

# **Yak Herding as the Main Source of Livelihood: Examining Challenges and Opportunities of Highlanders in Bhutan<sup>+</sup>**

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## **Abstract**

Yak farming is the mainstays of nomadic herders' economy in Bhutan. However, it has declined over the years despite diverse government interventions. Rapid socio-economic development and access to economic opportunities further hindered yak farming culture rather than helping to maintain highlanders' livelihood. The study was carried out in four gewogs, Chhoekhor, Sephu, Merak and Sakteng, that depends on yaks for their living. Questionnaire based semi-structured interview was conducted to identify the main challenges and opportunities of yak herding within the different regions and examined the cost-benefit of herding yaks within the premises of nomadic herder's livelihood sustenance. The study revealed

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that yak farming generates sufficient income to support the herders' livelihood even though the profit margin was minimal. Around 90% of herders earned cash income from yaks. Dry cheese was the main revenue generator of Chhoekhor and Sephu, while fermented cheese earned the highest income in Merak and Sephu. Yaks not only serve as the primary source of livelihood but also acts as a catalyst to generate additional income by gaining access to natural resources such as Cordyceps and herbal medicines. However, increased wildlife depredation on yaks and inadequate pastureland coupled with poor modern amenities threatened yak farming. The findings showed a declining trend in total yak population and number of yak-owning households particularly in Chhoekhor and Sephu compared to Merak and Sakteng. The future of yak farming in Bhutan is uncertain, but there is potential to address the challenges and ensure its continued importance to Bhutanese highlanders.

**Keywords:** yak farming, socio-economic, products, income, livelihood, Bhutan

## **Introduction**

Rearing livestock is one of the mainstays of livelihood for the majority of mountain communities around the globe. In east Asia, people from diverse regions, extending from the southern slopes of the Himalayas to the Hangai mountains of Mongolia and Russia in the north, and from Pamir Plateau in the west to the Qilian mountains in the east depend on yak farming (Qi et al., 2008). Vast areas in the Himalayas characterized by high elevation and harsh climate necessitates yak (*Bos grunniens*) pastoralism as a reliable source of livelihood (Jianlin, 2013), and as a symbol of wealth (Degen, 2007).

Yak herding is predominantly an age-old pastoral practice in all the mountain communities of the Himalayan Kingdom of Bhutan (Wangdi & Norbu, 2018). Yak herding is sparsely distributed in 10 districts or 34 sub-districts stretching across the northern belt of Bhutan. There are about 1100 yak herding households (Wangda, 2016), with over 51000 yaks, which

account for around 3% of the total livestock population (DoL, 2018). Yak herding pastoralists consisting less than 5% of total population occupy the northern belt and yaks provide around 3% of the market share for meat, butter and cheese (Derville & Bonnemaire, 2010). Yaks not only provide wool, hides, manure and draught power but also hold unique culture of mountain communities. Yak farming is, therefore, an important source of living for highlanders in Bhutan.

With the rapid progress of economic development, the highlanders are experiencing significant socio-economic changes (Namgay et al., 2014). Access to natural resources such as *Cordyceps* (medicinal fungus), *Paris polyphyla* (medicinal plant) and *Exida sp* (mushroom) further enhanced herders' livelihood. However, these alternative economic opportunities have become formidable competitors for yak farming (Wangdi, 2016); thus, challenging the continuity of age-old yak farming system. These effects have irreversibly influenced livelihood patterns, social structures and cultural identities of yak herding communities. Notably, the highlanders' dependency on yaks decreased significantly (Gurung, 2012).

In the recent past, some highlanders have abandoned yak rearing for agriculture farming and enterprises (Derville & Bonnemaire, 2010b; Gurung, 2012). This situation has been exacerbated by shortage of manpower, as the educated younger generations are attracted more to urban life than returning to village (Wangdi, 2016). Increasing challenge of low forage productivity and yak mortality (Derville & Bonnemaire, 2010; Dorji et al., 2020; Joshi et al., 2020) further debilitates yak farming. Moreover, wildlife depredation on yaks was perceived to be the primary threat in continuing yak rearing.

Currently, the majority of the mountain communities have been connected with farm roads, electricity and telecommunications. Despite these developments being purported to ameliorate nomads' livelihoods, yak rearing tradition has become a less attractive livelihood option.

