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Yak Milk Production in Northeast India: A Case study on prospects of yak herding in Arunachal Pradesh.

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Abstract

Dairy farming plays a crucial role in achieving Sustainable Development Goals (SDGs) by contributing to various aspects of sustainability such as household income; increased direct consumption of healthy and nutritious food; Women's empowerment and gender equality. As per the FAO (2015) report it is estimated that the dairy sector supports the livelihoods of upto 1 billion people worldwide. The dairy sector in India is dominated by cows and buffalos to produce milk and milk derivatives. However, rearing of Yak is commonly found in certain parts of India like Sikkim, Ladakh and Arunachal Pradesh nestled in lofty peaks of the Himalayas with rugged landscapes. In these climatic zones, yak herding communities have sustained themselves for centuries, preserving their rich cultural heritage. The yak herders have preserved their unique age-old practice of traditional yak rearing and Indigenous knowledge. In these states, the diminishing pastoral communities are engaged in the production of milk and milk derivatives such as fermented cheese and butter derived from yak. From the perspective of yak farming a smaller number of studies were conducted that too in Western countries. In the above context, the present study focuses on understanding the present scenario and prospects of yak herding relative to their current dairy products marketing and production models. The study also emphasizes the problems and opportunities in the field of yak herding in Northeast India, with special reference to Arunachal Pradesh.

Keywords: Yak herding, Indigenous knowledge, Milk production, Marketing, SDGs.

1. INTRODUCTION

Pastoralism is a form of agriculture where livestock, such as goats, sheep, cattle, yak and camels, are raised on natural pasturelands. These pastoral communities often move seasonally in search of fresh grazing grounds for their animals. Pastoralism in India is predominantly found in the arid and semi-arid regions of the country, such as Rajasthan, Gujarat, parts of Maharashtra, Karnataka, Andhra Pradesh, Himalayan terrains of Ladakh, Uttar Pradesh, Sikkim and Arunachal Pradesh. These regions offer suitable grazing lands for livestock. The main livestock raised by pastoralists in India include sheep, goats, camels, cattle and yaks. Highland pastoralism in India typically refers to the livelihood practices of pastoral communities residing in mountainous regions. Different regions have their preferences based on environmental suitability and cultural traditions. Pastoralism is a vital source of livelihood for millions of people in India, particularly those belonging to nomadic or semi-nomadic communities. These communities rely on their livestock for meat, milk, wool, and other products for sustenance and income. Many pastoral communities in India lead a semi-nomadic or fully nomadic lifestyle. They move with their herds in search of water and pasture, following traditional migration routes that have been passed down through generations.



Description: A Yak grazing during summer in a place called Tsegarthang at a height of 4800 metre asl in mago village of Tawang district. The yak herders move to high altitude areas during summer from april to august for grazing purpose. They live in nomadic tents and carry their milking activities to produce milk products such as cheese and butter.

Brokpa is a unique occupation among the Monpa tribe of Arunachal Pradesh because of its primary dependence on animal herding. Its high altitude, extreme climate, and remoteness render the region unsuitable for agriculture. Pastoralism is the only form of livelihood here. It is eminently suited to the region; the extreme cold, exacerbated by strong winds that blow across wide valleys and the low precipitation make this region a natural habitat for yak and sheep. All Brokpas have links with agricultural communities at lower elevations to provide them with grains in exchange for livestock products. And they all raise the same type of animals: yak, yak-cattle hybrids and sheep. They also share a similar language, which belongs to the Tibeto-Burman group of languages (Dhar, 2009) and culture;

across the region, they can usually communicate with each other in Tibetan, even though their local dialects differ. The Brokpa are all ardent believers of Buddhist practices and their religious and cultural practices are also similar. According to (Dondrup, 2008) Brokpa is an occupational/professional term and not a name of a language. He prefers the term Brokhe, Brok means 'grazing meadows' and ke means 'language'. The term 'Brokpa', commonly refers to the herders but the term generally refers to the yak herders or those who are dependent their livelihood on their herds. The term is used as the name of their ethnic group. Some communities are fully engaged in dairy farming in western Arunachal. The profession is hereditary, practising the traditional method of dairy farming. Locally, the dairy farmers are called *Brokpa*, a cluster of two terms, "*Brok*," meaning herd, and "*Pa*", meaning People.

The yak herders are engaged in processing the yak milk to produce value-added milk products such as cheese and butter using their traditional techniques. The traditional knowledge of yak rearing and milk processing is age-old Indigenous knowledge, passed on from generation to generation. The highlanders survive living in rough terrains by employing the knowledge of yak herding gained from their ancestors. The traditional way of milk production has provided a source of livelihood to the herding community in western Arunachal Pradesh. The herding communities have been isolated due to their remote locations. They have to travel for days by foot to reach their neighbouring villages and the lowlanders whom they refer to as agriculturist, to exchange their goods and produce such as cheese and butter for agricultural produce like grains, maize, rice, wheat, millet, etc.

