

ICIMOD

MANUAL

Rangeland resource and use assessment protocol



Copyright © 2019

International Centre for Integrated Mountain Development (ICIMOD)

This work is licensed under a Creative Commons Attribution Non-Commercial, No Derivatives 4.0 International License

<https://creativecommons.org/licenses/by-nc-nd/4.0/>

Note

This publication may be reproduced in whole or in part and in any form for educational or nonprofit purposes without special permission from the copyright holder, provided acknowledgement of the source is made. ICIMOD would appreciate receiving a copy of any publication that uses this publication as a source. No use of this publication may be made for resale or for any other commercial purpose whatsoever without prior permission in writing from ICIMOD.

The views and interpretations in this publication are those of the author(s). They are not attributable to ICIMOD and do not imply the expression of any opinion concerning the legal status of any country, territory, city or area of its authorities, or concerning the delimitation of its frontiers or boundaries, or the endorsement of any product.

This publication is available in electronic form at www.icimod.org/himaldoc.

Published by

International Centre for Integrated Mountain Development
GPO Box 3226, Kathmandu, Nepal

ISBN 978 92 9115 687 0 (electronic)

Production team

Shradha Ghale (Consultant editor)

Samuel Thomas (Senior editor)

Rachana Chettri (Editor)

Dharma R Maharjan (Graphic designer)

Photos:

Abhimanyu Pandey: pp 26-27, 44-45, 77

Alex Treadway: pp 4-5, 19, 25

Arun Shrestha: pp 43

ICIMOD archive: pp iv-v, 20-21

Jitendra Bajracharya: vi-1, 2-3, 78-79

Qobiljon Shokirov: p 80

Srijana Joshi: pp 38-39

Tao Zhang: pp 30-31

Wang Jinniu: pp 6-7, 9, 11(R), 12

Yi Shaoliang: cover, ii-iii

Citation

Joshi, S., Yi, S., Jinniu, W., Pasakhala, B., Ismail, M., Bisht, N., Qamar, F.M., Long, R., Wu, N., Foggin, M., Weikang, Y. Bari, F., Shokirov, Q., Ahmed, A., Essa, M. & Xu, W. (2019). *Rangeland resource and use assessment protocol*, Manual, ICIMOD, Kathmandu

MANUAL

Rangeland resource and use assessment protocol

Authors

Srijana Joshi¹, Yi Shaoliang¹, Wang Jinniu², Binaya Pasakhala¹, Mohammad Ismail¹, Neha Bisht¹, Faisal Mueen Qamar¹, Long Ruijun¹, Wu Ning², Marc Foggin³, Yang Weikang⁴, Faizul Bari⁵, Qobiljon Shokirov³, Ajaz Ahmed⁶, Muhammad Essa⁷, and Xu Wenxuan⁴

¹ International Centre For Integrated Mountain Development

² Chengdu Institute of Biology, Chinese Academy of Sciences, China

³ University of Central Asia, Tajikistan

⁴ Xinjiang Institute of Ecology and Geography, Chinese Academy of Sciences, China

⁵ Food and Agriculture Organization, Pakistan

⁶ Forest Department, Khyber Pakhtunkhwa, Pakistan

⁷ Forest Wildlife and Parks Department, Gilgit-Baltistan, Pakistan

Contents

PAGE iii

Abbreviations and acronyms

PAGE iv

Foreword

PAGE iv

Executive summary

PAGE v

Acknowledgements

PAGE 1-4

Introduction

Rangeland ecosystems in the Hindu Kush Himalayan region supply a range of ecosystem services. Multiple drivers of change have put pressure on HKH rangelands. Therefore, systematic and regular assessments of rangelands are necessary for their sustainable management.

PAGE 5-20

Part I – Rangeland resources survey

Geospatial technologies can be used to map out and determine rangeland area, produce maps of land cover and distribution of rangelands, and areas with high or low productivity. Such maps are useful in selecting sites for field survey.

PAGE 21-26

Part II – Rapid assessment of rangeland use by domestic animals

A large number of domestic livestock graze extensively on rangelands. Pastoral communities use various strategies for rangeland management. This section discusses methods to collect information about domestic livestock as well as local rangeland management practices.

PAGE 27-30

Part III – Rapid assessment of rangeland use by wildlife

Rangelands support a range of wildlife species. This section discusses methods to collect information on the distribution of important wildlife species and map their habitats in rangelands.



PAGE 31-38

Part IV – Rapid assessment of rangeland contribution to household economy

Rangelands contribute to household economies in mountain communities. This section examines the roles of men and women in managing rangeland resources through analyses of the methods used to assess the socioeconomic characteristics of local communities as well as the contributions of rangelands to household economies.

PAGE 39-42

Part V – Rangeland governance and institutions

State and local institutions govern rangelands in the Hindu Kush Himalaya. Understanding governance mechanisms is essential to ensuring equitable sharing of rangeland resources. This section discusses methods to identify formal and informal institutions related to livestock and rangeland management as it seeks to understand their strengths and weaknesses.

PAGE 43-44

References

PAGE 45-78

Annexes

PAGE 79-80

Glossary

Abbreviations and acronyms

GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
HKH	Hindu Kush Himalaya
HKPL	Hindu Kush Karakoram Pamir Landscape
hm²	Square hectometre
ICIMOD	International Centre for Integrated Mountain Development
SBD	Soil bulk density
SIDA	Swedish International Development Cooperation Agency
SWC	Soil water content
TFS	Total Forage Supply

Foreword

Rangeland ecosystems stretch across about 2 million km² of the Hindu Kush Himalaya (HKH), covering nearly 60% of the region. Rangelands in the HKH are multi-functional and provide a wide range of ecosystem services that are important not only to millions of local inhabitants but also to billions of people who live beyond the rangeland areas. Over the past decades, rangelands have faced increased disturbances amid global climate change, which adds uncertainty to predictions of future rangeland conditions. Today's monitoring needs are hence more complex (or multidimensional); yet these needs have to be addressed keeping the costs in mind. ICIMOD is a regional knowledge-based organization with long experience in rangeland resource management. The Centre works for rangeland improvement and conservation of transboundary landscapes in the HKH region with a view to identifying opportunities for the equitable development of people dependent on rangeland ecosystems.

This rangeland protocol has been developed primarily to support ICIMOD's regional partners working in transboundary landscapes (particularly the Hindu Kush Karakoram Pamir Landscape). It has been produced by ICIMOD in collaboration with ICIMOD's partners in the region. The protocol, which includes five main sections, will guide the monitoring of rangeland conditions and wildlife populations.

On behalf of ICIMOD, I would like to thank all the partners, stakeholders, and authors who have contributed to and supported the development of this manual.



David Molden, PhD
Director General, ICIMOD



Executive summary

Rangelands make up the largest ecosystem in the Hindu Kush Himalayan region. They cover about 60% of the total land area of the region and provide a wide range of ecosystem services. This *Rangeland resource assessment protocol* is a standardized protocol for rapidly assessing the quantity, quality, and spatial-temporal distribution of rangeland resources. It can be used to i) collect information on the pattern and dynamics of rangeland uses by domestic animals and wildlife, ii) review national and local policies and institutions governing rangeland resources management, and iii) provide scientific data and evidence to managers for improving practices, readjusting policies, and optimizing ecosystem health. This protocol is applicable to any type of rangeland at any location and can be used to compare different rangeland types.

Acknowledgements

This rangeland resource assessment and use protocol was produced with funding from the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH and the Swedish International Development Cooperation Agency (SIDA). It was developed by the International Centre for Integrated Mountain Development (ICIMOD) and its country partners from China, Pakistan, and Tajikistan through the Hindu Kush Karakoram Pamir Landscape (HKPL) Initiative. The initiative falls under the Regional Transboundary Landscape Programme, which is a joint effort to promote transboundary cooperation among member countries for landscape conservation.

We would like to extend our thanks to all national partner institutions of the HKPL Initiative in China,

Pakistan, and Tajikistan. We are grateful to Zhang Chi (China), Munavvar Alidodov (Tajikistan), and Zafeer Saqib (Pakistan), who offered valuable advice on the proposed methodology.

We would like to thank our reviewers Sanjeev Bhuchar and Abdul Wahid Jasra for their constructive and insightful comments that helped refine the content and structure of the paper.

We gratefully acknowledge the editorial, design and layout team – Samuel Thomas, Rachana Chettri, Shradha Ghale, and Dharma Ratna Maharjan for their editorial inputs and layout of the document.

David Molden, Director General of ICIMOD, and Eklabya Sharma, Deputy Director General, provided continuous support and guidance. ICIMOD colleagues Karma Phuntsho, Janita Gurung, Kamala Gurung, Rajan Kotru, Ghulam Ali, and Farid Ahmad offered input and support for the development of the protocol.



Introduction

Rangeland ecosystems in the Hindu Kush Himalayan region supply a range of ecosystem services. Multiple drivers of change have put pressure on HKH rangelands. Therefore, systematic and regular assessments of rangelands are necessary for their sustainable management.



Background

Rangelands are areas that are not suitable for cultivation because of low and erratic precipitation, rough topography, poor drainage, or cold temperatures, and which provide forage, water, and other resources for free grazing wild and domestic animals (Stoddart et al., 1975). Rangelands mainly include natural grasslands, savannahs, many wetlands, some deserts, tundra, and certain forb and shrub communities. Rangelands are a major ecosystem, and represent nearly 78% of the areas grazed by livestock (Asner et al., 2004; Sidahmed & Rota, 2004).

In the HKH region, rangeland ecosystems cover about 2 million km², or nearly 60% of the total geographical area (Wu et al., 2014). Rangelands in the HKH are multi-functional and provide a wide range of ecosystem services that are important not only to millions of local inhabitants but also to billions of people who live beyond the rangeland areas. Unfortunately, this resource experiences challenges such as climate change, globalization, and land degradation. Under-recognition of rangeland resources, lack of appropriate policies, and mismanagement are the main reasons behind rangeland degradation. Researchers and conservationists have gradually realized the importance of the HKH rangelands. As of now, however, there are not enough studies, policies, and government plans for sustainable use of rangelands (Sharma et al., 2007). ICIMOD is a regional knowledge-

based organization with long experience in rangeland resource management. The Centre promotes rangeland improvement and conservation in the HKH region with a view to identify opportunities for the equitable development of the people dependent on rangeland ecosystems.

Considering their ecological, cultural, social and economic importance, ICIMOD has identified six transboundary landscapes in the region: Hindu Kush Karakoram Pamir Landscape (HKPL), Kailash Sacred Landscape (KSL), Everest Landscape (EL), Kangchenjunga Landscape (KL), the Far Eastern Himalayan Landscape, and the Cherrapunjee-Chittagong Landscape (CCL) (Shakya et al., 2012). This protocol is primarily designed for the Hindu Kush Karakoram Pamir Landscape (HKPL), but it is applicable to other landscapes as well. The HKPL is a regional transboundary initiative that works to enhance cooperation among Afghanistan, China, Pakistan, and Tajikistan for biodiversity conservation and sustainable development in the western Hindu Kush Himalaya. The landscape is known for its snowy peaks, glaciated valleys, high-altitude wetlands, alpine pastures, and globally significant biodiversity. Rangelands form the major ecosystem in the HKPL and the main livelihood base for pastoral and agro-pastoral communities. These rangelands are currently fragmented as a result of infrastructure and unsustainable development. Traditional land use practices have been weakened and the economic situation of local herders has become precarious

(Joshi et al. 2013). In addition, the structure and condition of the vegetation in rangelands is expected to change due to climate variability and increased populations of both humans and livestock (Beg, 2011). In order to track these changes and provide reliable information for decision-makers, we need to systematically record, compare, and monitor key attributes of vegetation and soil. This protocol will help us collect site-based data on vegetation in the rangelands, such as flora species inventories, and soil structure and rangeland use by domestic animals and wildlife. Baseline information on rangelands is necessary for detecting future changes in the rangelands and improving grazing management and other practices.

