

## **Transforming Degraded Rangelands and Pastoralists' Livelihoods in Eastern Bhutan**

Authors: Millar, Joanne, and Tenzing, Karma

Source: Mountain Research and Development, 41(4)

Published By: International Mountain Society

URL: <https://doi.org/10.1659/MRD-JOURNAL-D-21-00025.1>

---

BioOne Complete ([complete.BioOne.org](https://complete.BioOne.org)) is a full-text database of 200 subscribed and open-access titles in the biological, ecological, and environmental sciences published by nonprofit societies, associations, museums, institutions, and presses.

Your use of this PDF, the BioOne Complete website, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at [www.bioone.org/terms-of-use](https://www.bioone.org/terms-of-use).

Usage of BioOne Complete content is strictly limited to personal, educational, and non - commercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

---

BioOne sees sustainable scholarly publishing as an inherently collaborative enterprise connecting authors, nonprofit publishers, academic institutions, research libraries, and research funders in the common goal of maximizing access to critical research.

# Transforming Degraded Rangelands and Pastoralists' Livelihoods in Eastern Bhutan

Joanne Millar\* and Karma Tenzing

\* Corresponding author: [jmillar@csu.edu.au](mailto:jmillar@csu.edu.au)

Institute for Land, Water and Society, Charles Sturt University, PO Box 789, Albury, Australia 2640

© 2021 Millar and Tenzing. This open access article is licensed under a Creative Commons Attribution 4.0 International License (<http://creativecommons.org/licenses/by/4.0/>). Please credit the authors and the full source.



High-elevation rangelands in Bhutan provide livelihoods for many herding communities. However, severe rangeland degradation in the far eastern region is threatening livestock productivity, biodiversity conservation, and household

wellbeing. This paper describes a 3-year community-based rangeland project in eastern Bhutan aimed at restoring and protecting high-elevation rangelands, including wildlife habitats, grasslands, and watersheds, while improving livelihoods. Herder families (120) of the Brokpa ethnic group participated in group management training, savings schemes, pasture improvement, revegetation, and conservation education. Herders restored 35 ha of severely eroded rangeland and sowed 80 ha of improved pasture, and 148 household members invested in savings, with 10 households borrowing funds to diversify income. Households were interviewed before and after the project using semistructured

interview guides to determine their perceptions of the project's impacts and limitations. Respondents were satisfied that gully erosion was under control, savings groups were generating income, community cohesion had improved, and awareness of red panda conservation had increased. However, there was ongoing winter fodder shortage, heavy rain damage, and lack of consensus about improving communal pasture areas. We conclude that pastoralists' willingness and ability to restore mountain rangelands will depend on the security of their use rights to graze and manage high-elevation areas. Building trust between mountain communities and agencies and staying committed to long-term social and environmental change are essential for practitioners and policymakers.

**Keywords:** Bhutan; high-elevation rangeland; rangeland degradation; yak herders; pastoralism.

**Received:** 21 March 2021 **Accepted:** 21 September 2021

## Introduction

High-elevation rangelands located between 2500 and 5500 masl in the Himalayas provide pasturage for yaks, yak/cattle crosses, horses, sheep, and goats, which support the livelihoods of many ethnic minority communities (Aryal et al 2014; Wu et al 2014; Gentle and Thwaites 2016; Singh et al 2021). Some of these communities are made up of nomadic or seminomadic herders practicing traditional transhumant pastoralism, in which they spend most of the year moving their livestock between seasonal pastures (Namgay et al 2013; Aryal et al 2014; Tenzing et al 2017). Over the last century, Himalayan rangeland degradation has become problematic because of climate change, timber and mineral extraction, changing government policies, and declining grasslands, causing soil erosion and major landslides (Xu et al 2009; Chaudhary and Bawa 2011; Tabassum et al 2014; Wu et al 2014; Dorji et al 2020; Namgay et al 2021). For example, Tabassum et al (2014) found overexploitation of communal rangelands in the mountains of Pakistan was caused by changes in property regimes and disruption of traditional management systems. In Nepal and Sikkim, the creation of national parks and community forestry has encroached into traditional grazing areas, putting more pressure on the remaining grazing areas (Gentle and Thwaites 2016; Singh et al 2021). Increasing demand for timber and minerals has

pushed roads and infrastructure further into mountain rangeland areas in Nepal, China, and Pakistan, causing soil erosion and landslides (Aryal et al 2014; Tabassum et al 2014; Wenjun and Huntsinger 2011). Xu et al (2009) and Kulkarni et al (2013) demonstrated that the impact of climate change in the Himalayas is already affecting water availability, biodiversity, tree line advancement, monsoonal shift, and loss of soil carbon.

Himalayan pastoralists are affected by rangeland degradation to varying degrees, as most of the impact factors are beyond their control. Wu et al (2014) found that a shortage of pasture forced Hindu Kush communities to abandon traditional systems of livestock-based livelihoods to pursue alternative options such as waged labor, tourism, and petty businesses. Transhumant pastoralists in Nepal have had to change livestock migratory routes to avoid conservation areas, and many young people have migrated overseas for work (Aryal et al 2014). In Central Asia and China, forced sedentarization has led to increasing livestock numbers per household and further pasture degradation (Kreutzmann 2012).