Implementation of pastureland nationalization policy has further deterred the highlanders to continue yak farming (Dorji, 2013; Gyeltshen, 2010; Wangdi & Norbu, 2018). These changes have not only threatened the tradition of yak farming culture but also affected the preservation of unique mountain community culture and traditions.

To address this situation, the government endorsed the Highland Development Program as one of the flagship programs for the 12th Five Year Plan (MoAF, 2017), including free distribution of high-quality breeding bulls and improving yak breeds through artificial insemination. The legalization of Cordyceps harvest by highlanders was one of the major interventions to elevate the livelihoods (Cannon et al. 2009; Wangchuk et al., 2013). The government also recognized the yak herding households as the legitimate users of nationalized pastureland (Gyeltshen, 2010). Formation of a yak federation to promote and protect yaks, yak product diversification, improve product marketability and sharing of knowledge within yak herding society were some of the prudent interventions.

This study was aims to identify the fundamental challenges and opportunities of yak herding and how access to alternative economic opportunities assisted in addressing yak farming challenges. The study also briefly explores the perceived cost-benefit of herding yaks and its associated threats of future yak farming in Bhutan.

## **Methodology**

### ***Study area***

The study was conducted in four gewogs (sub-districts): Chhoekhor gewog under Bumthang district, Sephu gewog in Wangdue Phodrang district (central), Merak and Sakteng gewogs in Tashigang district (eastern) in Bhutan (Figure 1). The majority of residents from these gewogs depend solely on yaks to fulfill their basic needs, including milk, as well as products such as butter, cheese, dried cheese, fermented cheese, and

clothing (Chand 2017; Chettri 2008; Gyamtsho 2000). Residents also generate income from the sale of yak products and occasionally live yaks and meat. The yak-rearing people of Chhoekhor and Sephu are commonly known as *Bjobs*, while in Merak and Sakteng, they are called *Brokpas*. Both the *Bjob* and *Brokpa* are semi-nomadic inhabitants, synonymous with herdsmen and shepherds.

The vegetation of the study area ranges from the wet sub-tropical zone to the alpine geographical zone with grasslands/meadows, rhododendron shrub berries, and conifer forests. Temperature varies with elevation, with winter snow and extreme cold, and abundant summer rain. All fundamental communal utilities, such as power, telecommunication, health and education, and road networks, are available to the gewogs of the study area. Detailed characteristics of the study area are presented in Table 1.

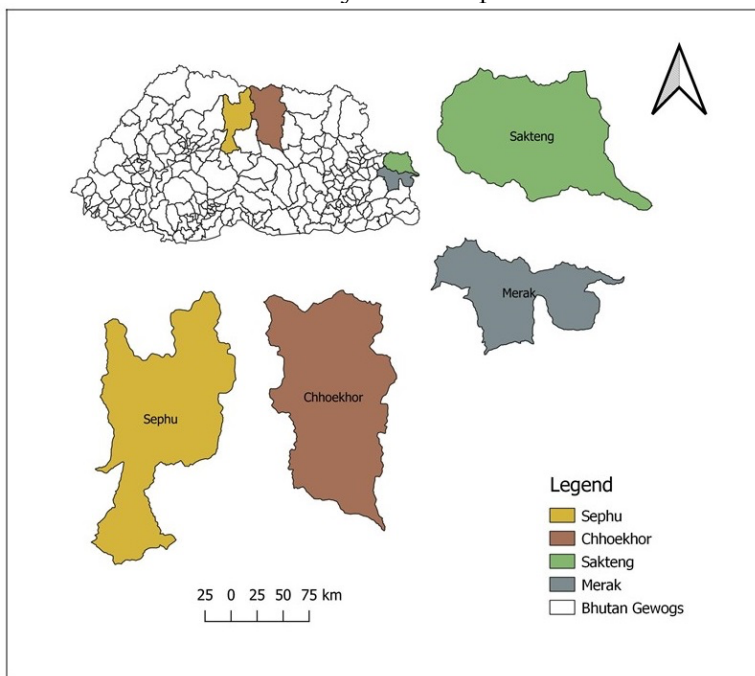


Figure 1. Study area

These gewogs were selected because they were established as pasture-based villages, where conventional agricultural farming was not feasible due to extreme climatic conditions (Ura, 2002). With the emergence of better economic opportunities, the highlanders of Chhoekhor and Sephu are gradually shifting their livelihood dependency to Cordyceps (Cannon et al., 2009; Wangchuk et al., 2013; Wangchuk & Wangdi, 2015), with yak farming—now a secondary income source. However, the highlanders of Merak and Sakteng continue to embrace yak herding as their primary source of livelihood (Chand, 2017; Dorji et al., 2020; Wangdi & Norbu, 2018).