This protocol outlines types of information to be collected during rangeland surveys; steps to be followed in field measurement; and procedures for social survey and participatory meetings. It contains all the tables, questionnaires, and workshop exercises to be used during surveys. The specific objectives of the protocol are to:

1. Assess the quantity, quality, and spatial-temporal distribution of rangeland resources
2. Collect information on the pattern and dynamics of rangeland use by domestic animals and wildlife
3. Review national and local policies and institutions governing rangeland resource management, and provide scientific data and evidences to managers for improving practices, readjusting policies, and optimizing ecosystem health

Rangelands in the Hindu Kush Himalaya are multi-functional and provide a wide range of ecosystem services that are important not only to millions of local inhabitants but also to billions of people who live beyond the rangeland areas. Unfortunately, rangelands are experiencing many challenges, such as climate change, globalization, and land degradation.



PART I

Rangeland resource survey

Geospatial technologies can be used to map out and determine rangeland area, produce maps of land cover and distribution of rangelands, and areas with high or low productivity. Such maps are useful in selecting sites for field survey.



Rangeland resource survey will collect data and information on rangeland area, geographical distribution, types, productivity, seasonal pastures, carrying capacity, plant nutrients, soil properties, trends of change, etc.

Map preparation

Geospatial technologies will be used to map out and determine rangeland area, produce maps of land cover and distribution of rangelands, and areas with high or low productivity. The map will be useful in selecting sites for field survey.

Field measurements

Field survey/measurements will be carried out to collect information on rangeland plant community:

- Community species composition (line-point transect method)
- Frequency and density of species
- Dominant species (3–5 species)
- Height of dominant species
- Foliar cover and basal cover of dominant species (5 individuals of each species)
- Aboveground biomass of dominant species
- Community cover
- Community height

- Aboveground biomass of community (dominant species + remaining live plants)
- Forage productivity (green biomass + litter)

Note: Soil and plant biomass samples will be collected from the same plots and quadrats and taken for lab analysis.

Main steps for field measurement

Step 1. Select sites

Institutions conducting the assessment will work together to determine the types of rangelands for the field survey, the number of sites to be surveyed in each the institution type of rangeland, and the geographical location for the survey.

Based on GIS mapping and the preliminary survey (literature review, field visit, consultations with experts and local communities), it is recommended that rangelands in the area be classified into maximum 5–6 types. Thermal and moisture conditions, dominant vegetation species, and the height and cover of the vegetation are some of the indicators for classification of rangelands. Later, a maximum of three major types of rangeland can be selected ensuring that all types are adequately covered by the field survey.

For each type, 5–6 sites should be selected for field

measurements; this means 40–50 sites should be measured for the whole landscape (three countries). For each country, 15–18 sites from all 3 types should be selected for measurements. Ideally, the chosen site should be undisturbed or only lightly grazed. However, it is very difficult to find fields that have not been grazed as disturbances always exist. Therefore, as a rule of thumb, the sites selected for field measurements should be lightly grazed and can be finalized with support from local experts and GIS technologies.

Step 2. Collect background information on the site

It is important to observe, measure, and provide basic information on the natural characteristics of pastures/rangelands. These include the site information record, which can provide basic background information on the natural environment and use of the rangeland (Table 1.1). See annex 1.

- Collect information on the geographical location of the pasture/rangeland: latitude and longitude as well as administrative district and landscape characterizations (mountain, basin and valley); altitude and slope orientation and gradients
- Collect information on climatic parameters:
 1. Temperature (mean monthly temperature, highest and lowest temperature, mean annual temperature)

2. Precipitation (monthly and annual precipitation), illumination, relative humidity, absolute humidity, evapotranspiration $\geq 10^{\circ}\text{C}$ accumulated temperature
3. Date of early frost and late frost as well as the number of frostless days, snow dates and snow depth, depth of frozen soil
4. Greening and withering dates of rangelands
5. Maximum rainfall month and driest month; the month with the most rainfall; the driest month
6. Snowfall dates of winter pasture, date of mountain sealing, cumulated snow depth and melting time. Snowfall time of winter pasture and the time of mountain seal; snow depth of winter pasture and melting time.

Step 3. Take a photo/photos of the landscape

Take photos of the landscape at each site to monitor future changes in vegetation over time. Number each photograph and write down its details (GPS location, direction/angle, site name) Figure 1.

FIGURE 1 TAKE PHOTOS OF THE LANDSCAPE AT EACH SITE



Step 4. Determine dominant species

- Local rangeland experts can be consulted for the identification of dominant species in the selected sites. In that case, a single transect will be adequate for sampling.
- If there are no local rangeland experts, three transect lines should be laid out following the line-point hit method to determine the dominant species by frequency, cover and biomass (see Buckland et al., 1993).

TABLE 1.1 SAMPLE SITE INFORMATION SHEET

Name of observer: _____ **Date:** _____

Study site: _____ Rangeland type: _____

GPS location: _____

Altitude: _____

Mean annual precipitation: _____

Maximum rainfall month: _____

Mean annual temperature: _____

Current growing condition: Good Medium Bad

Soil type: Sand Silt Clay Loam

Frost date: _____

Early Frost Week/Month: _____

Late Frost Week/Month: _____

Snowfall dates: _____

Snow maximum depth: _____

Phenology

Greening date _____

Withering date _____

Grazing system** _____

* Grazing system includes rotational and continuous

** Rangeland types: alpine meadow; alpine steppe; alpine desert; sub alpine meadow; sub alpine steppe; sub alpine desert

- The transect line may be selected either systematically or randomly. Similarly, the number and frequency of hits along the transect line will be recorded.

1. Make visual observation and judgement to determine the dominant species.
2. Record the frequency and cover of species, which is represented by the “hit” (3 transects, use a 2 m string with ca. 1 mm diameter or a measuring tape), line-point method (also see Figure 2), place a needle at every 5 cm distance, Points = Examination of many points on a site to estimate the proportion of “hits” or occurrences for a plant species) and biomass (cut all “hit” plant species, and choose the top five most frequently hit to measure their masses).
3. Sort out dominant species with greater frequency and cover (Table 1.2). See annex 2.

Step 5. Locate the plots (3) and quadrats (15) for community survey

- At each site, at least three plots measuring 10 m x 10 m should be established.
- The plots should be laid parallel to each other, with at least 20 m space between them.
- Within each plot, five quadrats measuring 1 m x 1 m can be laid diagonally (totalling 15 quadrats in each site).
- The distance between the quadrats should be 3 m. The layout of the plots and quadrats is shown in Figure 3.

Step 6. Measure the community height and cover within each quadrat

FIGURE 3 PLOTS AND QUADRATS OF PLANT COMMUNITY COMPOSITION SURVEY IN THE FIELD

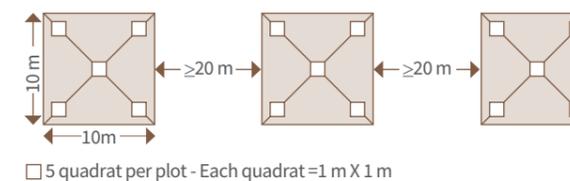


FIGURE 4 TAKE A PHOTO OF EACH QUADRAT AND WRITE DOWN ITS DETAILS



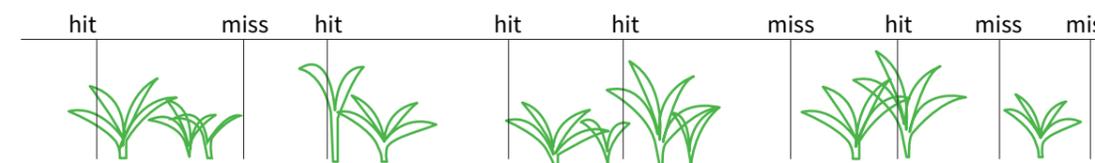
- Within each 1 m x 1 m quadrat, measure and record the community height and cover as shown in Table 1.3. See annex 3.

Note: Before measurement, take a photograph of each quadrat and number the photo properly (name the photos of each quadrat, country + site name + plot_# + quadrat_#) Figure 4.

Height: A steel ruler (1–1.5 m long) can be used to

FIGURE 2 SCHEMATIC DIAGRAM OF THE LINE-POINT HIT METHOD ALONG WITH THE TRANSECT

Transect line



% cover = number of points = 5/9 = 55.6%

Source: Elzinga et al., 1998

TABLE 1.2 DETERMINATION OF DOMINANT SPECIES BASED ON “HIT”

Point	Transect 1			Transect 2			Transect 3		
	Hit (Y/N)	Species	Cover (%)	Hit (Y/N)	Species	Cover (%)	Hit (Y/N)	Species	Cover (%)
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									

Source: Herrick et al. (2009)

TABLE 1.3 COMMUNITY INFORMATION FOR EACH SITE (CONSISTS OF 3 PLOTS WITH 15 QUADRATS)

Name of site:		Plot no.:		Quadrat no.:		
Community cover (%)	Name of species	Average height (m)	Aboveground biomass			
			Fresh mass (g)	Air-dry mass (g)	Oven-dry mass (g)	
	Dominant species #1					
	Dominant species #2					
	Dominant species #3					
	Dominant species #4					
	Dominant species #5					
	Other living plant					
	Plant litter					

measure the height of the community, taking three readings at different points in each quadrat (Table 1.3). Measure the natural growing height of the plants without stretching them.

Overall cover: For the sake of convenience in this study, the overall vegetal cover of the rangelands shall be estimated through visual judgement (eye observation), using percentage ground cover, by experts.

Step 7. Measure the foliar cover, basal area and height of the dominant species

Within each quadrat, for each dominant species, five individuals will be randomly selected to measure the foliar cover, basal cover and height. The results will be recorded in Table 1.4.

The following methods are recommended:

- **Foliar cover:** Estimate foliar cover of plants in the quadrat using the line-point method as shown in Figure 4. Record the estimate as % of the total area.
- **Basal cover:** It refers to the proportion of the plant extending into the soil. To estimate basal cover, cut the aboveground part of each individual and

FIGURE 5 DIAGRAMMATIC PRESENTATION OF FOLIAR COVER (LEFT) AND BASAL COVER (RIGHT)



Source: Launchbaugh, 2012

measure and record the diameter of the stump in Table 1.4. See Figure 5.

- **Height of dominant species:**
 1. Use the steel ruler to measure the height of the cut individuals of the dominant species. The plant sample should be measured without stretching it.
 2. Record the results in Table 1.4.
 3. Put five cut individuals of each species in paper bags (one individual in one bag) to measure the oven-dry mass of each individual. Make sure the bags are numbered/labelled correctly so that the information corresponds to Table 1.4. See annex 5.

Step 8. Collect samples for biomass and plant nutrient measurements

- For grasslands, within each 1 m x 1 m quadrat, cut the aboveground part of all plants in the quadrat.
- Separate the dominant species from other live plants.
- Collect all the visible litters within each quadrat. Weigh the fresh mass of each sample.
- For each quadrat, there will be one sample for each dominant species, one sample for the remaining live plants, and one sample for litter, totalling 5–7 samples (See Figure 6).
- After weighing, enter the weight into Table 1–3 and put the weighed sample into a numbered/labelled paper bag.
- Make sure the numbers/labels on the bags correspond to the ones in the table.

FIGURE 6 COMMUNITY COMPOSITION WITH DOMINANT SPECIES, OTHER LIVE PLANTS, AND LITTER SORTED



TABLE 1.5 CARBON AND NITROGEN CONTENT OF TOP THREE DOMINANT SPECIES, OTHER LIVING PLANTS AND LITTER

Plot No.	Name of species	C content	N content	C:N
1	Dominant species #1			
	Dominant species #2			
	Dominant species #3			
	Other living plants			
	Litter			
2	Dominant species #1			
	Dominant species #2			
	Dominant species #3			
	Other living plants			
	Litter			
3	Dominant species #1			
	Dominant species #2			
	Dominant species #3			
	Other living plants			
	Litter			

Step 12. Analyse soil properties

Samples collected from the field will be treated for measuring the SMC, SBD (Ring-cut samples), and total C, N and P (mixed soil samples). Please see Step 9 on soil sample collection.