2. OBJECTIVES

The present study focuses on understanding the present scenario and prospects of yak herding relative to their current dairy products marketing and production models. The study also emphasizes the problems and opportunities in the field of yak herding in Northeast India, with special reference to Arunachal Pradesh.

3. RESEARCH METHODOLOGY

The study is focused on the two westernmost districts of Arunachal Pradesh *i.e* Tawang and West kameng as the yak herders are mostly found only in these regions of the state. Yak herders from 7 circles of Tawang district and 1 circle from West Kameng district are interviewed using a structured schedule for collecting data. Many of the yak herders are illiterate and do not speak a language other than their own *Bro-keh* language. 233 sample respondents were estimated using Yamane's Formula of sample size estimator out of which 178 herders are from Tawang district and 55 herders are from Dirang circle of West kameng district.

All statistical analyses were performed in SPSS 16. The milk output produced by herders daily during their summer grazing is used to determine the milk production. The yak production depends largely on grassland resources at elevations ranging from 3000 m to 5000 m. The per-day milk output from the yak herders was tested for normality. The quantile-quantile plot, Kolmogorov-Smirnov Test and Shapiro-Wilk's test showed that the milk production was not normally distributed ($p < 0.05$). The Kruskal-Wallis test was used for further analysis. The Kruskal-Wallis test is a non-parametric test used to compare three or more groups on a continuous or ordinal outcome. It's often used when the assumptions of a one-way ANOVA (e.g., normality, equal variances) are not met.

Likert-type items were used to get insight into the herders' future plans and their decision on yak farming were converted to a binary variable because there were only a few respondents who selected a specific answer option. Binary logistics regression was used to

test the relationship between the respondent's characteristics and their future plans concerning their herd size. The Hosmer-Lemshow goodness of fit test was used to assess the model. Hosmer-Lemshow static indicates a poor fit if the significance value is less than 0.05. Here the model adequately fits the data with $p=0.389$. Hence, there is no difference between the observed and predicted models. Furthermore, model fitness was assessed by calculating McFadden's pseudo R^2 . A value of 0.36 suggests the model is an improvement over the null model, but it doesn't imply the model explains 35.68 % of the variance in the way that traditional R^2 does in linear regression.

4. RESULT AND DISCUSSION

4.1 Herders Classification and Milk Production

Table 1.5.1 exhibits the yak herders' classification following their milch animal holding. If a farmer has 1 to 4 milch animals on the farm, then he or she is considered a small farmer. In the same way, if a farmer maintains 5 to 6 milch animals on the farm, it is called a medium farmer and large farmers are the ones who maintain greater than 6 milch animals on the farm.

Table 1: Yak Herder's classification based on Milch Animal Holding

Herders classification	Number	Percentage
Small herders (1-4 Milch Animals)	19	8.2%
Medium herders (5-7 Milh Animals)	39	16.7%
Large herders (greater than 7 milch Animals)	175	75.1%
Total	233	100

Source: sample survey 2022-23.

The classification of the herders is done based on the number of milking animals held by the herders. The majority of the herders in the sample belong to the large herders category which accounts for 75.1% of the total sample herders. This means that the majority of the herders hold more than 7 milching animals. The milching animals are comprised of female and yak breeds which are milked daily. The herders live a tough life migrating seasonally with their herds for grazing purposes. So, they need to hold more than 7 milking animals to carry their dairy production. As per the study, 8.2% of the herders fall under the small herders who have less than 4 milching animals and only 16.7% of the herders are from the medium category holding 5 to 7 milching animals.

Table 2: Daily milk production during Summer Migration

Daily milk production (in litres)	Number of herders	Percentage
Less than 15	15	6.4
16-20	28	12.0
21-25	36	15.5
26-30	24	10.3
31-35	52	22.3
36-40	33	14.2
41-45	30	12.9
46-50	10	4.3
51-55	3	1.3
56 or above	2	0.9
Total	233	100%

Source: sample survey, 2022-23.

As per the study, table 2 illustrates that 22.3% of the herders have a milk production of 31 to 35 litres per day, followed by 15.5% of the dairy farmers who produce 21 to 25 litres of milk daily. Only 0.9% of the herders are competent to produce more than 56 litres of milk daily. Large herders are more numerous than small and medium-sized herders, but because

they frequently only milk what is required to make cheese and butter, they yield less milk overall. They have limited means of preserving and storing the milk because they are summer-time nomads living in tents and small stone huts.