Despite Bjobs and Brokpas having kindred livelihood strategies, their yak products brands have always been distinct. For example, dried hard cheese is the main product of Bjobs, while the Brokpas produce fermented cheese (Joshi, 2009). They not only branded disparate yak products for their survival but also practiced unique cultures and traditions. Fodder availability and size of pastureland vary between the regions even though the pastureland landscape appear similar. Market access and development activities differed greatly depending on the location of the Bjobs and Brokpas settlements.

Table 1. *Basic statistics of the study areas*

<b>Category</b>	<b>Chhoekhor</b>	<b>Sephu</b>	<b>Merak</b>	<b>Sakteng</b>
Gewog (village block) area (km <sup>2</sup> )	1530.4	1108.01	867.70	910
Household (number)	2250	352	353	396
Population (inhabitants)	10190	1510	2413	2541
Tsamdro area (acres)	28633.4	36294.7	40780.5	42799
Yak (heads)	3160	2496	2878	3672
<i>Dzo-dzom</i> (heads)	38	0	4857	4327
Altitude range (masl)	2600-5800	2600-3500	3000-3500	1724-4250
Number of tsamdro area (acres)/yak	8.9	14.5	5.3	5.4

Source: Livestock Status, 2019

### **Data collection and analysis**

A total of 107 households were interviewed from Chhoekhor (n=24), Sephu (n=43), Merak (n=20), and Sakteng (n=20) gewogs. The survey was conducted during October - February, 2020, when the herds migrate to lower altitude in winter months. A semi-structured questionnaire was used for data collection. This allowed both interviewer and respondents to follow new leads and served as a general guide to cover a set of topics. The questionnaire ensured the collection of reliable, comparable, and quality data within 20-25 minutes of interview duration for each respondents.

Purposive rather than random sampling was chosen in the study area to ensure that participants had some lived experience with yak herding pastoralism. Purposive sampling serves best when obtaining a probability sample is impossible, and respondents cannot be surveyed twice (Sharma, 2017) due to the nature of their living and livelihood patterns. Most key respondents were selected based on their extensive knowledge; others were chosen through the snowball technique, where one informant recommended that a particular herder would be useful, who then suggests the next potential key informant (Noy, 2008).

The interviews were conducted face-to-face in their homesteads because most of the yak herders are illiterate and inaccessible by telecommunication. Prior to formal interview, interviewers thoroughly explained the objectives of the study and sought consent from respondents for the interview. All data were collected by the primary author, co-authors, and research assistants from the Ugyen Wangchuck Institute for Conservation and Environmental Research. The gathered data were descriptively analyzed and the results are presented in percentage frequency distributions in this paper.

## **Results and Discussion**

### ***Attributes of respondents***

Of the 107 herders interviewed, 59.8% were male. More than half (64.4%) of the respondents were herders and others work as either farmer and or herder (35.6%). The majority (87%) were uneducated, while the remaining percentage had attended primary education (Table 2). About 19% of respondents reared yaks for more than 40 years, 40% reared yaks between 20 and 40 years and 30% and 14% reared yaks between 10 and 20 years respectively. Respondents' ages ranged from 31 to 53 years. The average household size across the study sites was relatively the same, with slightly more than 4 people per household (hh). The national average household size of Bhutan is 3.9 people/hh.