FOR MEASURING SOIL MOISTURE CONTENT (SMC) AND SOIL BULK DENSITY (SBD) (RING-CUTTING SAMPLES):

- Transfer samples from the Ziploc bags into an aluminium box.
- Measure the wet weight and enter it into Table 1.6. Annex 6.
- Oven-dry at 80°C for 48 hours, weigh and record the results.

$$SMC \% = \frac{\text{Weight of moist soil (M)} - \text{Weight of dry soil (D)}}{\text{Weight of dry soil (D)}}$$

$$SBD \% = \frac{\text{Weight of moist soil (g)}}{\text{Volume of dry (cm}^3\text{)}}$$

FOR MEASURING THE TOTAL C, N, AND P (MIXED SOIL SAMPLES FROM THE FIELD):

- Air-dry the samples on plastic sheets for 24 hours.
- Sieve the samples using a mesh with 2 mm diameter.
- Take samples (2–3 g for each sample).
- Measure the C and N through dry combustion using the standard method (Kjedahl, 1883; Walker and Black, 1934).
- The total P in soils should be estimated by extraction with 0.5 M sodium hydroxide sodium carbonate solution (Olsen and Sommers, 1982).
- Enter data into Table 1.6.

D) CARRYING CAPACITY CALCULATION

There are many definitions of ‘carrying capacity’. Various methods can be used to determine carrying capacity. In this manual, ‘carrying capacity’ is discussed only in relation to rangeland management and use. The manual adopts the terminologies and methodologies used by the Ministry of Agriculture, China.

Some terminologies

Carrying capacity: The carrying capacity of a rangeland area can be defined as the number of grazing animals (often sheep units) that the rangeland can support in a given period. It can be further divided into theoretical/proper carrying capacity and standing/actual carrying capacity.

Theoretical carrying capacity: This concept involves the following:

1. The number of animals that can be supported by rangelands through adequate grazing
2. Grazing does not affect the ability of the rangeland to maintain its ecological functions and to continuously produce forage.
3. Animals using the rangeland should get enough food to maintain their normal growth, reproduction, and production of dairy products.

Theoretical carrying capacity can be expressed by animal unit (sheep unit./hm².day), time unit (sheep unit. day/hm²) or grassland area unit (hm²/sheep unit. day).

Standing carrying capacity: The actual number of animals using the rangelands.

In calculating carrying capacity, the following factors need to be considered:

Available area of rangeland (hm²): The actual area of rangelands that can be effectively used by animals for grazing. This means the area of rangelands deducted by the area of settlements, roads, water bodies, farming lands, forest, bare lands, etc. as well as rangelands where animals don’t graze.

Forage yield (kg/hm²): The per unit area production of above-ground forage including herb layers and young leaves of shrubs and trees. In the HKPL, young leaves of shrubs and trees can be ignored.

Forage supply (kg): The amount of forage that an area or pasture can yield. It can be easily obtained by multiplying the forage yield with the total area of the pasture.

Regrowth rate of forage (%): At peak of the rangeland’s growth season, the rangeland will continue to produce forage even when animals graze on it. The ratio of this new growth of forage to the quantity of the forage at its peak season (at the time being used by the animals) is called the regrowth rate of forage. The regrowth

TABLE 1.6 PHYSICAL-CHEMICAL PROPERTIES OF SOIL SAMPLES AT EACH SITE

Plot #	Quadrat #	Wet weight (g)	Oven dried (g)	SMC (%)	SBD (g cm ⁻³)	TC (%)	TN (%)	TP (%)
1	1							
	2							
	3							
	4							
	5							
2	1							
	2							
	3							
	4							
	5							
3	1							
	2							
	3							
	4							
	5							

rate of forage greatly varies across types of rangelands and grasslands. In the tropical area, the regrowth rate can be very high. For the HKPL area, most of the rangelands belong to temperate deserts/steppe, cold temperate and rigid rangelands with a regrowth rate of only 0–5%. Another type of less extensive but important rangeland in the HKPL is temperate meadow, which can have a higher regrowth rate of 10–15%.

Annual variation rate of forage yield (%): The forage yield varies greatly according to annual rainfall, especially in arid areas. Variability depends on the ecological zone or type of rangeland, with the highest variability occurring in arid areas. If forage during a year of normal (multiple-year average) rainfall is used as a reference, forage yield in a given year can be readjusted using an annual variation rate of forage yield.

Based on China’s experience, the following rate of adjustment can be used to determine the actual rate of forage yield for our survey in the HKPL:

Rangeland type	Annual variation rate of forage yield (%)	
	Years with rainfall larger than 25% of multi-year average	Years with rainfall less than 75% of multi-year average
Desert/steppe rangelands	135	55
Temperate meadow (e.g., sage grass meadow in wet areas)	115	80

Rangeland utilization rate (%): For a natural rangeland, only a fraction of the total forage yield should be used by animals. Rangeland utilization rate (the percentage of the total forage yield consumed by animals) is related to a few factors: type of rangeland, season of use and the health of the rangeland. Based on criteria set by China, the following rangeland utilization rates are recommended for calculating the carrying capacity of the rangelands:

Rangeland type	Warm season grazing	Spring and autumn grazing	Winter grazing	Year-round grazing
Temperate meadow	50–60	30–40	60–70	50–55
Temperate and cold desert/steppe rangeland	20–30	15–25	20–30	20–30

For degraded rangelands, the utilization rate should be lower than those in the above table according to the degree of degradation.

Standard dry grass factor: This factor is introduced to account for the difference in forage quality and quantity among different types of rangelands. In the HKPL, we recommend 1.00–1.05 for sage/grass meadow and 0.85–0.95 for non-grass temperate rangeland.

CALCULATION OF THE FORAGE YIELD OF A GIVEN PASTURE

The first step for determining the carrying capacity of rangelands is to calculate the forage yield of a given pasture or all the pastures, taking into account factors such as available area, forage yield, regrowth rate, utilization rate, annual variation rate, standard dry grass factor and the seasonality of use. Most of the pastures are used seasonally – for example, some are used in spring and autumn, some in winter, some only in summer (like some alpine pastures), and others are used all year round. The forage yield of such pastures will thus be calculated differently and separately. For example, for those used in the warm season, we may need to consider the regrowth rate. But for those used only in wintertime, the regrowth rate needs to be taken into account.

1) Forage yield of warm season grazing pastures and spring + autumn grazing pastures:

$$Y_w = Y_{wm} \times (1 + Gr) \times Df / Ry \dots \dots \dots (1)$$

Where

Y_w = Forage yield (in kg/hm²) in warm season or spring+autumn grazing pastures;

Y_{wm} = Standing dry forage (14% moisture) (in kg/hm²) measured in the growing season.

*if possible, the average of three measurements – taken at the start of the growing season (when all are green), in the middle of the season (peak yield) and at the end of the season (yellow) – should be used. If due to remoteness three measurements are not possible, measurement can be taken at the peak season but with monthly adjustments to get the average.

Gr = Regrowth rate in % (see above)

Df = Standard dry grass factor

Ry = Annual variation rate in % (see above)

2) Forage yield of winter grazing pastures

$$Y_w = Y_{cm} * D_f/R_y \text{ (no regrowth rate) (2)}$$

Where

Y_w = Forage yield in winter season (yellow grass) pastures in kg/hm²;

Y_{cm} = Standing dry forage (14% moisture) measured at the winter season in kg/hm² (average of three measurements, if possible, each at the beginning, middle and end of the season)

D_f = Standard dry grass factor

R_y = Annual variation rate in % (see above)

3) Forage yield of year-round grazing pastures

$$Y_y = Y_{ym} * (1 + Gr) * D_f/R_y \text{ (3)}$$

Where

Y_y = Forage yield in year-round grazing pasture in kg/hm²;

Y_{ym} = Measured standing dry forage (14% moisture) in kg/hm²; if possible, four measurements should be taken (in the middle of spring, summer, autumn and winter) and the average should be used.

Gr = Regrowth rate in % (see above)

D_f = Standard dry grass factor

R_y = Annual variation rate in % (see above)

The total forage supply of the pasture can thus be easily obtained by multiplying per unit area forage yield and the total area of the pasture:

Forage supply (FS) = Forage yield (kg/hm²) * Area of pasture

If many pastures (grazing area of rangelands) are used for the same season, then the total forage supply for the given season would be the sum of forage supply from all the pastures.

Total forage supply (TFS) of a season = $\sum_1^n \text{Forage supply of each pasture}$

Where n is the number of pastures used in the same season (warm season, spring-autumn season or winter season).

CALCULATION OF THE THEORETICAL CARRYING CAPACITY OF RANGELANDS

The theoretical carrying capacity of rangelands can be determined through the unit-area forage yield (kg/hm²), the total area of available/utilizable rangelands (hm²), forage utilization rate (%), daily intake of animals (1.8 kg dry grass per sheep unit) and the number of days of grazing needed.

1) Per unit area theoretical carrying capacity (sheep unit/hm²) of a pasture

$$A_{us} = Y_w * E_w * D_{fw}/I_{us} * D_w$$

Where

A_{us} = Number of animals (sheep unit) that can be supported by a seasonal or year-round pasture (sheep unit)

Y_w = Forage yield of the pasture (kg/hm²)

E_w = Forage utilization rate (%)

D_{fw} = Standard dry grass factor

I_{us} = Daily intake of one sheep unit (1.8 kg standard dry grass)

D_w = Number of days of grazing on the concerned pasture (days)

2) Total number of animals that can be supported by a pasture

This can be easily obtained by multiplying per unit area carrying capacity (sheep unit/hm²) and the total area of the pasture:

$$= A_{us} \text{ (sheep unit/hm}^2\text{)} * A \text{ (hm}^2\text{)}$$

3) Total theoretical carrying capacity (in sheep unit) in a seasonal pasture

Total number of animals that can be supported by all the pastures in a given season = Total forage supply of the season (of all the pastures)/daily intake (1.8kg/sheep unit/day) * number of days of use

For example, for winter months:

Total number of animals (sheep unit) that can be supported by all the winter pastures = total forage supply from all the pastures divided by daily intake and the number of days of winter grazing;

The total number of animals that can be supported by different seasonal pastures¹ can be calculated in the above manner.

It should be noted that in the HKPL and other areas with very limited cut-and-carry fodder, the total number of days of animal grazing in different seasonal pastures should be 365 days.

3) Yearly total theoretical carrying capacity within a region (or total number of animals that can be supported by all the forage supply from a region):

$$\text{Total rangeland carrying capacity of a region (in sheep unit)} = \frac{N_w * D_w + N_s * D_s + N_c * D_c + N_y}{365}$$

Where

N_w = Number of animals that can be supported by warm season pastures (sheep unit)

D_w = Number of days of grazing on warm season pastures (days)

N_s = Number of animals that can be supported by spring plus autumn season pastures (sheep unit)

D_s = Number of days of grazing on spring plus autumn season pastures (days)

N_c = Number of animals that can be supported by winter pastures (sheep unit)

D_c = Number of days of grazing on winter season pastures (days)

N_y = Number of animals that can be supported by year-round pastures (sheep unit)



¹ Winter and summer pastures



PART II

Rapid assessment of rangeland use by domestic animals

A large number of domestic livestock graze extensively on rangelands. Pastoral communities use various strategies for rangeland management. This section discusses methods to collect information about domestic livestock as well as local rangeland management practices.

Globally, rangelands supply more than 70% of forage consumed by livestock (Lund, 2007). Different types of domestic livestock graze extensively on the rangelands of the HKH region (Ning et al., 2013). Traditionally, the pastoral communities in the region have been managing rangelands using various strategies such as manipulating the type and number of livestock and migrating to different pastures to take advantage of spatial variability (Miller and Craig, 1997). Information on the number of domestic livestock that use the pastures, migratory cycles and dominant vegetation in the pastures, etc. will be useful for developing effective rangeland management plans.

The objective of the rapid assessment is to identify and collect information about major pastures (grazing areas) used by villagers' livestock and to prepare a map showing those pastures and the migratory route of herders.

A group discussion should be organized to collect the necessary information. Tables 2.1 and 2.2 (See Annexes 7 and 8) are designed to collect information about pastures. During the discussion, participants map pastures and the migratory route of herders (Exercise 2.1).