Bhutan, in the eastern Himalayas, is also experiencing some rangeland degradation despite its global reputation for rich biodiversity, strict environmental standards, and philosophy of social wellbeing (Rinzin et al 2009). High-elevation rangelands cover 27,164 ha or 0.7% of the

country's total land area (Dorji 2011), supporting 1156 yak-herding households, which represent 1.12% of the total number of rural households in the country (PHCB 2017). Most herders in Bhutan are seminomadic, residing in permanent villages for some of the year and migrating to winter or summer pastures where they continue to milk yak or yak/cattle crosses to make cheese and butter (Namgay et al 2014; Wangdi 2016; Dorji et al 2020). Rangelands grazed in Bhutan are usually small open grassy areas, such as meadows inside forests dissected by deep ravines and gorges, valleys, and alpine and subalpine grasslands (Moktan et al 2008). Livestock also range free in state forests, and grazing rights to rangeland may include understory grazing in state forests (Ura 2002). A herder might access one or several rangelands under different property rights regimes (Tenzing et al 2017).

Rangeland degradation is threatening seminomadic yak herders' livelihoods and, combined with young people leaving for employment, has resulted in the abandonment of livestock-based livelihoods in some locations (Gyamtsho 2002; Moktan et al 2008; Namgay et al 2014). While some of the factors driving degradation are similar to those in other Himalayan countries, there are some unique drivers pertaining to Bhutan. Bhutan government policies, such as the ban on burning and lack of management rights, have indirectly triggered rangeland degradation due to shrub invasion (such as *Juniperus* and *Rhododendron* species), reducing both the quantity and quality of pastures (Gyeltshe et al 2010; Wangdi 2016; Tenzing et al 2017). Following the enactment of the Land Act of 1979, traditional rangeland user rights reverted to the Bhutan government with only grazing rights being granted, not management rights. Herders were prevented from implementing provisioning (eg improved pasture development) and maintenance activities (eg clearing, cutting, and burning), which in the past helped to ensure adequate fodder for livestock (Wangdi 2016; Tenzing et al 2017).

Historic inequities in ownership of grazing rights also existed (Tenzing et al 2021). The Bhutan government started a process of redistributing user rights from absentee or elite owners to local families dependent on livestock under the Land Act of Bhutan 2007. Under new leasing arrangements, herders will be permitted to grow improved pasture and manage grasslands if they develop a management plan. However, a lack of practical leasing implementation over the last decade has fueled confusion and uncertainty among herders (Gyeltshe et al 2010; Tenzing et al 2018).

Degradation of high-elevation rangelands is more acute in the eastern region of Bhutan, where yak/cattle cross populations are higher than in the central and western regions (Dorji et al 2020). Herders known as *Brokpas* (meaning people of the grasslands) graze and trade yak and cattle under traditional grazing rights that extend beyond the border with northeast India because of historic familial ties. Significant land degradation has occurred in this area over the last 50 years, particularly in winter grazing areas (which are also habitat for the globally endangered red panda), where livestock spend 7 to 8 months annually (Tenzing et al 2017). Herding families are caught in a vicious poverty cycle caused by declines in rangeland resources and labor and poor access to services (UNDP 2013). Despite the severity of the degradation, little attention has been given to addressing the problem because of remoteness and inaccessibility of the area and the lack of policy directives on

### BOX 1: Project details

- **Title:** Sustainable Rangeland Management to Protect Red Pandas and Herder Livelihoods
- **Partners:** 120 households from Merak village (30%), Bhutan Department of Forest and Park Services, Department of Livestock, World Wildlife Fund, and Charles Sturt University
- **Duration:** 3 years (1 April 2016 to 1 April 2019)
- **Budget:** US\$ 396,199
- **Website:** <https://redpandabhutan.wordpress.com>

high-elevation rangeland development in Bhutan. Engaging with pastoral communities to find solutions, and using their local knowledge combined with agency expertise, can lead to better outcomes (Selemani 2020; Mairomi and Kimengsi 2021).

From 2016 to 2019, a sustainable rangeland development project was implemented by the Department of Livestock, Forest and Park Services, and Charles Sturt University in Merak district, funded by the UK government Darwin Initiative Fund (Box 1). The aim was to work with the Merak village community to enable herders and agencies to restore high elevation rangelands, protect red panda forest habitat, and improve livelihoods through sustainable livestock and forest management. The authors were project leader and research officer. The objective of this paper is to present findings from the final household survey in 2019 on project impacts and limitations. We discuss the lessons learned from the project and implications for sustainable mountain development in the Himalayas.