Table 2. *Demographic characteristic of respondents*

<b>Category</b>	<b>Number of Respondents (%)</b>				
<b>Gender</b>	<b>Chokhor</b>	<b>Sephu</b>	<b>Merak</b>	<b>Sakteng</b>	<b>Total</b>
Female	9 (8.4)	23 (21.5)	7 (6.5)	4 (3.7)	43
Male	15 (14.0)	20 (18.7)	13 (12.1)	16 (15.0)	64
<b>Occupation</b>					
Herder	21 (19.6)	24 (22.4)	12 (11.2)	12 (11.2)	69
Both Farmer and Herder	3 (2.8)	19 (17.8)	8 (7.5)	8 (7.5)	38
<b>Education</b>					
Uneducated	22 (20.6)	36 (33.6)	19 (17.8)	16 (15.0)	93
Primary education	2 (1.9)	7 (6.5)	1 (0.9)	4 (3.7)	14
<b>Average</b>					
Average Age	31.8	47	53.2	42	
Average Household Members	4.5	4.5	4.7	4.2	
Average Yaks/HH	84.1	51.1	63.1	38.7	
Average Herd Member	2	2	2	2	

### ***Cost-benefit analysis of rearing yaks***

Given the nature of yak herders' livelihood patterns, a detail economic valuation of yak herding was beyond the scope of our study. Thus, perceived annual income and expenditure by herders from rearing yaks was the most appropriate approach



to understanding the economy of yak pastoralists. On average, the annual net income gained from yaks per household was highest in Merak (Nu. 78316), followed by Chhoekhor (Nu. 63224) and Sakteng (Nu. 33096), whereas Sephu showed a negative (Nu. -19740) (Table 3). The results showed that income generated from yak herding varies depending on the product and region. Sale of yaks, butter, and fermented cheese were the major sources of income in Merak and Sakteng, while butter and dry cheese served as the primary yak product in Chhoekhor and Sephu. Dry cheese is produced only in Chhoekhor and Sephu, with Chhoekhor earning the highest amount. Fermented cheese is produced only in Sephu, Merak and Sakteng, with Sakteng producing the highest amount. Although annual net income per household was lower compared to average national household income (Nu.406,134) (NSB, 2022) herdsman were able to make some profits to support their livelihood in all gewogs except Sephu.

Table 3. *Herders' perceived annual cost and income from rearing yaks*

<b>Income from yak herding</b>	<b>Chhoekhor</b>	<b>Sephu</b>	<b>Merak</b>	<b>Sakteng</b>
Sale of Yaks	833	6370	17703	29603
Butter	19985	10766	47299	22603
Cheese	1666	350	11774	2324
Dry Cheese	76545	15148	0	0
Fermented Cheese	0	49	47166	36148
Meat	7455	7259	18655	8302
Hair/Tail	728	3234	462	532
Porter & Pony	49	700	0	0
<b>(A) Mean Annual Income/HH(Nu.)</b>	<b>107261</b>	<b>43876</b>	<b>143059</b>	<b>99512</b>
<b>Expenditure for yak farming</b>				
Rice	12474	15771	24766	23324
Vegetables	6167	6419	5299	7903
Milk powder, Tea leaf & Sugar	8694	7448	8106	7777
Transportation	1043	5516	10402	9380
Salt (herders and yaks)	3724	7700	4333	5873
Maize flour	0	10500	9835	10801
Karma feed/Wheat flour/Oil	11935	10262	2002	1358
<b>(C) Mean Annual Expenditure/HH(Nu.)</b>	<b>44037</b>	<b>63616</b>	<b>64743</b>	<b>66416</b>
<b>(A-C) Net Income/HH(Nu.)</b>	<b>63224</b>	<b>-19740</b>	<b>78316</b>	<b>33096</b>

Previous studies (Gurung, 2019; Wangda, 2016; Wangdi, 2016) have claimed that yak herding is gradually becoming unattractive and unprofitable, particularly for highlanders who heavily relied on collection of Cordyceps. However, a study by Wangdi et al. (2021) showed that the sale of yak products was the most important source of income for herders. Our study corroborated the findings of Wangdi (2021) except Sephu indicating that yak herding continue to accrue financial benefits for herders.

Yak herding not only serves as the main source of livelihood but also assists to generate additional non-livestock income. For example, particularly for the herders of Chhoekhor and Sephu, yak herding act as a catalyst to collect Cordyceps beyond the permitted duration and access to unreachable mountain areas compared to non-yak herding Cordyceps collectors. And also yak herding families have a competitive advantage over non-yak herding households to collect high-quality Cordyceps due to nature of living in the mountains. These may result the herders of Chhoekhor and Sephu generating higher annual income from alternative economic opportunities than yak herding. Gurung (2019) and Choden et al. (2020) reported that the cordyceps collection was the main source of income for the highlanders of Chhoekhor and Sephu. Therefore, even though herding yaks may generate a modest income, yak farming is likely to play a key role in generating supplementary income for herders in Chhoekhor and Sephu.