Variable (standard unit)	Local unit	Conversion factor
Area (in hectare)		
Length and Distance (in metre, kilometre)		
Currency (in US dollar)		
Weight (in gram, kilogram)		

Exercise 2.1: Participatory mapping of major pastures and migration routes of herding communities

Objective: To map and collect information on major pastures/grazing areas of the landscape and the migrating route of the herding communities.

Expected outputs: 1) maps of major pastures and migration route; 2) information about major pastures and stopover points (e.g., market, vegetation, water points – streams, springs, ponds) along the migration route.

Participants: Each discussion should be attended by 10–15 key informants – local senior herders, and staffs of relevant governmental and non-governmental organizations.

Time: 1–2 days in each study area.

Preparation needed:

1. Conduct a scoping analysis of the survey area.
2. Develop a work plan.
3. Develop and print maps covering the target area (town or village cluster; rangeland and forests). Online maps can be used if there is internet and electricity connection. The scale of the maps should be large enough so that participants can see the features clearly.
4. Materials needed: Laptop, markers, pins, flipcharts, cards, etc.
5. Make logistical arrangements: Meeting venue, transportation, etc.
6. Print out workshop materials, including Table 2.1, Table 2.2, Table 2.3.

Workshop steps

Step 1: Explain the workshop's objectives and expected outputs to the participants.

Step 2: Explain the process of mapping the pastures using printed maps or online maps (Google Earth or Tianditu). Printed or online maps should be large enough for the participants to see their features clearly.

Step 3: Guide the participants to pinpoint all the pastures and mark them on the printed or online map.

Note: If local communities use different pastures or stopover points under exceptional circumstances such as drought, it is important to pinpoint them on the map. If there are too many pastures and stopover points or a different migratory route is used under exceptional circumstances, then it is advisable to prepare a separate map.

Step 4: Collect information about each pasture and stopover points along the migration route, including those used under exceptional circumstances, as shown in Table 2.2 and Table 2.3 (See Annex 9).

TABLE 2.2 FORMAT FOR COLLECTING INFORMATION ON PASTURE

Date of survey:		Location:					
1. General information of pasture							
1.1 Name							
1.2 Location (GPS coordinates)							
1.3 Elevation range (m)							
1.4 Total area (ha)							
1.5 Uses of pasture (please tick) <input type="checkbox"/> Fodder <input type="checkbox"/> Fuelwood <input type="checkbox"/> Timber <input type="checkbox"/> Medicinal plants <input type="checkbox"/> Edible fruits <input type="checkbox"/> Edible vegetables <input type="checkbox"/> Other (specify)							
2. Dominant vegetation							
3. Name of villages using the pasture		Number of households	Number of animals using pasture				
			Goat	Sheep	Yak	Camel	Other (specify)
3.1							
3.2							
3.3							
3.4							
3.5							
4. Month of arrival							
5. Month of departure							
6. Months of use							
7. Issues related to pasture use and management							

TABLE 2.3 FORMAT FOR COLLECTING INFORMATION ON STOPOVER POINTS ALONG THE MIGRATION ROUTE

Date of survey:	Location:	Year of use:				
1. General information of the village using the migration route						
Village/settlement						
Latitude						
Longitude						
Elevation range (m)						
2. Information about animals	Goat	Sheep	Yak	Camel	Otgher (specify)	Other (specify)
Breed of animals						
Number of animals						
3. Information of stopover points						
Stopover points location/name (Latitude, longitude and elevation)	Month of 1 st use	Duration of stay (days)	Month of 2 nd use	Duration of stay (days)	Dominant vegetation	Other information
a.						
b.						
c.						
d.						
e.						
f.						
g.						

- Step 5:** Take photos of the maps/migration pattern drawn during the discussion.
- Step 6:** Summarize workshop findings.
- Note:** Tables 2.2 and 2.3 should be created in Excel. Surveyors are advised to fill in all the information in Excel sheets. A Word format of the table is presented below for reference.

Explanatory notes for interviewer and facilitator

- Area, distance, and time can be measured in local units but their factor of conversion to standard units should be provided according to Table 2.1.
- Table 2.2 is for collecting information of only one pasture. If communities use multiple pastures, then the facilitator has to enter the information of each pasture into a separate table.
- In Table 2.2 subsection 1.2, delineate the area of the pasture using maps and provide the latitude and longitude of each corner. Google Earth can be used if there is internet, or else the area can be delineated on a paper map and the map has to be digitized later.
- In Table 2.2 subsection 1.5, tick appropriate option for uses of pasture, and also specify 'Other' uses.
- In Table 2.2 section 2, mention the local or botanical names of dominant vegetation in the pasture. If only local names are known, then consult a local botanist or expert to know their botanical names.
- In Table 2.2 section 3 column 7, specify 'Other' domestic animals and provide their numbers in different villages.
- In Table 2.2 section 4, mention the months when herders suse the pasture for the first time in a given year. In Section 5, mention when herders move out from pasture.
- In Table 2.2 section 6, mention the months when local communities use the pasture.
- In Table 2.2 section 7, mention the issues related to the use and management of the pasture. Such issues can include harvesting resources, grazing animals, resource sharing between communities, technical inputs and activities relating to pasture conservation, etc.
- Table 2.3 is for collecting information about stopover points along the herders' migration route to different pastures.

- In Table 2.3 section 2 column 6 and 7, specify 'Other' domestic animals using the migration route.
- In Table 2.3 section 2 column 1, provide the name and latitude and longitude of the point where herders stay overnight during their migration. The points can be located using paper maps or Google Earth if there's internet.
- In Table 2.3 section 3 column 2, mention the month when the herder stays at the stopover point for the first time. In column 4, mention the month when the herder stays at the stopover point for the second time during his/her return from the pasture. If the herder uses a different route on the return journey, the column will be blank.
- In Table 2.3 section 3 column 6, mention about dominant vegetation at the stopover point.
- In Table 2.3 section 3 column 7, provide other details about grazing or camping at stopover points. These may include whether the stopover point is used in normal or exceptional circumstances, availability of fuelwood, forage and water sources (streams, springs, lakes, and ponds), conflicts with nearby local communities, human-wildlife conflicts, etc.





PART III

Rapid assessment of rangeland use by wildlife

Rangelands support a range of wildlife species. This section discusses methods to collect information on the distribution of important wildlife species and map their habitats in rangelands.

Rangelands are habitats for a wide range of wildlife species, including threatened species (Kie & Thomas, 1988). Besides other objectives, rangeland use practices are aimed at managing the livestock-wildlife interface; thus the use practices will have consequences for wildlife, particularly herbivores. Identifying and collecting information about wildlife species that inhabit the pastures will be useful for developing wildlife management plans and for further research.

The objective of the rapid assessment is to collect information on the distribution of important wildlife species and map their habitats in the landscape. In addition, information on the nature of conflicts between wild and domestic animals will also be collected.

A group discussion will be conducted to collect information on the presence of wild animals in the landscape. A participatory mapping exercise (Exercise 3.1) is recommended for identifying the areas inhabited by the wild animals.

Exercise 3.1: Participatory mapping of major areas inhabited by wildlife

objectives: To map and collect information on the areas of distribution of important wildlife using the rangeland in the landscape.

Expected outputs: 1) maps of major areas inhabited by wildlife; 2) information on the population of the animals and their characteristics; 3) issues relating to wildlife conservation

Participants: In the group discussion, the participants can include local senior herders, hunters, wildlife experts and local communities with knowledge about wildlife in the landscape, staffs of protected areas and other relevant governmental and non-governmental organizations.

Time: 1–2 days in each working area

Preparation needed:

1. Do a scoping analysis of the survey area.
2. Develop a work plan.
3. Develop and print maps covering the target area (town or village cluster; rangeland and forests). Online maps can be used if there's access to the internet and electricity connection. The scale of the maps should be large enough so that participants can see the features clearly.

4. Materials needed: laptop, markers, pins, flipcharts, cards, etc.
5. Make logistical arrangements: meeting venue, transportation, etc.
6. Print out workshop materials, including Table 3.1.

Workshop steps

- Step 1:** Explain the objectives, expected outputs and rules of the workshop to the participants.
Note: This group discussion can be combined with Part II, provided the participants such as hunters, wildlife experts and staffs of protected areas participate in the discussion.
- Step 2:** Show the participants the printed map(s) and discuss key topographic features on the maps to familiarize them with the map(s); and/or
- Step 3:** Display an online map (Google Earth or Tianditu) of the area and discuss key topographic features of the landscape to familiarize the participants with the maps.
- Step 4:** Collect necessary information about the valleys used by wildlife, as shown in Table 3.1 (See Annex 10).
- Step 5:** Take photos of the maps/migration pattern that participants have drawn during the discussion session.
- Step 6:** Summarize workshop findings.

Explanatory notes to facilitator

- Table 3.1 section 1, provide information about the valley to be discussed with the group later. If there is more than one valley, use a separate table to collect the information.
- Table 3.1 section 2, provide details on wildlife species.
- Table 3.1 section 2 column 5, state 'yes' or 'no' depending on whether there are conflicts between local communities/herders/domestic animals and wild animals.
- Table 3.1 section 3, describe the nature of the conflict, which may be due to competition for forage, depredation of domestic animals by wild animals, transfer diseases and killing of wild animals by local communities and herders.
- Table 3.1 section 4, describe conflict mitigating strategies, if any, adopted by the local communities, herders and other stakeholders. Also mention whether or not those strategies have been effective in mitigating the conflicts.

TABLE 3.1 FORMAT FOR COLLECTING INFORMATION ON MAJOR VALLEYS USED BY WILDLIFE

Date of survey:

Location:

1. General information of valley					
1.1 Name					
1.2 Longitude		1.4. Elevation (range)			
1.3 Latitude		1.5. Total area (ha.)			
2. Description of human settlement in the valley					
2.1 Number of settlements					
2.2 Total population					
2.3 Estimated population of domestic animals using the pasture	Goat	Sheep	Yak	Camel	Others (specify)
3. Wildlife and their estimated population					
Wild animals	Presence (yes/no)	Estimated population	Forage/prey species	Conflicts with domestic animals (yes/no)	
3.1 Wild species:					
3.1.1 Spring					
3.1.2 Summer					
3.1.3 Autumn					
3.1.4 Winter					
3.2 Wild species:					
3.2.1 Spring					
3.2.2 Summer					
3.2.3 Autumn					
3.2.4 Winter					
3.3 Wild species:					
3.3.1 Spring					
3.3.2 Summer					
3.3.3 Autumn					
3.3.4 Winter					
4. Describe the nature of conflicts, if any, between wild and domestic animals					
5. Describe the conflict management strategy, if any, adopted by communities					



PART IV

Rapid assessment of rangeland contribution to household economy

Rangelands contribute to household economies in mountain communities. This section examines the roles of men and women in managing rangeland resources through analyses of the methods used to assess the socioeconomic characteristics of local communities as well as the contributions of rangelands to household economies.

Rangelands play a critical role in the economic development of the HKH region (Miller and Craig, 1997). They provide forage and water for domestic livestock of the pastoral communities. Livestock and their products such as milk, wool and hides are important income sources for mountain communities. In addition, rangelands supply fuelwood, medicinal plants, edible fruits and vegetables and many other resources, which directly support the livelihoods of mountain communities. They also provide cultural and recreational values that support the local mountain economy in the HKH region (Ning et al., 2016).

A rapid assessment of the socioeconomic characteristics of pastoral communities, livestock population, household income sources, rangeland use pattern and challenges will help us understand the dependency of local communities on rangelands. Such information is necessary for developing plans for better management of rangelands and for improving the livelihoods of pastoral communities. The assessment comprises a group discussion and a survey that uses a structured questionnaire (See Annex 11).

Exercise 4.1: Group discussion

Objectives: To collect information on local livelihood strategies, rangeland management practices

Expected outputs:

Participants: Each discussion should be attended by 10–15 key informants, particularly women, men, elders and youth members of rangeland dependent communities, local senior herders, hunters, staffs of protected areas and relevant governmental and non-governmental organizations.