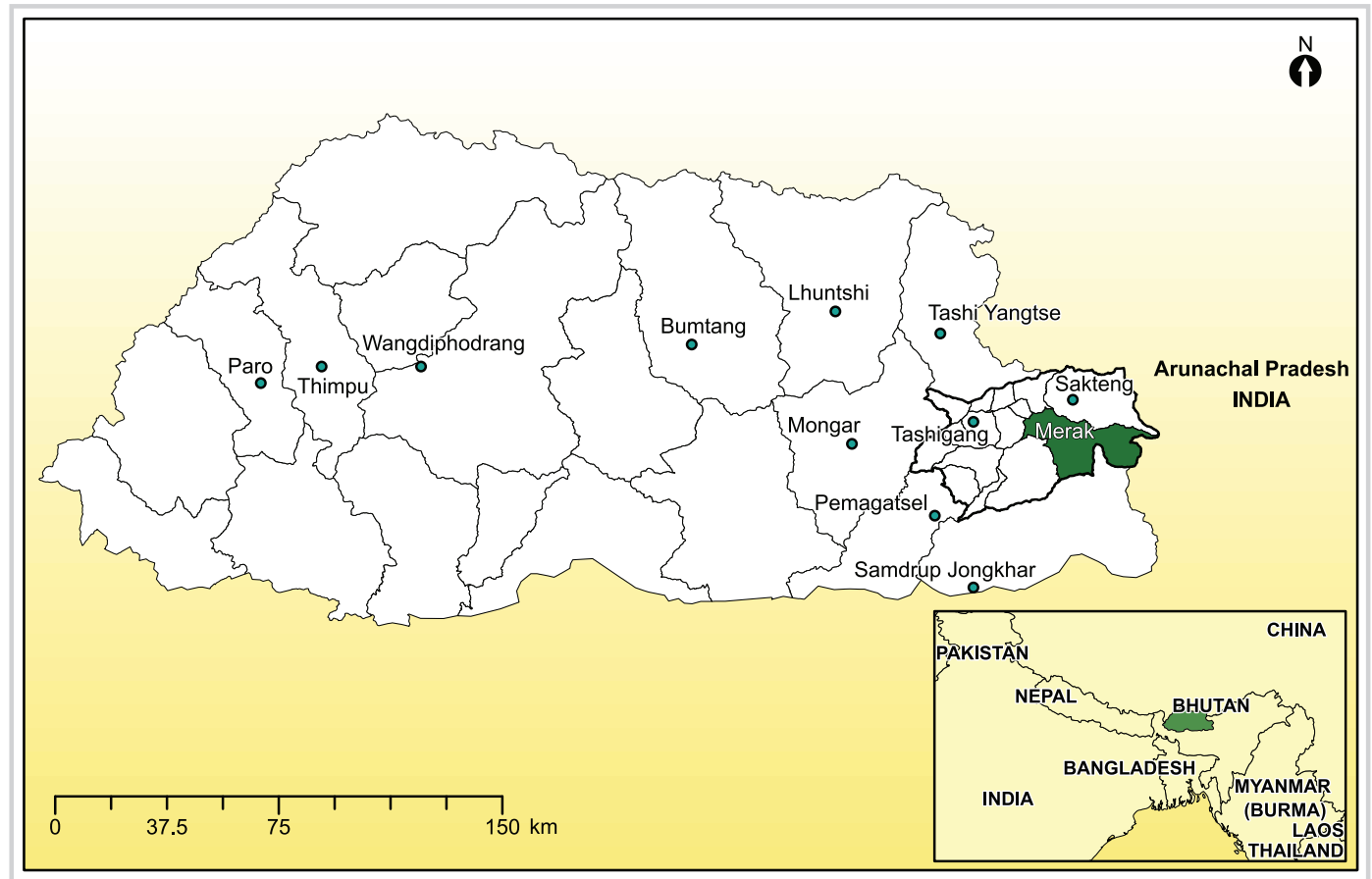
## Project methodology

### Project area

Merak village in Merak *gewog* (lowest administrative unit) is a remote village at an elevation of 3500 masl in eastern Bhutan (Figure 1). It is located in the eastern part of Trashigang district and shares a boundary with the Indian state of Arunachal Pradesh in the east. Merak *gewog* has 16,503.28 ha of rangelands and 14,719 head of livestock, comprising yak ( $n = 2963$ ), yak/cattle crosses ( $n = 4553$ ), cattle ( $n = 4547$ ), horses ( $n = 733$ ), sheep ( $n = 1851$ ), and goats ( $n = 72$ ) (DOL 2016). According to a socioeconomic survey conducted by the Sakteng Wildlife Sanctuary (SWS) in 2016, 85% of the 420 households in Merak village pursue yak herding as their primary income activity.

Despite the Land Act 2007 provisions, the *Brokpa* herders still practice traditional rangeland and yak management systems (Wangdi and Norbu 2018). Winter pastures are located at lower elevations (2500–3000 masl), spring and autumn pasture in transitional elevations (3000–3500 masl), and summer pasture at 3500–5000 masl. Rangelands are still managed under communal or private use right arrangements and were not altered by the project (Tenzing et al 2017). Those herders who do not have sufficient rangeland rent rangeland from other herders, absentee landlords, monasteries, and local temples. Traditionally, herders bartered their dairy products, such as fermented cheese and

**FIGURE 1** Project location: Merak village (approximate location labeled in white) in Merak gewog. (Map by Charles Sturt University Spatial Unit)



butter, for cereals and other household necessities with neighboring downstream communities, but now they sell and buy products via a road that reached the village in 2016. The main settlement village of Merak was connected to grid electricity in 2013 and includes a primary school, basic health unit, livestock extension center, park ranger office, and local government office.

### Project implementation

The rangeland project focused on the 3 adjoining leased winter pasture areas of Cheabling (27°19′44.87″N; 91°46′14.27″E), Drana (27°19′04.24″N; 91°45′41.30″E), and Sheytemi (27°19′02.04″N; 91°44′26.06″E), where there are significant natural resource management problems, such as flash floods and landslides during the rainy season (Figure 2). The area falls within the buffer zone of SWS, which is rich in biodiversity and home to many globally threatened species (UNESCO n.d.). There are 120 households that lease these areas from the government.