In Chhoekhor and Sephu, yak feeding patterns improved after the legalization of Cordyceps collection (Wangchuk & Wangdi, 2015) due to the increased purchase of commercial yak feeds. This study revealed that Chhoekhor and Sephu spent about 10 times more on commercial feeds such karma feed compared to Merak and Sakteng. Additional revenue gained from other sources not only improved nomads' livelihoods but also contributed to the dietary supplement of yaks.

***Yak-based food products and livelihood opportunities***

Around 90% of herding households earned cash income from yaks. In a few cases, income was substantial. The benchmark for market participation was set at an income equivalent to one annual minimum wage in 2015 (Nu. 0774 million), as herding at that level provides the same income as minimum wage employment for two herders. The extent to which production is geared towards markets is contingent upon the particular product and the demand of the market. Nearly all herding households (96%) earned income from the sale of butter, while the dry cheese product generated income for almost 61% of households, particularly in Chhoekhor and Sephu (Table 4). Fermented cheese was the main income-earning product (36%) in Merak and Sakteng. Meat was one of the most common lucrative yak products (50%), and wool, hair, and tail production were given more importance in Sephu than in other areas. The sale of live yaks and cheese both contributed 21% of household income. Earning at least annual minimum wage was the highest (10%) from the sale of dry cheese followed by sale of live yaks and fermented cheese.

*Table 4. Reported cash income from yaks and yak products*

Study Area	Income from the sale of live yaks (Nu.)			Income from butter (Nu.)		
	Number reporting cash income	% of hhs earning income (%)	% of hhs earning at least 1 minimum wage (Nu. 0774 million)	Number reporting cash income	% of hhs earning income	% of hhs earning at least 1 minimum wage (Nu. 0774 million)
Chhoekhor	1	4%	0	23	100%	0
Sephu	4	9%	10%	41	95%	0
Merak	10	50%	5%	20	100%	10%
Sakteng	8	40%	15%	19	95%	0
Total	23	21%	6%	103	96%	2%

Study Area	Income from cheese (Nu.)	Income from dry cheese (Nu.)
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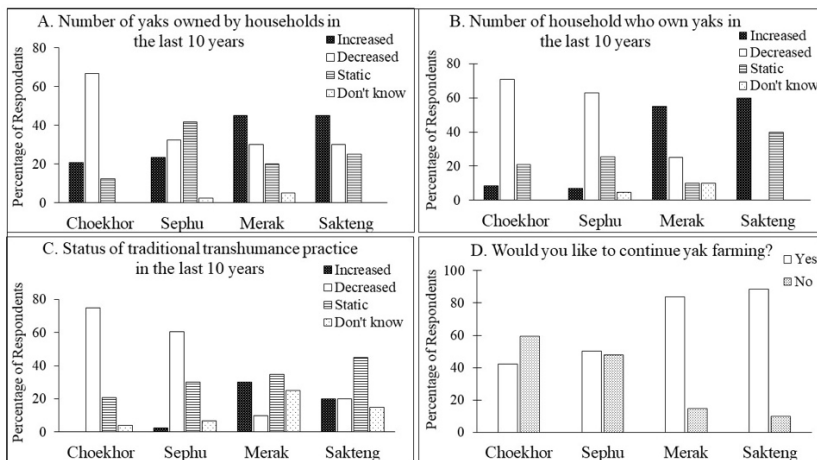
## *Yak Herding as the Main Source of Livelihood*