Time: 1–2 days in each study area

Group discussion steps

Step 1: Build a team.

Step 2: In consultation with local partners, select a village and develop a work plan.

Step 3: Collect secondary information about the village:

- Number of households and total population of the village
- Major income sources of households in the village
- Number of livestock in the past 10 years at the village level

Step 4: Travel to the field.

Step 5: Organize group discussions with local communities.

Step 6: Explain the objectives of the group discussion and collect information according to Table 4.1 and 4.2.

Step 7: Present group work followed by a discussion.

Step 8: Summarize workshop findings.

Step 9: Visit a few selected pastures and record the conditions of the pastures (optional).

Explanatory notes for interviewer and facilitator

- Table 4.1 section 1, 2 and 3 – provide the name, total population and number of households of the village where the group discussion will be conducted (See Annex 12).
- Table 4.1 section 4 – provide information on the types of animals raised in the village.
- Table 4.1 section 5 – provide information on income sources of people in the village. The income sources are classified into two groups:
 1. Rangeland based income sources include income generated from rangeland services such as selling of fodder, fuelwood and edible, medicinal and other plants collected from rangelands. They also include income from selling of livestock and livestock products.
 2. Non-rangeland based income sources include income from agriculture and non-farm based sources such as salary, pension, wages.
- Table 4.1 section 6 column 2 – list major rangeland based income sources in the village. Add more rows, if necessary, to list out rangeland based income sources. Column 3 shows the level of dependency classified into three categories:
 1. **High:** >65% of total income comes from rangeland based income sources;
 2. **Medium:** >35% & <65% of total income comes from rangeland based income sources;
 3. **Low:** <35% of total income comes from rangeland based income sources
- Table 4.1 section 6 column 4 – mention the estimated proportion of the village population having different degrees of dependency on rangeland based income source. The proportion of the population for each income source should add up to 100%.

TABLE 4.1 FORMAT FOR COLLECTING INFORMATION ON THE CONTRIBUTION OF RANGELANDS IN HOUSEHOLD ECONOMY

Date of survey:		Location:	
1. Name of village			
2. Total population			
3. Number of households			
4. Types of animals raised			
5. Income sources of the population	Rangeland based income sources (includes livestock and their products)		
	Non-rangeland based income sources		
6. Degree of dependency of population on rangeland based income sources	Rangeland based income sources (includes livestock and their products)	Level of dependency	Number of participants (number total participants)
	[Level of dependency]		
<i>High:</i> >65% of total income comes from rangeland based income sources;	1.	High	
<i>Medium:</i> >35% and <65% of total income comes from rangeland based income sources;		Medium	
<i>Low:</i> <35% of total income comes from rangeland based income sources		Low	
2.		High	
		Medium	
		Low	
3.		High	
		Medium	
		Low	
4.		High	
		Medium	
		Low	
7. Market price of livestock products	Rangeland products (includes livestock and their products)	Price per unit	
<i>Note:</i> Price and unit can be local; facilitator needs to confirm their conversion factor with USD and standard unit	a.		
	b.		
	c.		
	d.		
	e.		
	f.		
	g.		
8. Name of market			
9. Distance between market and village			
10. Challenges for production and selling rangeland products (includes livestock and their products)			
11. Opportunities for production and selling rangeland products (includes livestock and their products)			

TABLE 4.2 FORMAT FOR COLLECTING INFORMATION ON GENDER ROLES IN LIVESTOCK AND RANGELAND MANAGEMENT

Date of survey:		Location:			
1. Name of village					
2. Population	Social groups	Number of men		Number of women	
	Ethnic group				
	Non-ethnic group				
3. Labour division in livestock and rangeland management	Activity	Who? (Man or woman/ Both)		Hours/day	
	a.				
	b.				
	c.				
	d.				
	e.				
	f.				
	g.				
	h.				
	i.				
	j.				
4. Decision making power [Degree of power]	Activity	Degree of power of women			
	a. Livestock selection	High <input type="checkbox"/>	Medium <input type="checkbox"/>	Low <input type="checkbox"/>	
	b. Selection of grazing pasture	High <input type="checkbox"/>	Medium <input type="checkbox"/>	Low <input type="checkbox"/>	
	c. Selling of livestock products:	High <input type="checkbox"/>	Medium <input type="checkbox"/>	Low <input type="checkbox"/>	
	d. Selling of livestock products:	High <input type="checkbox"/>	Medium <input type="checkbox"/>	Low <input type="checkbox"/>	
	e. Selling of livestock products:	High <input type="checkbox"/>	Medium <input type="checkbox"/>	Low <input type="checkbox"/>	
	f. Selling of rangeland products:	High <input type="checkbox"/>	Medium <input type="checkbox"/>	Low <input type="checkbox"/>	
	g. Selling of rangeland products:	High <input type="checkbox"/>	Medium <input type="checkbox"/>	Low <input type="checkbox"/>	
	h. Selling of rangeland products:	High <input type="checkbox"/>	Medium <input type="checkbox"/>	Low <input type="checkbox"/>	
	i. Spending money for daily goods and services	High <input type="checkbox"/>	Medium <input type="checkbox"/>	Low <input type="checkbox"/>	
	j. Investments	High <input type="checkbox"/>	Medium <input type="checkbox"/>	Low <input type="checkbox"/>	
5. Ownership	a. Agricultural land	Man <input type="checkbox"/>	Woman <input type="checkbox"/>	Joint <input type="checkbox"/>	Not Applicable <input type="checkbox"/>
	b. House	Man <input type="checkbox"/>	Woman <input type="checkbox"/>	Joint <input type="checkbox"/>	Not Applicable <input type="checkbox"/>
	c. Pasture	Man <input type="checkbox"/>	Woman <input type="checkbox"/>	Joint <input type="checkbox"/>	Not Applicable <input type="checkbox"/>
	d. Livestock	Man <input type="checkbox"/>	Woman <input type="checkbox"/>	Joint <input type="checkbox"/>	Not Applicable <input type="checkbox"/>
6. Participation	i. In percent, representation of women in the executive committee of local association/groups				
	ii. In percent, membership of women in local association/groups				
	iii. In percent (average), attendance of women in local meetings				

- Table 4.1 section 7 column 2 – make a list of rangeland products (including livestock and their products) sold in the market. Add rows in column 2, if necessary. In column 3 mention the price per unit of the products. The price and units can be local but provide the conversion factors as shown in Table 2.1.
- Table 4.1 section 8 and 9 – provide the name of the market where the rangeland products are sold, and its distance from village, respectively. If there is more than one market, provide the distance between each market and the village.
- Table 4.1 section 10 and 11 – explain the challenges and opportunities for production and selling of rangeland products, respectively.
- Table 4.2 is for collecting information on gender roles in livestock and rangeland management.
- Table 4.2 section 2 – provide the number of men (column 3) and women (column 4) for ethnic (row 2) and non-ethnic (row 3) groups in the village (See Annex 13).
- Table 4.2 section 3 column 2 – indicate the activity related to livestock and rangeland management. In column 3, mention whether the daily activity (hours/day) is mostly done by male or female members of the households in the village.
- In column 4, mention the amount of time spent on the activity. If the activity is carried out by both men and women, then separately indicate the amount of time spent by men and women. If it's not a daily activity, clearly indicate the frequency of the activity and the amount of time spent on it.
- Table 4.2 section 4 is a perception-based question. Column 2 shows activities related to livestock and rangeland management for which men and women of a household make decisions. Activity number c, d and e are for livestock products, and f, g and h for rangeland products. Please specify the livestock and rangeland products.
- Table 4.2 section 4 is a perception-based question. Column 3 shows the perception of the participants for an activity classified into three categories:
 - High: Women often make decisions about the activity.
 - Medium: Women sometimes make decisions about the activity.
 - Low: Only men make decisions about the activity.

Inside the parentheses (row 2 to 11), indicate the number of participants who raise their hand for each of these options (high, medium and low). The sum of the three options should equal the total number of participants.

- Table 4.2 section 5 is about who owns the assets – agricultural land, house, pasture and livestock. These assets may be owned by a male member of the household, a female member of the household, or jointly owned by both the man and the woman. 'Not applicable' is for cases where none of the household members own those assets. Inside the parentheses (row 1 to 3) indicate the number of participants who raise their hand for each of these options (high, medium and low). The sum of the three options should equal the total number of participants.
- Table 4.2 section 6 – indicate the average number (percent) of women represented at different levels in local organizations as well as at the meetings of such organizations. These organizations may be formal or informal.

Exercise 4.2: Household questionnaire survey

Objective of the study: The general objective of the study area is to examine both market and non-market values generated by livestock production in the Hindu Kush Karakoram Pamir Landscape (HKPL) area for understanding the importance of rangelands and potential of implementing payment for ecosystem service schemes.

The specific objectives of the survey are to:

- Collect data on livestock production and its trends over years in the HKPL.
- Analyse market and non-market values of livestock production.
- Assess contribution of livestock production to household economy.

Definitions:

- Market value of livestock: Income derived by an individual by selling live animals or products derived from them to other households in the community, traders who come to the village or traders in a local market. It also includes income from draught power of the animals for transporting goods or for land preparation.

- Non-market value of livestock: The asset value of animals; milk and meat products and animal fibres, skins, and hides consumed for the household; manure produced; draught power for transporting goods or for land preparation for personal use.

Sampling procedure and size

A local administrative unit of the landscape can be taken for selection of sample households. Prior knowledge and experience of the area is desirable for selection of the unit; therefore, participation of local partners and leaders is recommended during the sampling process. Further, the following criteria are suggested for selection of the unit:

- The unit is representative of the broader landscape, based on prior knowledge and experiences.
- Livestock production is the major livelihood of local communities.
- Local communities face problems and challenges relating to rangeland management and livestock production.

For each site, a sampling size of 50–100 households will be sufficient for the purpose of the study.

Selection of samples

If the total number of households in the site is less than or equal to 50, then total enumeration is suggested. If the number of households is more than 50, then a systematic random sampling should be done for selection of samples.

For selection of samples, the names of household heads should be listed and numbered. A household is then randomly selected as a starting point; other households are selected at fixed, periodic intervals. The periodic interval can be determined based on the total number of households and sample size.

Collect secondary information

- Number of livestock at the sampled administrative level
- Number of households and total population
- Incomes and composition of the communities
- Studies, reports, and surveys conducted in the area for the past 10 years
- Government-supported livestock related programmes implemented in the past 10 years

Instructions for field enumerators

1. Interviews with respondents should not exceed 90 minutes and should ideally run for less than 60 minutes. The enumerators should understand and be familiar with the questions.
2. Interviews should preferably be conducted when respondents are not too busy, such as after crops have been sown or before harvest.
3. The respondents may not want to share personal information or might be biased while providing some information (such as income, livestock herd size) to complete strangers. Therefore, the enumerator has to explain the objective of the survey to respondents and ensure that the collected personal information is used only for the purpose of the study and is not shared with others. Organizing group discussions and key informant interviews in the community before conducting the questionnaire survey will help to build rapport between local community members and enumerators.
4. Start the interview with a general question such as “What types of livestock do you own?” rather than asking “How many cattle do you own?” or “How many buffalos do you own?” Another example: Start with “What products do you make from milk?” rather than “Do you make yoghurt?” or “Do you make cheese?” After asking the general questions, ask the detailed questions.
5. When interviewing, the enumerators should not put words into the mouth of the respondent or suggest any answers. It is OK if the respondent cannot answer a question. If you really need an answer and think the farmer has the information but has not really understood the question, gently prompt him. For example, if a farmer has a problem answering the question “What are the main problems you face with your livestock?” suggest “theft of animals”, “deaths due to injuries”, “lack of water on summer pastures”, “shortage of winter feed”. If he answers “Yes” to all of these, then ask him which is the most important, then the second most important, etc.
6. During the interview, the enumerators should avoid getting into a discussion on any topic that is not in the questionnaire. Take some notes to capture the main points of this discussion so that you can include them in your final report, perhaps as an anecdote.