An integrated program was developed using gender-inclusive capacity building (ensuring equal and effective participation by women and men), reforestation of eroded areas, conservation education, and livelihood savings schemes. Group management training was held with 90 families to develop greater understanding and skills in planning, conflict resolution and negotiation, problem solving, and managing committees. These skills were identified as weaknesses in project planning. Two savings

groups (one in Merak village and one in a subvillage called Gengu) were formed following a 3-day training course involving 98 households in August 2017. The aim was to build household capacity to save funds for microbusinesses. Each group formed a committee with office bearers and was given an iron safe, passbooks, and ledger books.

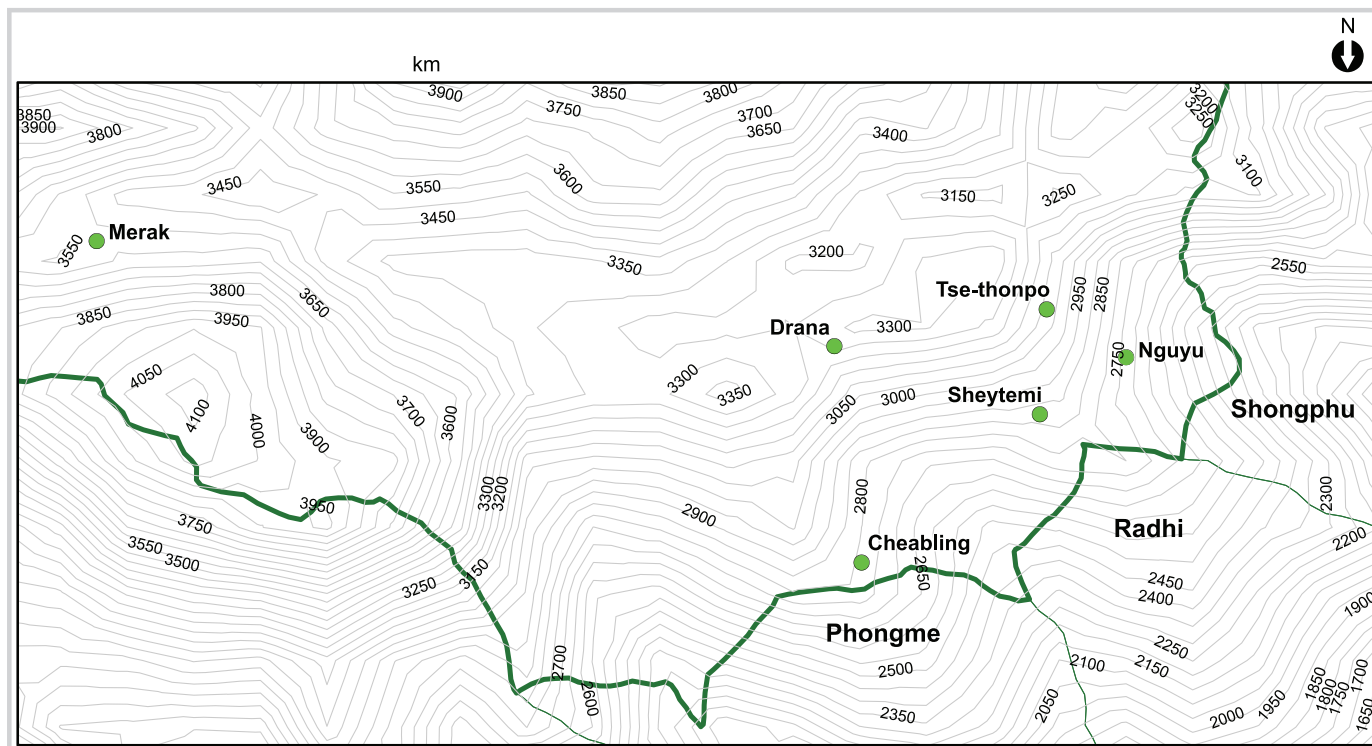
Local Bhutanese forest and livestock officers worked with herders to fence and plant a 35 ha eroded gully at Drana (between Cheabling and Sheytemi) with 23,000 trees, build 136 check dams (Figure 3A), and sow 80 ha of improved pasture for winter fodder (Figure 3B). Forest logging and firewood collection were banned across the degraded winter grazing area in consultation with Merak households, with permit access to other areas on approval from SWS. A study tour to central Bhutan enabled herders to learn about pasture improvement. The same tour went to Sikkim to witness community-based red panda conservation. School students and parents were involved in learning about red panda conservation, including threats caused by overgrazing, tree lopping, and domestic dogs. Two junior ranger clubs were formed in the schools. Community meetings and awareness sessions were held on a regular basis on different topics related to rangeland conservation and management.