	Number reporting cash income	% of hhs earning income (%)	% of hhs earning at least 1 minimum wage (Nu. 0774 million)	Number reporting cash income	% of hhs earning income	% of hhs earning at least 1 minimum wage (Nu. 0774 million)
Chhoekhor	2	9%	0	23	100%	39%
Sephu	2	5%	0	42	98%	5%
Merak	10	50%	0	0	0	0
Sakteng	8	40%	0	0	0	0
Total	22	21%	0	65	61%	10%
Study Area	Income from fermented cheese (Nu.)			Income from meat (Nu.)		
	Number reporting cash income	% of hhs earning income (%)	% of hhs earning at least 1 minimum wage (Nu. 0774 million)	Number reporting cash income	% of hhs earning income	% of hhs earning at least 1 minimum wage (Nu. 0774 million)
Chhoekhor	0	0	0	7	30%	4%
Sephu	1	2%	0	21	49%	2%
Merak	19	95%	20%	15	75%	0
Sakteng	18	90%	10%	11	55%	0
Total	38	36%	6%	54	50%	2%
Study Area	Income from wool, hair, and tail (Nu.)			Income from porter and pony (Nu.)		
	Number reporting cash income	% of hhs earning income	% of hhs earning at least 1 minimum wage (Nu. 0774 million)	Number reporting cash income	% of hhs earning income	% of hhs earning at least 1 minimum wage (Nu. 0774 million)
Chhoekhor	3	13%	0	1	4%	0
Sephu	22	51%	0	1	2%	0
Merak	2	10%	0	0	0	0
Sakteng	3	15%	0	0	0	0
Total	30	28%	0	2	7%	0

### ***Past, present, and the future of yak farming***

The characteristics of yak herding households (e.g. the number of households herding yaks, the total number of yaks) and transhumance practices over the previous ten years, and the

long-term commitment to yak farming varied among the gewogs (Figure 2).



*Figure 2. Perception of yak farming status*

Chhoekhor and Sephu gewogs, with access to alternative income sources such as Cordyceps collection, appear to have a substantial influence on yak farming practice. Alternative income sources appeared to have a major impact on the yak population, the number of households owning yaks, and traditional transhumance practice leading to the gradual disappearance of yak farming in most of the mountain communities. Highlanders preferred Cordyceps and medicinal plants collection over yak herding due to high economic return (Dorji et al., 2020; Wangdi, 2016). These alternative incomes have enabled herders of Chhoekhor and Sephu to construct new permanent residents in the lower hills and owned luxury family cars. The future of yak farming in Chhoekhor and Sephu may depend on the sustainability of Cordyceps, whereas households in Merak and Sakteng may continue to rely on yaks for their livelihood.

Attitudes to yak farming (Figure 2) suggest that mountain communities with access to alternative economic opportunities that are less strenuous yet yield a high income are more likely

to abandon yak rearing. After the legalization of the Cordyceps harvest in 2004 by the Royal Government of Bhutan (Cannon et al. 2009), the price of Cordyceps increased drastically. For top-quality Cordyceps, collectors on the Himalayan plateau were paid up to USD 12,500 per kilogram (Cannon et al., 2009). The price on the international market in 2018 was US\$ 56,000 per kg (Damodar, 2019), while the high-quality Cordyceps was auctioned at about US\$ 29,000 per kg in Bhutan (DAMC, 2019), thus, signifying the fungus as an economically important income generator in the country (Wu et al., 2016).

This study suggests that the motivation of nomadic herders of Chhoekhor and Sephu to continue yak farming is likely to be influenced by the availability of alternative economic opportunities. Choden et al. (2020) posited that herders' focus more on Cordyceps collection has not only lowered their revenue from animal husbandry in the short term but has also limited their potential for future financial income if Cordyceps viability decreases. The loss of Cordyceps habitat is not only predicted (Yan et al. 2017) but is currently threatened owing to overexploitation and deterioration of its habitat as a result of climate change (Negi, Joshi, & Bohra, 2015). More importantly, the current Covid-19 pandemic may have adversely impacted their livelihood who relied on alternative economic opportunities; thus, herders need to question the resilience and sustainability of such income sources and weigh its merits for their future livelihood.

### ***Challenges of yak farming***

Yak depredation by wild animals was the greatest impediment for Sephu (60.5%) and Chhoekhor (58.3%), respectively, a situation supported by Gurung (2012). Other studies (Dorji et al., 2020; Jamtsho & Katel, 2019; Sangay & Vernes, 2008; Wangchuk & Wangdi, 2015; Wangdi, 2016) reported similar results. This may be explained by the fact that Sephu and Chhoekhor hold vast rugged mountain terrains pastureland, leading to more likely interaction with wild animals. This threatens the livelihood of highlanders and discourages the nomads to continue yak farming.