7. All the questions in the form should be answered. The space in the questionnaire should not be left empty; otherwise it becomes unclear whether the enumerator forgot to ask the question or forgot to write down the answer. In some cases, the question may not be applicable to the respondent, or the respondent may say, “I do not know.” Here are some examples:
 - If the question is “Do you own yaks?” and the answer is “No yaks”, write “0” or “zero” in the space.
 - If the question is “What percentage of your family income comes from crops?” and the answer is “none”, write “0” or “zero” in the space provided.
 - If the response to a certain question indicates that the next question isn’t applicable to the respondent, enter in the space provided a clear “dash” (“–”). For example, if the answer to a question is “No” and the next question starts with “If Yes...” then you should enter a “dash”.
8. Need for crosschecking: Questions about the number of livestock appear twice in the questionnaire. This provides an opportunity to crosscheck the information provided. The respondent may say s/he has already replied to the question. Offer a plausible reason for asking the question again. You don’t want him/her to think you are suspicious about his answers.
9. Herd composition keeps changing; thus, recording it is a complex task. The survey intends to collect information on the number of adult and female livestock owned on the day of the interview. Besides the number of livestock owned only by the respondent, a herd might include:
 - Livestock from one or several families, such as friend and neighbour
 - Livestock of a landowner to whom the respondent pays rent
10. Age categories of different livestock may differ from region to region within the same country. Therefore, livestock are grouped as follows:
 - species (cattle, yaks, etc.)
 - adults (>1 year old) and young stock (<1 year old)
 - sex (male/female)

11. The following terms are used in the questionnaires:
 - lambs (young sheep) and kids (young goats)
 - ewes (female sheep) and rams (male sheep)
 - does (female goats) and bucks (male goats)
 - Be familiar with other terms.
12. Check the data you collected as soon as you finish interviewing each day, while the information is still fresh in your mind, even if this means working in the evening. If any of the answers provided by the respondent sounds problematic, hopefully you will have noticed it during the interview and addressed the problem, as it is awkward returning to the respondent’s house to ask questions again. So when you go through the questionnaires at the end of the day, you are mainly double-checking the answers for yourself.
13. The data should be entered into Excel either on the day it is collected or as soon as possible thereafter. Entering data from each interview can take as long as the interview itself. Afterwards you should check to ensure that you have entered it correctly.

Format of Report

1. Title page
2. Table of contents
3. Abbreviations and acronyms
4. Acknowledgement
5. Brief introduction
6. Methodology
 - Criteria for selection of survey site
 - Process of sampling and sample size
 - Methods of data collection
7. Descriptions of the village: natural environment, demographic data, ethnic composition, socioeconomic development, programmes, rangelands resources and key pastures, tenureship of the pastures, other stakeholders of the pastures besides the villagers, major livestock kept in the village, spatial-temporal movement of animals
8. Review of studies on rangeland resources, their uses and market and market value of livestock over the last 10 years
9. Summary of available statistics on livestock
10. Key observations in the study
11. References
12. Annexes

Questionnaires (attached as annex)



PART V

Rangeland governance and institutions

State and local institutions govern rangelands in the Hindu Kush Himalaya. Understanding governance mechanisms is essential to ensuring equitable sharing of rangeland resources. This section discusses methods to identify formal and informal institutions related to livestock and rangeland management and understand their strengths and weaknesses.

The state and local institutions govern the management of rangeland resources. Such institutions play a key role in ensuring the sustainability of resources. It is important to understand rangeland governance mechanisms and stakeholders to develop inclusive plans for equitable sharing of rangeland resources (Dong et al., 2009).

In the HKH, both men and women play an important role in rangeland management but the power relations are often skewed in favour of men (Verma and Khadka, 2016). Institutions can reinforce men's power and perpetuate inequity or provide a platform for gender transformation. Therefore, the rapid assessment process needs to consider the gender aspects of rangeland management for governance and institution analysis.

The overall objectives of the rapid assessment of rangeland governance and institutions are to identify formal and informal institutions related to livestock and rangeland management and understand their strengths and weaknesses. Literature review, interviews and group discussions with key government and non-government stakeholders are recommended for the rapid assessment of rangeland governance and institutions.

- Literature review:** The existing policy and legislation, particularly relating to livestock and rangeland, should be reviewed to understand the institutional arrangement at different levels. The documents include policy statements, strategies, laws, regulations, customary and governmental mechanisms, and government plans and programmes. Peer-reviewed articles and grey literature are also important documents for review. Conducting a literature review before interviews and group discussions will help the researcher identify key stakeholders and come up with pertinent questions for interviews and group discussions. The information collected from interviews and group discussions should also be validated through a literature review.
- Key informant interviews:** The key informants for interviews include (a) leaders of local associations, both formal and informal; (b) government and non-government officials, particularly those from departments related to livestock, forestry, agriculture, rangelands, protected area and their technical extensions at the central, district and local level. The interviews should focus on existing formal and informal

institutions, practices, and programmes relating to livestock and rangelands. The interviews will help the researcher identify participants for group discussion. The checklist for key informant interviews is provided in Table 5.1.

- Group discussion:** Participants of group discussion should include representatives of local communities dependent on rangelands, particularly herding communities, and livestock traders. Group discussion should focus on the functioning of existing institutions, their effectiveness, and problems and challenges faced by communities in livestock and rangeland management.

Explanatory notes for interviewer and facilitator

- Table 5.1 includes a list of questions for key informant interviews. It is not an exhaustive list, and needs to be improvised based on the local context and the literature review.
- Facilitators should define “institution” to the participants of Exercise 5.1 in the following manner:
- Institutions here mean any mechanisms or organizations/bodies that decide the ownership and use rights of rangelands, set rules and supervise the daily use of rangeland resources, and settle conflicts arising from rangeland uses.
- In Table 5.2 column 3, mention whether the organization is governmental, non-governmental, a registered association, or a user group of local herders, communities and traders. These may also be informal or unregistered organizations engaged in a wide range of activities (e.g., production, marketing, transportation) relating to rangeland and livestock management.
- In Table 5.2 column 4, mention the administrative level at which the organization operates, such as local, district, national level or any appropriate level (See Annex 14).
- In Table 5.2 column 5, briefly mention the functions and responsibilities of the organization or the legislation that prescribes those functions and responsibilities to the organization. In addition, checklists of issues relating to rangeland management are listed in Table 5.3.
- In Table 5.2 column 5, mention the objectives and activities of the programmes implemented by the organization.

TABLE 5.1 LIST OF IMPORTANT QUESTIONS FOR KEY INFORMANT INTERVIEWS WITH GOVERNMENT (G) AND NON-GOVERNMENT (NG) OFFICIALS, LOCAL LEADERS (LL) AND GRASSROOTS (GR) ORGANIZATIONS

S.N.	Questions	Interviewee
1.	What are the major roles and responsibilities of your organization relating to livestock and rangeland management [in the area]?	G, NG, GR
2.	What are the policy and legislative frameworks that govern the functioning of your organization?	G, NG, GR
3.	What are the programmes (e.g., rangeland conservation, livelihood improvement, marketing, livestock and feed production, capacity development, research, etc.) implemented by your organization for livestock and rangeland management [in the area]?	G, NG, GR
4.	Do the activities of the programmes ensure gender and social inclusiveness? Explain how.	G, NG, GR
5.	What are the priorities of your organization for livestock and/or rangeland management?	G, NG, LL, GR
6.	What are the challenges (e.g., technical, financial, policy, social, institutional, etc.) for implementing livestock and rangeland management programmes [in the area]?	G, NG, LL, GR
7.	How are women of local and herding communities involved in (a) designing and (b) implementing the programmes [in the area]?	G, NG, LL, GR
8.	Does your organization collaborate with other organizations (formal and informal) working on issues related to livestock and rangeland management? Explain how.	G, NG, LL, GR
9.	Do women participate in decision-making at your organization? Explain how.	GR
10.	What are the roles and responsibilities of (a) men and (b) women in your community relating to livestock and rangeland management?	LL

Note: Organization refers to both formal and informal ones

TABLE 5.2 FUNCTIONS AND RESPONSIBILITIES OF FORMAL AND INFORMAL INSTITUTIONS AT DIFFERENT LEVELS

S.N.	Name of organization	Type of organization (formal – government, non-government, associations; informal, private sector, academic institutions)	Level of operation (local, district, national, or any other level)	Functions and responsibilities (Act, Guideline, Directives)	Programmes (objective and activities)
1.					
2.					
3.					
4.					
5.					

TABLE 5.3 CHECKLIST OF ISSUES FOR RANGELAND MANAGEMENT

S.N.	Issues
1	Ownership of rangelands
2	Access to rangeland resources – who can access; what resources can be harvested and how much; when?
3	Planning of rangeland uses
4	Monitoring of rangeland uses
5	Decision-making process on: <ul style="list-style-type: none"> • Migration date and route • Total number of animals allowed to graze in the pasture • Number of animals each household is allowed to raise • Settling conflicts between households within the same village • Settling conflicts between households from different villages • Settling conflicts between communities and government agency
6	Veterinary and extension (e.g., livestock, fodder, market, etc.) services
7	Financial support
8	Information services (e.g., weather, market price)

Exercise 5.1: Identifying institutions governing rangeland uses

- **Justification:** Institutions, both formal and customary, play a very important role in natural resources management. For effective resources management, it is important to understand how different institutions function.
- **Objectives:** To collect information about institutions that manage the rangelands.
- **Expected outputs:** List of organizations, their roles and responsibilities, and programmes for rangeland management.
- **Time:** 1.5 hours
- **Participants:** Herder representatives, grassroots leaders, township government officials, and county government departments of livestock, forestry, agriculture, environment, etc.

Workshop steps:

- Step 1:** Explain meeting objectives.
- Step 2:** Divide the participants into two groups:
 - Group 1: Representatives of herder communities and grassroots organizations
 - Group 2: Government and non-government officials
- Note:** Separate group discussions may be organized for local communities and officials from government and non-government organizations.
- Step 3:** The facilitators run the session according to Table 5.1.
- Step 4:** Presentation of group work followed by a discussion.
- Step 5:** Summarize workshop findings.

References

Asner, G.P., Elmore, A.J., Olander, L.P., Martin, R.E. & Harris, A.T. (2004). Grazing Systems, Ecosystem Responses, and Global Change. *Annual Review of Environment and Resources*, 29:261–299

Beg, G.A. (2011). Current status of pastoral systems in Gilgit-Baltistan and Chitral, Pakistan. In Kreuzmann H., Abdulalishoev, K., Zhaohui, L., Richter (eds) *Pastoralism and rangeland management in the context of climate change GIZ Bonn*. 131–146

Buckland, S.T., Anderson, D.R., Burnham, K. P. & Laake, J. L. (1993). *Distance Sampling: Estimating Abundance of Biological Populations*. London: Chapman and Hall. ISBN 0-412-42660-9

Dong, S., Lassoie, J., Shrestha, K.K., Zhaoli, Y., Sharma, E. & Pariya, D. (2009). Institutional development for sustainable rangeland resource and ecosystem management in mountainous areas of northern Nepal. *Journal of Environmental Management*, 90: 994–1003

Elzinga, C.L., Salzer, D.W. & Willoughby, J.W. (1998). Measuring and Monitoring Plant Populations. *Technical Reference 1730-1*. Bureau of Land Management. Denver, Colorado. USDI, BLM

Joshi, S., Jasra, W.A., Ismail, M., Shrestha, R.M., Yi, S. & Ning, W. (2013). Herders’ perceptions of and responses to climate change in Northern Pakistan. *Environmental Management*, 52:639–648

Herrick, J.E., Van Zee, J.W., Havstad, K.M., Burkett, L.M. & Whitford, W.G. (2009). *Monitoring manual for grassland, shrubland, and savanna ecosystems*. University of Arizona Press, Tucson, AZ, USA.