Table 3: Result of Normality Test

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Milk production	.075	233	.003	.980	233	.003

Table 3 shows that the p-value (0.003) is less than the 0.005 level of significance. A low p-value (less than 0.05) suggests that the data significantly deviates from normality. This implies that the milk production of the yak herders in the study region does not follow a normal distribution. Therefore, a non-parametric test should be applied for further analysis.

Table 4: Result of Kruskal-Wallis for difference in milk production by Farm size

Test Statistics		
Chi-square	Df	Asymp. Sig.
89.505	2	.000

The Kruskal-Wallis test was used to evaluate the difference in milk production between the small, medium and large herders. The test showed that there was a significant difference between the farm size concerning the dependent variable as Milk output, with a Chi-square value (89.505) greater than the critical value (5.138) with df=2.

A Dunn-Bonferroni test was used to compare the groups in pairs to find out which was significantly different. The Dunn-Bonferroni test revealed that the pairwise group comparisons of *large herder - medium herder* and *large herder - small herder* has an adjusted p-value less than 0.05 and thus, based on the available data, it can be assumed that these groups were significantly different in pairs.

4.2 Herder's Future plan with herd size in the next 10 years

A logistic regression analysis was performed to examine the influence of respondents' characteristics such as gender (female), age, region (Tawang), source of income yak rearing and others, herd size and milk output on variable herders plan concerning to development of herd size in next 10 years to predict the value "probably yes or definitely yes". Logistic regression analysis showed that the model as a whole was significant ($\text{Chi}^2(6) = 87.38, p < .001, n = 233$).

Table 5: Binary Logit model results for variables influencing the herders's plans for the development of their herd size in the next 10 years.

Variables	Coefficient B	Standard error	z	p	Odds Ratio	95% conf. interval
Constant	1.54	1.1	1.4	.162	4.68	0.54 - 40.69
Gender male	0.4	0.58	0.69	.49	1.5	0.48 - 4.7
Age	-0.15	0.03	6.09	<.001	0.86	0.82 - 0.9
source_of_Income yak rearing and others	-0.28	0.53	0.54	.591	0.75	0.27 - 2.12
Herdsizes	-0.01	0.02	0.41	.684	0.99	0.94 - 1.04
Milk output	0.11	0.03	4.01	<.001	1.12	1.06 - 1.18

Number of observations=233; Hosmer and Lemshow test $\chi^2(6)=87.38$ ($p < .001$); correct prediction=84.5%; McFadden Psuedo $R^2=0.36$; * significant at $p < 0.05$

For every one-unit increase in Age, the log odds of the outcome decrease by -0.15. The odds ratio of 0.86 suggests a 14.15% decrease in the odds of the outcome for each additional unit of Age. The p-value of $<.001$ is below the conventional 0.05 threshold, suggesting that Age is statistically significant at the 5% level.

For every one-unit increase in milk output, the log odds of the outcome increase by 0.11. The odds ratio of 1.12 suggests an 11.97% increase in the odds of the outcome for each additional unit of milk output. The p-value of $<.001$ is below the conventional 0.05 threshold, suggesting that milk output is statistically significant at the 5% level.

4.3 Problems and Opportunities in Yak herding

In Arunachal Pradesh, yak herding faces some unique challenges and opportunities due to the region's specific geographical, climatic, and socio-economic conditions. Yak herding is considered to be a challenging profession which requires the herder to be physically strong enough to survive in the tough terrains along with their herd. Yak herders move to high-altitude areas during summer with their herds and camp at the height of 3500- 4500 metres ASL for around 3 to 4 months. They have to carry the necessary supplies along with other traditional equipment to prepare cheese and butter. Sometimes they are accompanied by their better half during the summer migration to help and assist them on their journey and come back to their village after a few days of stay. The women in the brokpa community play an important role in supporting their male counterparts. Women are responsible for bringing the supplies to them on a timely basis when the herders are out of supply. The milk products such as cheese are packed in leather bags for long durability while the butter is packed in leaves and wooden containers. Butter and cheese have many uses in the Monpa community of Arunachal Pradesh. Fermented cheese is one of the most important ingredients in their ethnic cuisines.

4.3.1 Declining number of yak herders

It has been observed that many of the herding families have sold their livestock animals and are shifting towards other occupations which are available nowadays. Due to developmental activities in the remote areas, many of the herders are slowly leaving the herding profession and are engaged in other activities such as working as contractual labour for contractors, moving to cities for better livelihood opportunities, working as porters for the Indian army units deployed in the remote areas and so on. The difficulties they face while herding yaks are a major factor in this change in their line of work. Declining numbers of yak herds and herdsmen to take up yak rearing would result in shortages of the supply of yak and its related products (Mody, Gombu, & Abo, 2015).

