over to raising improved jersey cattle mainly because of ever declining labor in the household. Tamanget al (2009) in his study attributed labor shortages as the main causes of declining buffalo population in Bhutan.

Government interventions required to sustain buffalo farming in Bhutan

Buffalo farming has high potentials in improving the rural livelihoods in the country. It could be reared by small farmers with small land holdings at minimal management interventions. It is felt imperative that special supports are required to sustain buffalo farming, and in this study farmer's respondents had similar general view that the buffalo farming will grow and sustain ifgovernment provide supports in five major areas in order of priority - capacity development (35.48 %), feed and fodder development (24.19 %), breeding and management (20.97 %), and 9.68 % each on animal health services and infrastructure supports.Dhendup (2011) also recommended that appropriate and timely interventions particularly subsidy on breeding inputs and pasture development policy could perhaps revive and sustain tradition of buffalo farming in Bhutan.

The specific supports required from government are elaborated hereunder:

1. Making buffalo farming lucrative to younger generation through capacity development (awareness, training, study tour, exchange visits, organizing buffalo exhibition and marts)
2. Ensuring initial resources support, i.e. leasing of government land, loan support, subsidy on investments (procurement and supply of live inputs, materials for dairy shed, silo-pit construction, supply of fencing materials and seeds and seedlings for pasture development)
3. Improving of the existing local breeds through cross breeding (sourcing and promoting suitable buffalo breeds (Murrah), explore and introduce AI services, supply of superior bull, develop and implement proper breeding strategy)
4. Ensuring effective animal health services, i.e. timely vaccination against notifiable diseases, arrange adequate drugs and medicine year round, and ensuring adequate field staffs in place to render extension related services.
5. Providing post production supports on processing and marketing (group formation, milk processing equipment, milk processing unit and product diversification with a focus to produce Mozzarella cheese and target high ends hotels in Bhutan).

CONCLUSION AND RECOMMENDATIONS

Buffalo farming is important to many rural farmers of the southern foothills both socio-culturally and economically. Buffalo farming was and will remain as an integral part of agricultural farming system. Buffaloes are known to be efficient feed converters and hardy animals- that could thrive under minimal management interventions, and can be reared by small marginal or landless farmers. Therefore, considering the land topography and limited or small land holdings of people in Bhutan it will be appropriate to promote buffalo farming particularly in the southern districts foothills. The buffalo population is declining at the alarming rate of about 6 % per annum, which requires immediate government intervention to promote sustainable buffalo farming by including buffalo development framework within the national livestock development policy. The growth or adoption of buffalo farming in the southern foothills will reduce pressure on the government parts on outsourcing and meeting a high demand of productive cattle, which at present are met through outsourcing from neighboring Indian states.

The reproductive and productive performance of the buffaloes under Bhutanese conditions was found comparatively good in comparison to available information from neighboring countries rearing buffalo; however, there is a high potential to improve productivity through adoption of improved management practices, promoting pasture development and fodder conservation, rendering of effective and efficient health and breeding services.

Currently, the farmers are rearing non- descriptive types of Buffaloes. It is imperative to conduct genetic characterization of Buffalo bred types of Bhutan through building strong institutional linkages and networking mechanism within SAARC countries and with international research institutes/centers. Such research information will provide a strong platform for future development interventions and conservation measures in case of its uniqueness.

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