Kie, J.G. & Thomas, J.W. (1988). Rangeland vegetation as wildlife habitat. In Tueller, P.T. (ed.) *Vegetation science applications for rangeland analysis and management*. Kluwer Academic Publishers: The Netherlands

Kjeldahl, J. (1883). New method for the determination of nitrogen. *Chemistry News*. 48 (1240):101–102

Launchbaugh, K. (2012). *Principles of vegetation measurement and assessment and ecological monitoring and analysis*. Module 8 assessing cover. University of Idaho

Lund, H.G. (2007). Accounting for the world’s rangelands. *Rangelands*, 29, 3–10

Miller, D.J. & Craig, S.R. (1997). *Rangelands and pastoral development in the Hindu Kush-Himalayas*. Proceedings of a regional experts’ meeting November 5–7 1996. ICIMOD: Kathmandu, Nepal

Olsen, S. R. & Sommers. L.E. (1982). Determination of available phosphorus. In Page, A.L., Miller, R.H. & Keeney, D.R. (eds). *Method of Soil Analysis*, vol. 2. 403. Madison, WI: American Society of Agronomy

Ning, W., Rawat G.S. & Sharma, E. (2013). *High-Altitude Ecosystem Interfaces in the Hindu Kush Himalayan Region*. ICIMOD: Kathmandu, Nepal

Sharma, E., Zhaoli, Y. & Sharma, B. (2007). ICIMOD’s Regional Rangeland Program for the Hindu Kush–Himalayas. *Mountain Research and Development* 27:174–177

Sidahmed, A.E. & Rota, A. (2004). IFAD’s Experience in Supporting Community-based Livestock and Rangeland Development. In Richard, C. & Hoffman, Kate (eds.) *Strategic Innovations for Improving Pastoral Livelihoods in the Hindu Kush-Himalayan Highlands*, Vol. II: Technical Papers. ICIMOD: Kathmandu, Nepal

Stoddart, L.A. et al (1975). *Range Management*. New York: McGraw Hill Book Company

Verma, R. & Khadka, M. (2016). *Gender and pastoralism in the rangelands of the Hindu Kush Himalayas: Knowledge, culture and livelihoods at the margins of the margin*. ICIMOD: Kathmandu, Nepal

Walkley, A. & Black, I.A. (1934). An examination of the Degtjareff method for determining soil organic matter, and a proposed modification of the chromic acid titration method. *Soil Science* 37:29–38





Annexes

Sample site information sheet

Name of Observer: NR	Date: 11.09.2017
Study site: Zorkul	*Rangeland type: Alpine Steppc
GPS location: N 37.41872	E 073.75152
Altitude: 4191	
Mean annual precipitation: 100 - 200mm	
Maximum rainfall month: 200mm	
Mean annual temperature: 3.80°C	
Current growing condition: <input type="checkbox"/> Good <input checked="" type="checkbox"/> Medium <input type="checkbox"/> Bad	
Soil type: <input type="checkbox"/> Sand <input type="checkbox"/> Silt <input type="checkbox"/> Clay <input checked="" type="checkbox"/> Loam	
Frost date:	
Early Frost Week/Month: Beginning of October	
Late Frost Week/Month: Mid to Late October	
Snowfall dates: Early: September Late: End of April	
Snow maximum depth: 70 cm	
Phenology	
Greening date: April	
Withering date: End of September	
*Grazing system: No grazing system in place / seasonal	

Determination of dominant species based on "hit"

Point	Transect 1			Transect 2			Transect 3		
	Hit (Y/N)	Species	Cover (%)	Hit (Y/N)	Species	Cover (%)	Hit (Y/N)	Species	Cover (%)
1	Y	Cymbopogon	12%						
2	Y	Poa							
3	Y	Panicum							
4	Y	Plantago	24%						
5	Y	Plantago							
6	N	-							
7	Y	Plantago							
8	N	-							
9	Y	Artemisia							
10	Y	Stipa	16%						
11	Y	Stipa							
12	Y	Astragalus							
13	N	-							
14	N	-							
15	N	-							
16	Y	Cymbopogon							
17	Y	Cymbopogon							
18	Y	Poa							
19	Y	Stipa							
20	N	-							
21	Y	Plantago							
22	Y	Plantago							
23	Y	Stipa							
24	N	-							
25	Y	Plantago							
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									
38									

Community information from each site (consists of 3 plots with 15 quadrats)

Name of Site: <i>Ghalyat Pasture</i>		Plot no.: <i>1</i>	Quadrat no.: <i>1</i>			
Community cover (%)	Name of species	Average height (m)	Aboveground biomass			
			Fresh mass (g)	Air-dry mass (g)	Oven-dry mass (g)	
<i>90%</i>	Dominant species #1	<i>Cymbopogon spp</i>	<i>↑</i>	<i>110</i>	<i>52</i>	<i>40</i>
	Dominant species #2	<i>Poa annua</i>	<i>80cm</i>	<i>66</i>	<i>28</i>	<i>21</i>
	Dominant species #3	<i>Panicum spp</i>	<i>↓</i>	<i>109</i>	<i>44</i>	<i>20</i>
	Dominant species #4	<i>Avena spp</i>		<i>87</i>	<i>43</i>	<i>23</i>
	Dominant species #5	<i>Primula spp</i>		<i>77</i>	<i>45</i>	<i>21</i>
	Other living plant		<i>140</i>	<i>70</i>	<i>40</i>	
	Plant litter		<i>40</i>	<i>30</i>	<i>10</i>	

Description of different variables

Name of site: <i>Ghalyat Pasture</i>		Plot no: <i>1</i>	Quadrat no.: <i>1</i>		
Name of species: <i>Cymbopogon spp</i>					
Individuals	1	2	3	4	5
Basal cover (%)	<i>16</i>	<i>19</i>	<i>9</i>	<i>9</i>	<i>10</i>
Foliar cover (%)	<i>20</i>	<i>30</i>	<i>15</i>	<i>15</i>	<i>15</i>
Height (cm)	<i>6</i>	<i>6</i>	<i>8</i>	<i>9</i>	<i>9</i>
Fresh mass (g)	<i>110</i>	<i>141</i>	<i>75</i>	<i>99</i>	<i>114</i>
Dry mass (g)	<i>52</i>	<i>69</i>	<i>37</i>	<i>41</i>	<i>56</i>
Name of species: <i>Poa annua</i>					
Individuals	1	2	3	4	5
Basal cover (%)	<i>20</i>	<i>15</i>	<i>9</i>	<i>10</i>	<i>3</i>
Foliar cover (%)	<i>35</i>	<i>25</i>	<i>15</i>	<i>20</i>	<i>5</i>
Height (cm)	<i>12</i>	<i>12</i>	<i>7</i>	<i>5</i>	<i>5</i>
Fresh mass (g)	<i>117</i>	<i>100</i>	<i>134</i>	<i>61</i>	<i>14</i>
Dry mass (g)	<i>64</i>	<i>50</i>	<i>69</i>	<i>23</i>	<i>7</i>
Name of species: <i>Panicum spp</i>					
Individuals	1	2	3	4	5
Basal cover (%)	<i>16</i>	<i>15</i>	<i>9</i>	<i>8</i>	<i>11</i>
Foliar cover (%)	<i>30</i>	<i>25</i>	<i>20</i>	<i>18</i>	<i>25</i>
Height (cm)	<i>12</i>	<i>10</i>	<i>10</i>	<i>10</i>	<i>12</i>
Fresh mass (g)	<i>31</i>	<i>28</i>	<i>30</i>	<i>33</i>	<i>33</i>
Dry mass (g)	<i>13</i>	<i>9</i>	<i>11</i>	<i>13</i>	<i>3</i>
Name of species: <i>Avena spp</i>					
Individuals	1	2	3	4	5
Basal cover (%)	<i>16</i>	<i>11</i>	<i>9</i>	<i>10</i>	<i>1</i>
Foliar cover (%)	<i>35</i>	<i>25</i>	<i>15</i>	<i>20</i>	<i>5</i>
Height (cm)	<i>12</i>	<i>12</i>	<i>7</i>	<i>5</i>	<i>5</i>
Fresh mass (g)	<i>117</i>	<i>104</i>	<i>77</i>	<i>111</i>	<i>22</i>
Dry mass (g)	<i>60</i>	<i>45</i>	<i>34</i>	<i>58</i>	<i>12</i>
Name of species:					
Individuals	1	2	3	4	5
Basal cover (%)	<i>4</i>	<i>3</i>	<i>2</i>	<i>3</i>	<i>2</i>
Foliar cover (%)	<i>8</i>	<i>5</i>	<i>2</i>	<i>5</i>	<i>5</i>
Height (cm)	<i>12</i>	<i>10</i>	<i>6</i>	<i>9</i>	<i>7</i>
Fresh mass (g)	<i>77</i>	<i>38</i>	<i>15</i>	<i>54</i>	<i>63</i>
Dry mass (g)	<i>37</i>	<i>17</i>	<i>6</i>	<i>25</i>	<i>28</i>

Carbon and nitrogen content of the top three dominant species, other living plants and litter

Plot No.	Name of species	C content (mg/g)	N content (mg/g)	C:N	
1	Dominant species #1	<i>Plantago spp</i>	423	23.0	18.39
	Dominant species #2	<i>Artemisia spp</i>	415.8	15.8	28.59
	Dominant species #3	<i>Cymbopogon spp</i>	332.6	26.2	12.69
	Other living plants	-			
	Litter	-	41.9	1.2	34.91
2	Dominant species #1				
	Dominant species #2				
	Dominant species #3				
	Other living plants				
	Litter				
3	Dominant species #1				
	Dominant species #2				
	Dominant species #3				
	Other living plants				
	Litter				

Physical-chemical properties of soil samples at each site

Plot #	Quadrat #	Wet weight (g)	Oven dried (g)	SMC (%)	SBD (g cm ⁻³)	TC (%)	TN (%)	TP (%)
1	1	100	60	18	1.38	14.3	11.4	11.2
	2							
	3							
	4							
	5							
2	1							
	2							
	3							
	4							
	5							
3	1							
	2							
	3							
	4							
	5							

Conversion factor from local to standard units

S.N.	Variable (standard unit)	Local unit	Conversion factor
1.	Area (in hectare)	Kanal	1 Kanal = 0.05 ha
2.	Length and Distance (in metre, kilometre)		
3.	Currency (in US dollar)	Pakistani Rupee (PKR)	1 USD = 130 PKR
4.	Weight (in gram, kilogram)		

Format for collecting information on pasture

Date of Survey: 21/09/2017		Location: Immit				
1. General information of pasture						
1.1. Name	Bukh					
1.2. Location (GPS coordinates)	Lat: 36.1696N Long: 73.9862E					
1.3. Elevational range (m)	3200-4000					
1.4. Total area (ha.)	45					
1.5. Uses of pasture (please tick)	<input checked="" type="checkbox"/> Fodder <input checked="" type="checkbox"/> Fuelwood <input type="checkbox"/> Timber <input checked="" type="checkbox"/> Medicinal plants <input type="checkbox"/> Edible fruits <input type="checkbox"/> Edible vegetables <input type="checkbox"/> Other (specify) <input type="checkbox"/> Other (specify)					
2. Dominant vegetation	Juniperous excelsa, Betula utilis, Salix sp.					
3. Name of villages using the pasture	Number of households	Number of animals using pasture				
		Goat	Sheep	Yak	Camel	Other (specify) Cattle
3.1. Immit	81	250	100	50	100	
3.2. Mujawis	61	100	200	80	200	
3.3. Boath	56	200	200	30	100	
3.4.						
3.5.						
4. Month of arrival	June					
5. Month of departure	September					
6. Months of use	June, July, August, September					
7. Issues related to pasture use and management	Availability of fodder and medicinal plants have reduced.					