4.3.2 Unorganised market for yak-related products

The market for yak-related products is unorganised. It is very difficult for a person to reach out to a yak herder to purchase yak products such as cheese and butter. Since the herders have a limited amount of stock of the produced goods, the residents have to demand in advance. Earlier the yak-related products were not sold but rather were bartered for agricultural goods for which they had to travel for days to reach out to the people. Traditionally, the herders used to follow the system of *Nei-tsang*, where the herders build a good relationship with a family from the low-altitude villagers who are engaged in agricultural activities. The herders used to travel and stay at their houses and exchange their milk products for agricultural goods. The host family acts as an agent between the herder and

the villagers who need the milk products. For the service, a part of the exchanged goods and a certain portion of their milk product is offered to the host family by the yak herder. With the advent of time, this traditional system has vanished.

4.3.3 Challenges during seasonal migration

Yak husbandry following seasonal migratory patterns is a traditional, and one of the most important, livelihoods in these harsh mountain regions. When winter snowfall begins, yaks are brought down to lower winter pastures, as the weather grows warmer, yak herds return to higher summer grasslands (Ning, Krishna P Oli, Gilani, Joshi, & Bisht). The seasonal migration in yak rearing is physically and mentally challenging to the young generations. The childrens are engaged to support their parents in the herding activities during their school breaks. Many parents fail to teach their childrens the traditional ways of yak herding since the young generation are willing to learn and carry the herding activities. Those who find better livelihood options are shifting their age old herding profession.

4.3.4 Education to the young generation

Yak herding customs and techniques were traditionally handed down from one generation to the next. Now that modernized and a westernized educational system has been implemented, families that herd yaks choose to send their children to school, leaving the elderly to take care of the animals. The majority of youths are unwilling to start herding yaks. In places like Nyukamdung and Senge in dirang circle of West Kameng where the extended family owns agricultural land, the yak herders appear to be giving up yak rearing more quickly. Over the past ten years, almost 60% of the yak herders who previously bred yaks have stopped doing so (Dervillé, 2010). Accessibility to academic institutions and economic centers has risen due to improved road accessibility. This has given young people in the mountains multiple economic opportunities.

4.3.5 Institutional supports to encourage yak herding

The main research organization dedicated to the study and advancement of yak is ICAR-National Research Centre on Yak (ICAR-NRC on Yak). It is the only organization with the authority to formulate research plans for the long-term, sustainable growth of yak farming in the nation. The research institute has been putting efforts in improving the life of the yak herdings through various training programs and extensive support camps. The research divisions for animal nutrition, physiology and reproduction, animal genetics and breeding, animal health, livestock production and management, livestock product technology, and veterinary extension education are principally under the direction of the institute. Their vast research endeavors have been crucial in supporting the long-term sustainability of yak herding and the expansion of yak populations across the country. Yak herders are provided with workshops and training/awareness campaigns as part of their Scheduled Tribe Component (STC) program. Inputs including concentrate feed, full feed blocks, chelated mineral combinations, tents, tarpaulin, gumboots, solar light, and basic veterinary treatments like anthelmintics, antidiarrheals, and wound healers are distributed to tribal yak farmers. Forward-thinking yak herders and dairy farmers are also given access to cream separators and chaff cutters. A bankable scheme for the yak rearers was developed by the National Research Centre on Yak (NRCY). The scheme was approved National Bank for Agriculture and Rural Development (NABARD). Under the scheme, a yak farmer can avail a loan up to Rs 5.65

lakh. The National Insurance Company Ltd. and the National Research Centre on Yak (NRCY) have partnered to insure their livestock.

Furthermore, the State Government has launched a fodder scheme for the yak herders in the state. The State Government launched the Chief Minister's White Revolution Scheme (CMWRS). The scheme's primary objective is to uplift milk production in the state by facilitating the farmers with capital support and promoting a cooperative society as an organized model for the farmers. The total programme cost of Rs 750 lakh has been earmarked only for milk production in 5 potential state districts. The scheme offers a 50% capital subsidy up to Rs.3 lakh for a minimum of 2 cows for the beneficiaries. It also provides working capital loans on Kisan credit cards are limited to Rs. 3 lakh per farmer.

5. CONCLUSION

Yak herding is revealed to be a challenging occupation. Even though there are fewer and fewer yak herders in the region, it has been observed that they still make a respectable living. The primary cause of the decline in herder population is the difficulties of maintaining such a difficult occupation. A person must be strong both psychologically and physically to continue in such a profession given the hardships and physical demands. These kinds of rearing operations yield good profits. The brokpa population in the two districts had, up until recently, mostly lived a secluded and solitary life, lost in their world and mainly untouched by government policy. Their response to government-funded development programs meant to help them assimilate into society is still conflicted, almost ten years later. The number of yak herders in the area is decreasing, despite government programs and initiatives aimed at enhancing their standard of living. The government started and suggested the sedentarization of livestock animals as a replacement for the migration system, but the herders are rigid in adopting such new strategy which are against their age old traditional practice.

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