### Evaluation methods and data analysis

Evaluation of activities, outputs, outcomes, and impacts followed a framework developed by the UK Darwin Initiative Fund. An adaptive approach was used for social and



**FIGURE 2** Winter pastures of Cheabbling, Drana, and Sheytemi. The green line denotes the border with the lower gewogs. (Map by Charles Sturt University Spatial Unit)



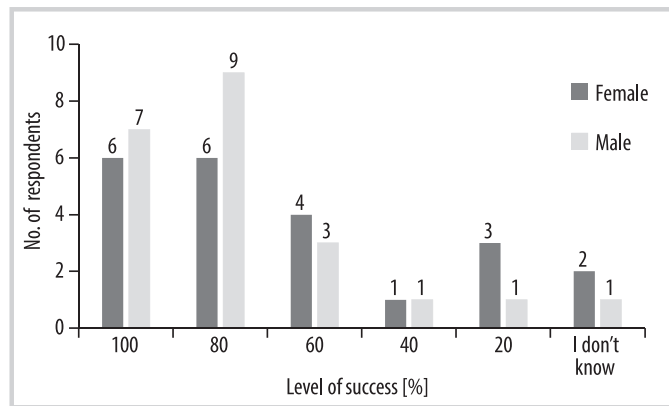
ecological research using qualitative and quantitative data and a variety of ways to analyze and present findings (written, visual, oral). A baseline household survey was conducted in October 2016 and a final household survey in April 2019 using semistructured interviews conducted by forestry and livestock staff and university students. Meetings and trip notes, field observations, blog stories, and case study interviews were also used to capture livelihood and environmental impacts. Camera traps, field walks, and photo points were the main methods for monitoring red panda presence, vegetation cover, and erosion control.

The baseline survey involved a random sample of 77 of the 120 households (64%), while the final survey interviewed 45 households (39%). Sampling was random as many families were herding in distant pastures and unavailable for interview. Community meetings were held to explain the purpose of the surveys and invite households to participate. Survey enumerators were trained in research ethics and interview techniques. The interviews were conducted in Tshangla, a dialect spoken by people from the eastern part of Bhutan. Results were analyzed to create descriptive statistics and organize quotes into themes around high-

**FIGURE 3** Project activities included, among others, (A) check dam construction with herders and (B) social learning on pasture improvement. (Photos by Norbu Yangdon and Joanne Millar)



**FIGURE 4** Estimate of erosion control from reforestation by gender ( $n = 45$ ). (Source: Final household survey 2019)



elevation rangeland use and perceived impacts of interventions.

## Results

In this section, we present information on the characteristics of respondents to the final project survey, their perceptions of project impacts and limitations, and results from project monitoring records.

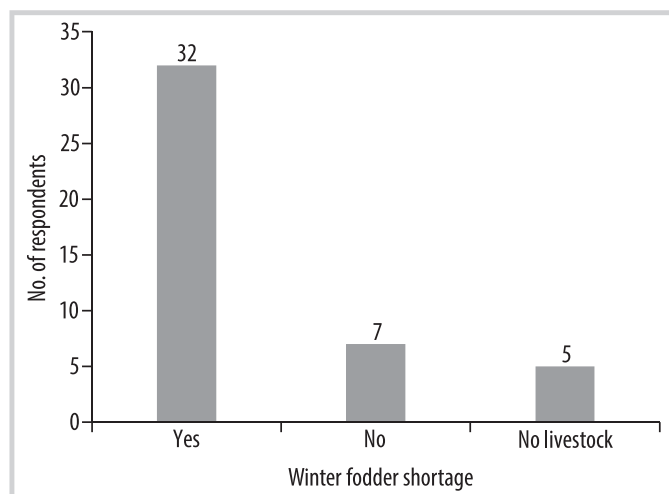
### Survey respondent characteristics

Forty-six percent of respondents were male and 54% female. Ages ranged from 20 to 80 years, with a mean age of 46 years. The average household size was 7 members, much higher than the national average household size of 3.9 (PHCB 2017). The majority of households used less than 40 ha and 11.68% did not own any rangeland.

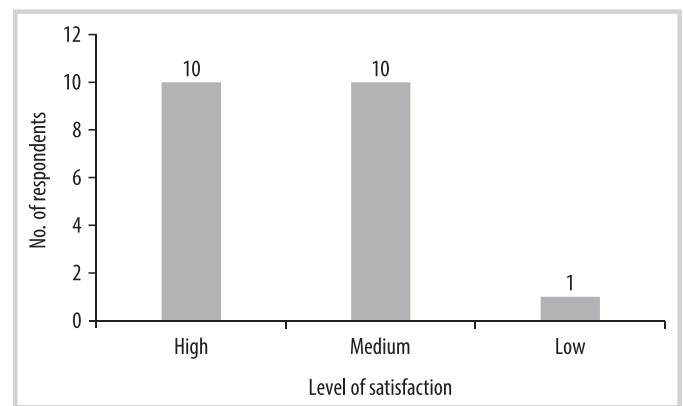
### Project impacts

**Rangeland rehabilitation:** Two-thirds of respondents (more men than women) estimated gully erosion control between 80 and 100%, whereas about a third of respondents were more realistic in their estimate of 20–60% erosion control, including more women (Figure 4). This estimated range was

**FIGURE 5** Number of households still experiencing winter fodder shortage. (Source: Final household survey 2019)



**FIGURE 6** Savings group member satisfaction ( $n = 21$ ). (Source: Final household survey 2019)



closer to the 50% erosion control and 40% vegetation cover confirmed by photo points and on-ground assessment (Millar et al 2019). Some herders may not have directly observed the gully rehabilitation if their grazing leases were far away, whereas others made direct observations of the area. One male herder observed, “It has helped prevent flash floods and make clean water.”