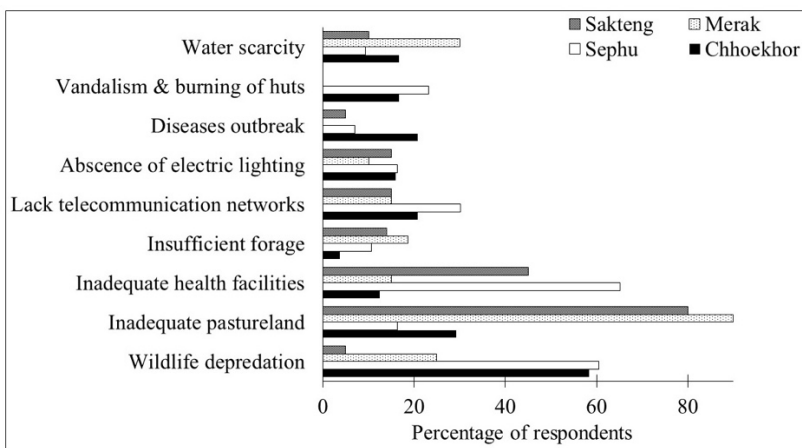


Figure 3. Primary challenges of yak farming

Respondents from Merak (90%) and Sakteng (80%) believed insufficient pastureland was the main challenge for yak farming (Figure 3). Inadequate pastureland for herders of Merak and Sakteng was one of the long-standing challenges. Moktan et al. (2008) explained that complex traditional transhumance resource sharing systems such as multiple households and villages gaining access to the same pastureland during different seasons was a leading cause of pastureland scarcity. The grazing ownership was seasonal due to the overlap of users during different seasons between the herders of high and low altitudes (Ura, 2002). As a result, there is insufficient time for natural forage regeneration, reducing forage productivity. Furthermore, increased population of cattles, *dzo* (first generation male progeny from yak and local cattle crossbreeding) and *dzom* (first generation female progeny from yak and local cattle crossbreeding), leads to overgrazing of forage in the pastureland. Thus, inadequate pastureland was the key challenge in Merak and Sakteng owing to saturated grazing land and increased yak population.

Of the total of 500198 hectares of registered pastureland in Bhutan, Merak and Sakteng share over 6%, and this provides a grazing area of over one hectare per yak (Wangdi & Norbu,

2018). Furthermore, if shrub cover, non-grazable space, and fodder grazed by wild animals are excluded, the actual grazable area may be less than half of this (Gyeltshen, 2010; Wangchuk et al., 2013). Most importantly, pastureland expansion has reached saturation, since both the gewogs share their pastureland border with Arunachal Pradesh in the north and east, while west and south with Phongmey, Radi, and Kangpara gewogs. Consequently, the availability of pastureland for Merak and Sakteng is relatively limited in comparison to Chhoekhor and Sephu.

Despite a substantial variation in pastureland size between central and eastern gewogs, the difference in insufficient fodder was minimal, with highest forage scarcity in Merak. Since herders of Merak and Sakteng have built extensive pastureland border structures, stone walls in summer pastureland and wooden fences in winter grazing land, these border structures not only address the pastureland trespassing conflicts among herders but also may have helped pastureland resource management (Wangdi & Norbu, 2018). These authors further claim that herders also carry out forage production tasks such as removal of stones and inedible plants, allowing greater area for fodder. Additionally, fences prevent wild animals from grazing pastureland during plant regeneration (Chophyel, 2009). Herders in Chhoekhor and Sephu do not use a pastureland management strategy, as observed during our field visit. As a result, one may conclude pastureland resource management systems could address the challenge of inadequate fodder. As pastureland nationalization intended, leasing of pastureland to highlanders based on number of yaks may address both insufficient pastureland and forage. Absence of health facilities was severe in Sephu and Sakteng gewog with 65% and 45% respectively. The lack of telecommunications, absence of electric lighting, disease outbreak and vandalism of huts occurred mostly in Sephu and Chhoekhor. A study by Gurung (2019) and Wangchuk & Wangdi (2015) supported the findings particularly hut vandalism by non-yak herding *Cordyceps* collectors. Scarcity of water is more prevalent in Merak than in other gewogs. A similar finding was reported by