Heavy monsoon rain events in 2017 damaged some of the plantings, fencing, and check dams, which had to be rebuilt and expanded in 2018. Climate change will continue to impact the area but check dams appear to be slowing runoff and building sediment for revegetation (Millar et al 2019). Although 45 households are now grazing improved pasture over 80 ha, winter fodder production has not yet met demand, as the final survey revealed that most respondents (73%) continued to have winter fodder shortages (Figure 5).

**Savings schemes and livelihood impacts:** The Gengu savings group has 89 members and the Merak group has 59 members (total 148 members from all 120 households, with 60% women). Each member invests BTN 100–150 per month (US\$ 1.50–2.00). Over 18 months, the group saved a total of BTN 381,000 (US\$ 5177) with approximately BTN 200,000 (US\$ 2717) borrowed by 10 households. Households can borrow up to BTN 30,000 per year (US\$ 407). Case studies of households (women and men) who have borrowed funds showing how they have used the funds for new and existing enterprises such as cheese making, carving wooden bowls, small shops, carpentry, and livestock can be seen at [www.redpandabhutan.wordpress.com](http://www.redpandabhutan.wordpress.com).

Respondents (95%) in the final household survey expressed a high to medium level of satisfaction with being savings group members (Figure 6). About 70% of respondents reported that income had increased in the last 3 years and 58% stated they had started new livelihood activities. One herding family was inspired by the study tour to improve their homestay, create a handicraft shop, and make rhododendron wine (Figure 7). One of the savings groups successfully applied for Helvetas funding to establish a women's wool processing center, which uses portable carding machines. Women are now producing weaving products for sale across Bhutan. Hence, the savings groups combined with learning opportunities have enabled households to diversify their enterprises and income. The following quote demonstrates how members perceived benefits from the savings scheme: “We can save for our



**FIGURE 7** Handicraft shop established by a *Brokpa* family. (Photo by Joanne Millar)



children; we don't need to worry about losing it" (female herder from Cheabling).

The final household survey in 2019 also showed that 86% of respondents thought community cohesiveness had improved since group training, and most respondents (77%) rated community capacity as very good or good. As one respondent said: "People are listening to each other; they share ideas and come up with good solution to the problem."

Another herder said, "Because of the group training, we came to know about the importance of group work; we also gained new knowledge and ideas toward conserving nature."

**Red panda conservation awareness:** The household survey in 2016 found very little community knowledge of red panda ecology, movements, or population changes. However, most people interviewed (60%) knew red panda ate bamboo and 42% suggested protecting habitat and restoring bamboo was important. The final household survey in 2019 showed that 88% of the 45 people interviewed had learned more about red panda threats, habitat requirements, and breeding from SWS presentations or indirectly via word of mouth, as shown by the following quotes:

*We learned that we humans tend to encroach in the territories of the [red] panda, which led to decrease in their population. If we protect them by planting their food and making boundaries we can save them.*

*(female herder from Sheytemi)*

*Our village [Merak] is the main habitat of red pandas; they mainly feed on grass and red berries [labreb]; they are herbivorous; they are harmless; endangered species; sometimes they fall victim to our dogs.*

*(male herder from Sheytemi)*

## Discussion (lessons learned)

### Herder willingness to restore rangelands depends on full implementation of new grazing and management rights

In a perverse way, the severity of the land degradation situation and declining livestock productivity created a crisis for *Brokpa* herders that incentivized them to agree to act in partnership with agencies. The herders with private leases

took advantage of special government permission to establish pastures in the project area, despite management rights not yet being fully granted under the new lease program. However, households with shared communal leases took longer to reach consensus on sowing improved pasture, fearing it would lead to conflict over fencing off areas and restricting livestock movement. After a pasture field day, where herders learned how to sow and manage pastures, about half of the households with communal leases decided to adopt pasture improvement in the final year of the project.

A couple of herders built fences in the wrong places in a bid to secure private use of forested rangelands, and had to take them down. In contrast, fencing and restoration of the Drana gully was supported by all households involved, as it did not provide productive grazing and was seen as a public good. The lesson learned was that donor projects could have some influence at a local level on granting management rights, but only within the prevailing leasing and decision-making systems, which were beyond their control. Until implementation of the national lease reallocation is finalized, herders are reluctant to make improvement decisions (Tenzing et al 2018).

Under the new rangeland leasing arrangement, users in Bhutan will be permitted to grow improved pasture and implement maintenance activities, such as burning, clearing, and cutting shrubs and bushes grown on pasture as per approved management plans. Elsewhere, degraded rangeland restoration approaches include setting up exclosures (Yayneshtet et al 2009), grazing management (Papanastasis 2009), reducing grazing intensity, selective planting of grasses, reseeding and artificial seeding (Li et al 2013), extensive vegetation reseeding, weed control, shrub plantations, and reforestation (Yayneshtet et al 2009; Li et al 2013).

### Partnering with communities requires trust, credibility, and commitment from agencies to work together

The credibility of the government staff who had a history of working with *Brokpas* played a key role in engaging the Merak community of herding families. They knew how to communicate at various levels of Merak society and how to establish trust. Nevertheless, trust had to be continually reinforced with regular communication to address community concerns. State and nonstate actors need to have a sound understanding of the past and present social context of pastoralists. A thorough knowledge of the environmental situation is also required, including all the causal factors of resource overuse and land degradation. Agency staff from the different disciplines of forestry, livestock, and wildlife conservation had to learn to work together outside the norm, where they often see each other as foes: conservation conflicting with livestock production. As the project advanced, they began to see activities and outcomes as "win-win"; for example, fencing areas for pasture production enabled bamboo to regenerate for red pandas and slowed soil erosion.

In mountainous developing countries, like Bhutan, there are many competing development projects occurring in the same location. This creates many demands on households and local officials and limits how much time local people can devote to a rangeland project. There is a need for agencies to

be aware of competing interests and allow space for engagement and collaboration. Dependency on aid programs to fix problems also creates a “waiting” attitude in government and communities with a reluctance to invest in their own savings for private or public improvements. One solution is to have cost-sharing schemes where people have to invest something to get a return, as we did with the savings schemes. The savings groups have gone on to establish a wool processing center and weaving group in Merak to increase income from textile products.

## Conclusion

The project started a journey toward transforming degraded mountain rangelands and improving herder livelihoods. The Merak community and local agencies are more confident in working together to restore and protect rangelands. Rangeland restoration may take several years to bring biodiversity and productivity returns, but will provide useful demonstration sites for scaling out rangeland rehabilitation in other districts. Livelihood diversification gave quicker returns, and in the future it may reduce household dependence on livestock as the primary source of income. The likelihood of reducing livestock numbers and grazing pressure to restore rangelands is low because of the cultural and economic status associated with yak rearing and cheese making by the *Brokpa* people in eastern Bhutan.

Key recommendations to policymakers and practitioners are:

- Work with pastoralists to determine clear grazing and management rights of rangelands.
- Build trust with herder communities and stay committed to long-term social and environmental change.
- Encourage collaboration between agencies with different rangeland interests and expertise.
- Facilitate capacity building in group management and conflict resolution so herder communities can organize and act.

## ACKNOWLEDGMENTS

We acknowledge funding support from the UK Darwin Initiative Fund, Charles Sturt University, and the World Wildlife Fund. We thank the Merak community and staff from Sakteng Wildlife Sanctuary, Department of Livestock, and Red Panda Network for their hard work and dedication.

## REFERENCES

- Aryal S, Maraseni TN, Cockfield G.** 2014. Sustainability of transhumance grazing systems under socio-economic threats in Langtang, Nepal. *Journal of Mountain Science* 11(4):1023–1034.
- Chaudhary P, Bawa KS.** 2011. Local perceptions of climate change validated by scientific evidence in the Himalayas. *Biology Letters* 7(5):767–770.
- DOL [Department of Livestock].** 2016. *Livestock Statistics 2016*. Thimphu, Bhutan: Department of Livestock, Ministry of Agriculture and Forests.
- Dorji K.** 2011. *Rangeland Tenure Transfer: An Analysis of Policy and Legal Issues in Bhutan*. Thimphu, Bhutan: Policy and Planning Division, Ministry of Agriculture and Forests.
- Dorji N, Derks M, Dorji P, Groot Koerhamp PWG, Bokkers EAM.** 2020. Herders and livestock professionals' experiences and perceptions of developments and challenges in yak farming in Bhutan. *Animal Production Science* 60:2004–2020. <https://doi.org/10.1071/AN19090>.
- Gentle P, Thwaites R.** 2016. Transhumant pastoralism in the context of socioeconomic and climate change in the mountains of Nepal. *Mountain Research and Development* 36(2):173–182.
- Gyamtscho P.** 2002. Condition and potential for improvement of high altitude rangelands. *Journal of Bhutan Studies* 7:82–98.
- Gyeltshen T, Tshering N, Tsering K.** 2010. *Implication of Legislative Reform Under the Land Act of Bhutan, 2007: A Case Study on Nationalisation of Tsamdrog and*