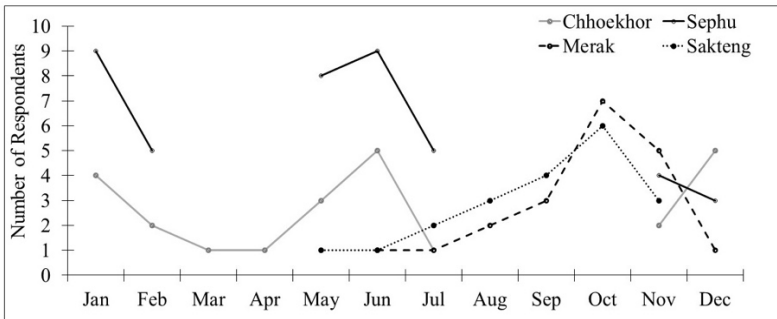


Wangchuk and Wangdi (2018) and further posited that global warming has caused harsh climatic conditions with frequent droughts, and ascent of snow lines creating difficulties for yak farming.

Despite planned socio-economic developments starting in Bhutan about six decades ago, development interventions in remote high-elevation areas were limited (Wangda, 2016). The nature of nomadic herding and the rugged mountain terrain requires substantial resources to establish basic amenities such as health, telecommunications, electricity and roads. Consequently, highlanders of yak herding communities benefited minimally from modern socio-economic development activities.

### ***Wildlife depredation on yaks***

In Merak and Sakteng, peak yak depredation occurred in the autumn through early winter, coinciding with yak migration to lower altitudes (Figure 4). Predation by tigers, wild dogs and black bears occurred in late autumn through early spring at lower elevations (Jamtsho & Wangchuk, 2016). Pastoralists of Merak and Sakteng may have minimized the predation risk during both summer and winter by limiting grazing to specific grazing land. However, when the herds gradually descend to lowlands in the autumn, predators have more opportunities. The nature of nomadic herders' subsistence strategy, which encroaches on animal habitat and competes for shared and scarce forest resources during migration further increases the chance of predation.



*Figure 4. Wild animal predation on yaks in different months*

In Chhoekhor and Sephu, yak predation mostly occurred during summer and winter (Figure 4), and corresponds with the Cordyceps collection season, when yaks were left on free-range grazing without herders. Jamtsho and Katel (2019) reported a high depredation summer rate since livestock moved frequently, exposing them to predators. Similarly, yaks were also depredated in winter in the central region, findings corroborated by Sangay & Vernes (2014). In winter, most of the grassland remains dry and yaks were kept on free-range grazing without a herder during the day and also without corralling at night increasing their vulnerability. Particularly, female yaks were not milked during the winter season to ensure calves remained strong enough to return to summer grazing land, thus remaining exposed to wildlife attacks. Moreover, yaks become weak in winter due to the low availability of nutrient forage making it easy for predators. A consistent yak herding by herders during the winter and Cordyceps collecting season has the potential to reduce yak depredation. The introduction of a livestock insurance scheme for highlanders may help to protect nomadic yak herders' livelihood.

## **Conclusion**

The study's findings highlighted the significant role that yak herding plays in supporting the livelihoods of yak herders, particularly in regions like Merak and Sakteng. However, the

declining trend in total yak population and the number of yak-owning households, particularly in Chhoekhor and Sephu, is concerning and indicates potential future ramifications.

The increase in wildlife depredation on yaks and inadequate pastureland, coupled with poor modern amenities, pose significant threats to yak farming. These issues could lead to a further decline in the yak population, making it more challenging for herders to sustain their livelihood. This situation could also have significant implications for the future of yak farming in Bhutan as a whole, given that yak farming is a vital source of livelihood for many highland communities.

Furthermore, the decline in the yak population and the number of yak-owning households in Chhoekhor and Sephu could lead to a loss of traditional knowledge and cultural practices associated with yak farming. This could have adverse effects on the Bhutanese culture and heritage. More importantly, the role of herders indirectly guarding the state's northern belt natural resources from external intruders, which are often remote and difficult to access, and contribution to border security will be weakened.

To mitigate these challenges, there is a need for concerted efforts to promote and support sustainable yak farming practices, including measures to reduce wildlife depredation and improve pastureland management. The government and other stakeholders could also invest in modern amenities and infrastructure to support the herders' livelihoods, such as improving access to markets, healthcare, education, and communication services. The government should strategically promote to reduce number of yak population by keeping only productive yaks, as well as improving the yak breed for better yak progeny.

The future of yak farming in Bhutan is uncertain, but there is potential to address the challenges and support sustainable yak farming culture to ensure its continued importance to highlanders livelihood and Bhutanese culture.

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