- Sokshing and its Associated Socioeconomic and Environmental Consequences*. Thimphu, Bhutan: Watershed Management Division, Department of Forest and Park Services.
- Kulkarni A, Patwardhan S, Kumar KK, Ashok K, Krishnan R.** 2013. Projected climate change in the Hindu Kush–Himalayan region by using the high-resolution regional climate model PRECIS. *Mountain Research and Development* 33(2):142–151. <https://doi.org/10.1659/MRD-JOURNAL-D-11-00131.1>.
- Kreutzmann H.** 2012. Pastoral practices in transition: Animal husbandry in high Asian contexts. In: Kreutzmann H, editor. *Pastoral Practices in High Asia*. Advances in Asian Human-Environment Research. Dordrecht, the Netherlands: Springer, pp 1–20.
- Li XL, Gao J, Brierley G, Qiao Y-M, Zhang J, Yang Y-W.** 2013. Rangeland degradation on the Qinghai-Tibet plateau: Implications for rehabilitation. *Land Degradation & Development* 24(1):72–80.
- Mairomi HW, Kimengsi JN.** 2021. Community based actors and participation in rangeland management: Lessons from the western highlands of Cameroon. *Sustainability* 13(4):1700. <https://doi.org/10.3390/su13041700>.
- Millar J, Tenzing K, Dorjee T, Wangdi T.** 2019. *Darwin Initiative: Final Report. Sustainable Rangeland Management to Protect Red Panda and Herder Livelihoods*. Albury, Australia: Institute for Land, Water and Society, Charles Sturt University. [https://cdn.csu.edu.au/\\_data/assets/pdf\\_file/0008/3927743/23009-Final-Report-2019.pdf](https://cdn.csu.edu.au/_data/assets/pdf_file/0008/3927743/23009-Final-Report-2019.pdf); accessed on 21 July 2021.
- Moktan MR, Norbu L, Nirola H, Dukpa K, Rai TB, Dorji R.** 2008. Ecological and social aspects of transhumant herding in Bhutan. *Mountain Research and Development* 28(1):41–48.
- Namgay K, Millar J, Black R.** 2013. Transhumant agro-pastoralism in Bhutan: Exploring contemporary practices and socio-cultural traditions. *Pastoralism: Research, Policy and Practice* 3(1):13.
- Namgay K, Millar J, Black R.** 2021. The future of transhumants sustainable resource use in Bhutan: Pressures and policies. *Frontiers in Sustainable Food Systems* 5:618351. <https://doi.org/10.3389/fsufs.2021.618351>.
- Namgay K, Millar J, Black R, Samdup T.** 2014. Changes in transhumant agro-pastoralism in Bhutan: A disappearing livelihood? *Human Ecology* 42:779–792.
- Papanastasis VP.** 2009. Restoration of degraded grazing lands through grazing management: Can it work? *Restoration Ecology* 17(4):441–445.
- PHCB [Population and Housing Census of Bhutan].** 2017. *Population and Housing Census of Bhutan*. Thimphu, Bhutan: National Statistics Bureau.
- Rinzin C, Vermeulen WJV, Wassen MJ.** 2009. Nature conservation and human well-being in Bhutan: An assessment of local community perceptions. *Journal of Environment & Development* 18(2):177–202.
- Selemani IS.** 2020. Indigenous knowledge and rangeland's biodiversity conservation in Tanzania: Success and failure. *Biodiversity and Conservation* 29:3863–3876. <https://doi.org/10.1007/s10531-020-02060-z>
- Singh R, Sharma RK, Bhutia TU, Bhutia K, Babu S.** 2021. Conservation policies, ecotourism and end of pastoralism in India? *Frontiers in Sustainable Food Systems* 5:613998. <https://doi.org/10.3389/fsufs.2021.613998>.
- SWS [Sakteng Wildlife Sanctuary].** 2016. *Socio-Economic Survey Report for Sakteng Wildlife Sanctuary*. Tashigang, Bhutan: SWS.
- Tabassum I, Rahman F, Haq F.** 2014. Dynamics of communal land degradation and its implications in the arid mountains of Pakistan: A study of district Karak, Khyber Pakhtunkhwa. *Journal of Mountain Science* 11(2):485–495.
- Tenzing K, Millar J, Black R.** 2017. Changes in property rights and management of high-elevation rangelands in Bhutan: Implications for sustainable development of herder communities. *Mountain Research and Development* 37(3):353–366.
- Tenzing K, Millar J, Black R.** 2018. Exploring governance structures of high altitude rangeland in Bhutan using Ostrom's design principles. *International Journal of the Commons* 12(1):428–459.
- Tenzing K, Millar J, Black R.** 2021. How property rights influence equity, efficiency and sustainability of high-altitude rangeland management in Bhutan. *Pastoralism* 11:7. <https://doi.org/10.1186/s13570-021-00193-6>.
- UNDP [United Nations Development Program].** 2013. *Country Programme Landscape Strategy COMDEKS Bhutan. Restoring and Managing Landscapes in Gamri Watershed Trashigang*. New York, NY: UNDP.
- UNESCO [United Nations Educational, Scientific and Cultural Organization].** n.d. Sakteng Wildlife Sanctuary (SWS). <http://whc.unesco.org/en/tentativelists/5701/>; accessed on 12 November 2020.
- Ura K.** 2002. Herdmen's dilemma. *Journal of Bhutan Studies* 7:1–43.
- Wangdi J.** 2016. The future of yak farming in Bhutan: Policy measures government should adopt. *Rangeland Journal* 38(4):367–371.
- Wangdi S, Norbu N.** 2018. Good fences are key to sustainable pasture management and harmonious pastoral society of Merak and Sakteng in Bhutan. *Pastoralism: Research, Policy and Practice* 8(1):4.
- Wenjun L, Huntsinger L.** 2011. China's grassland contract policy and its impacts on herder ability to benefit in Inner Mongolia: Tragic feedbacks. *Ecology and Society* 16(2):1.
- Wu N, Ismail M, Joshi S, Yi S-L, Shrestha RM, Jasra AW.** 2014. Livelihood diversification as an adaptation approach to change in the pastoral Hindu-Kush Himalayan region. *Journal of Mountain Science* 11(5):1342–1355.
- Xu J, Grumbine RE, Shrestha A, Eriksson M, Yang X, Wang Y, Wilkes A.** 2009. The melting Himalayas: Cascading effects of climate change on water, biodiversity, and livelihoods. *Conservation Biology* 23(3):520–530.
- Yayneset T, Elk LO, Moe SR.** 2009. The effects of enclosures in restoring degraded semi-arid vegetation in communal grazing lands in northern Ethiopia. *Journal of Arid Environments* 73(4):542–549.