Format for collecting information on stopover points along the migration route

Table 2.3: Format for collecting information on stopover points along the migration route

Date of Survey: 22 September 2017		Location: Immit		Year of use: 2016		
1. General information of the village using the migration route						
1.1. Village/settlement	Immit					
1.2. Longitude	73.8345E					
1.3. Latitude	36.5256N					
1.4. Elevational range (m)	2200-2450 m					
2. Information about animals						
	Goat	Sheep	Yak	Camel	Other (specify)	Other (specify)
2.1. Breed of animals	No information	No information	No information		cattle	
2.2. Number of animals	250	100	100		100	
3. Information of stopover points						
Stopover points location/name (Latitude, longitude and elevation)	Month of 1 st use	Duration of stay (days)	Month of 2 nd use	Duration of stay (days)	Dominant vegetation	Other information
a. Yubi (36.5622 N, 73.7518 E, 2590m)	June	10	September	10	Gentiana sp. Anemone sp.	Good availability of water
b. Matra (36.5659 N, 73.7669 E, 2850m)	June	10	September	7	Gentiana sp. Anemone sp.	Good availability of water sometimes conflict with local communities
c.						Water scarcity
d. Jarku (36.5783 N, 73.7223 E, 3708m)	June	5	September	7	Polygonum sp. Anemone sp. Sedum sp.	Animals are grazed here until 1 st week of September.
e.						
f.						

Format for collecting information on major valleys used by wildlife

Date of Survey: 23/09/2017		Location: Immit		
1. General information of valley				
1.1. Name	Shimsal			
1.2. Longitude	36.44	1.4. Elevation (range)	4,200 - 4,700	
1.3. Latitude	75.68	1.5. Total area (ha.)		
2. Wildlife and their estimated population				
Wild animals	Presence (yes/no)	Estimated population	Forage/prey species	Conflicts with domestic animals (yes/no)
2.1. Wild species: Ibex				
		5000	Ephedra gerardiana Artemisia indica	No
2.1.1. Spring	Yes			
2.1.2. Summer	Yes			
2.1.3. Autumn	Yes			
2.1.4. Winter	Yes			
2.2. Wild species: Snow leopard				
		25	Ibex, Blue sheep	Yes
2.2.1. Spring	Yes			
2.2.2. Summer	Yes			
2.2.3. Autumn	Yes			
2.2.4. Winter	Yes			
2.3. Wild species: Blue sheep				
		5600	Koalasia sp., Carex sp.	No
2.3.1. Spring	Yes			
2.3.2. Summer	Yes			
2.3.3. Autumn	Yes			
2.3.4. Winter	Yes			
3. Describe the nature of conflicts, if any, between wild and domestic animals	Every year, 1-2 cases of livestock depredation by snow leopard are reported.			
4. Describe the conflict management strategy, if any, adopted by communities	No measures have been undertaken to manage conflict.			

Assessment of rangeland and use

A. Background information

- A1. Country: *Pakistan*..... A2. Name of region (A2): *Gilgit Baltistan*
- A3. Name of district: *Ghizir*..... A4. Name of village/area: *Immit*
- A5. Name of surveyor: *Ahmed* A6. Date of interview: *16/09/2017*
- A7. Name of respondent: *Isshad*
- A8. Gender of respondent (Please tick the appropriate one): A8a. Man ; A8b. Woman
- A9. Age of respondent: *43* years A10: Ethnicity of respondent: *Gushpwe*
- A11: Type of production system (Please tick the appropriate one):
- A11a. *Nomadic*..... A11b. *Transhumance*
- A11c. *Sedentary/Agro-pastoralist*..... A11d. *Sedentary/pastoralist*.....
- A12. Distance of the household to
- (A12a) Vehicle roads (A12a): *2 km*
- (A12b) Markets (A12b): *2 km*
- (A12c) School (A12c): *1.4 km*
- (A12d) Hospital (clinics): *2 km*
- (A12e) Agricultural extension/livestock service centre: *1 km*
- A13. Access of the household to (Please tick the appropriate one)
- (A13a) Vehicles roads: Yes No
- (A13b) Electricity: Yes No
- (A13c) Drinking water: Yes No
- (A13d) Internet: Yes No
- (A14e) TV signal/radio: Yes No
- (A14f) Mobile phone: Yes No

B. General information (at the household level)

B1. Total number of adults in the household:

	Male	Female
Adult (>15 years)	(B1a) <i>2</i>	(B1b) <i>2</i>
Children (< or = 15 years)	(B1c) <i>1</i>	(B1d) <i>1</i>
Who is the nominal head of the household?	(B1e) <i>Man</i>	

B2. Marital status of respondent (Please tick the appropriate one):

- B2a. *Unmarried*: B2b. *Married*: B2c. *Widow/Widower*:
 B2d. *Divorced*:

B3. How many household members are working in another place?

- B3a. *Man*: *1*..... B3b. *Woman*: *1*.....

B4. Number of household members involved in herding livestock:

- B4a. *Adult Man*: *1*..... B4b. *Adult woman*: *1*..... B4c. *Children*:

B5. Which category of rangelands do your livestock graze on (multiple choice) (Please tick the appropriate one)?

- B5a. *Open access*:
 B5b. *Community land*:
 B5c. *Land you own/lease that only your livestock graze*:

B6. The area of rangelands over which you have exclusive grazing rights within a walking distance from your village or tent: *0*..... (write down the local unit but convert it later)

B7. Besides grazing, what other resources did you collect directly from the rangelands for family use in the past 12 months?

Resources	Unit	Estimated quantity	Market value (if any) in local currency	Name of local currency
Fuelwood (shrubs, grasses, timber, etc.)	kg	(B7a) 600	(B7b) 9000	...P.K.R... Pakistani Rupee
Fuelwood (peats)		(B7c)	(B7d)	
Hay/fodder (cut grasses for winter use, etc.)		(B7e)	(B7f)	
Timber/construction materials	a.m.	(B7g) 50	(B7h) 15,000	
Medicinal plants		(B7i)	(B7j)	
Edible plants/vegetable		(B7k)	(B7l)	
Edible fruits/dry nuts		(B7m)	(B7n)	
Dry/fallen leaves (e.g., for fertilizer)		(B7o)	(B7p)	
Wildlife products		(B7q)	(B7r)	
Others (specify)				

B8. If you own an area of forest for wood and fuel supply, what is the area? 29.. (unit: Kanal)

B9. How many adult livestock (>1 year old) does your household keep today?

Animals	Number of adults kept (>1 year old)	Mean value per head	Name of local currency
Cattle	(B9a) 6	(B8b) 40,000	Pakistani Rupee
Purebred yak	(B9c)	(B9d)	
Crossbreeds of yak and cattle	(B9c)	(B9f)	
Buffaloes	(B9g)	(B9h)	
Horses	(B9i)	(B9j)	
Mules	(B9k)	(B9l)	
Donkeys	(B9m)	(B9n)	
Sheep	(B9o) 12	(B9p) 6,000	
Goats	(B9q)	(B9r)	
Camels	(B9s)	(B9t)	
Rabbits	(B9u)	(B9v)	
Chicken	(B9w) 10	(B9x) 500	

B10. For what purpose(s) are you raising these animals (multiple choices)?

Animals	Marketing for Cash	Meat for family consumption	Milk/egg	Manure	Transport service (including for tourists)	Ploughing	Others
Cattle			✓	✓		✓	
Pure yaks							
Crossbreeds of yaks & cattle							
Buffaloes							
Horses							
Mules							
Donkeys							
Sheep	✓	✓					
Goats							
Pigs							
Rabbits							
Chicken	✓	✓	✓				
Others (please specify)							

B11. What are the three major main problems you face today in raising livestock?

- B11a. Lack of manpower.....
 B11b. Fodder scarcity.....
 B11c. Lack of veterinary services.....

B12. What were the three major problems you faced during the last 10 years in raising livestock?

- B12a. Lack of market.....
 B12b. Lack of veterinary services.....
 B12c. Depredation by wildlife.....

C. Family ownership of livestock

C1. Number of adult livestock (>1 year old) owned by the **family** of the respondent on the day of the interview and 10 years ago.

Animals	On the day of interview	10 years ago	This question is for verification since you already asked about the number of livestock kept by the household in B9 above. Here you are asking about the number owned by the respondent's family. The numbers provided here must not exceed the numbers for Question 9. If they are higher, you need to check the responses to Question 9.
Cattle	(C1a) 6	(C1b) 8	
Pure yaks	(C1c)	(C1d)	
Crossbreeds of yaks & cattle	(C1e)	(C1f)	
Buffaloes	(C1g)	(C1h)	
Horses	(C1i)	(C1j)	
Mules	(C1k)	(C1l)	
Donkeys	(C1m)	(C1n)	
Sheep	(C1o) 12	(C1p) 60	
Goats	(C1q) 0	(C1r) 30	
Pigs	(C1s)	(C1t)	
Rabbits	(C1u)	(C1v)	
Chicken	(C1w) 10	(C1x) 80	

C2. What are the reasons why your ownership of livestock changed during the last 10 years?

...Lack of manpower; fodder scarcity.....

C3. Would you like to invest in additional livestock in the future (Please tick the appropriate one)?

C3a. Yes..... C3b. No ..✓.....

C4. Write down the reasons for your last answer *Lack of manpowers*
and fodder scarcity

C5. If C3 is yes, in which livestock [if C3 is no, skip to C7]? *X*

C6. If C3 is yes, in which feeds would you give them [if C3 is no, skip to C7]?

C6a. First response: *X*

C6b. Second response: *X*

C6c. Third response: *X*

C7. Do you know any government/non-government programmes supporting livestock management or rangeland use in your area?

C7a. Yes. C7b. No.....

C8. If C7 is yes, can you name some of the programmes [if C7 is no, skip to section D]?

C8a: *Veterinary dispensary*

C8b: *Snow Leopard Foundation*

C8c:

D. Production of milk, wool, cashmere, etc. during the last 12 months

D1. Total daily milk production (litres) of all female animals in herd by species. (Multiply total daily production by the number of days per month and add up the monthly production to get the total annual production. If respondents do not know daily yield by month, ask about the total annual production of all female animals in the herd for each species.)

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Total
Cow	60	60	60	60	60	60	60	60	60	60	60	60	(D1a) 720
Buffalo													(D1b)
Yak													(D1c)
Sheep													(D1d)
Goat													(D1e)
Camel													(D1f)
Others (please specify)													

D2. Who is primarily responsible for processing milk and other animal products (wool, etc.) (Please tick the appropriate one)?

D2a. Man: D2b. Woman: D2c. Both:

D3. Production of milk products and animal fibres by all animals in the herd during the last 12 months

Products	Yoghurt	Cheese	Ghee	Kurut	Other products (please specify)	Other products (please specify)	Wool	Cashmere
Unit			kg				kg	
Quantity produced	(D3a)	(D3b)	(D3c) 10	(D3d)	(D3e)	(D3f)	(D3g) 20	(D3h)

	Cashmere	Goat hair	Yak hair	Skins	Hides	Other products (please specify)	Other products (please specify)	Manure
Unit								kg
Quantity produced	(D3h)	(D3i)	(D3j)	(D3k)	(D3l)	(D3m)	(D3n)	(D3o) 5000

D4. Quantity of livestock products used in the house for consumption and processing during the last 12 months. (The rest is sold.)

Product used in house	Milk	Yoghurt	Cheese	Ghee	Kurut	Other products (please specify)	Other products (please specify)	Meat
Unit	litre			kg				kg
Quantity used in house	(D4a) 720	(D4b)	(D4c)	(D4d) 10	(D4e)	(D4f)	(D4g)	(D4h) 60

	Wool	Cashmere	Goat hair	Yak hair	Other products (please specify)	Skins	Hides
Unit	kg						
Quantity used in house	(D4i) 10	(D4j)	(D4k)	(D4l)	(D4m)	(D4n)	(D4o)

E. Sale of livestock and value added products during the last 12 months

E1. What are the main marketing problems that you face selling your animals and animal products?

E1a. 1st response... *Low price due to high competition*.....

E1b. 2nd response

E1c. 3rd response

E2. Number and value of your own livestock used for guests, weddings, etc. in the last 12 months

	Cattle	Yaks	Buffalo	Sheep	Goats	Pigs	Rabbits	Other animals (please specify)
Number used	(E2a)	(E2b)	(E2c)	(E2d) 2	(E2e)	(E2f)	(E2g)	(E2h)
Value per head	(E2i)	(E2j)	(E2k)	(E2l) 6,000	(E2m)	(E2n)	(E2o)	(E2p)

E3 and E4. Sale of livestock belonging to family during the last 12 months and income from sales

	E3. Number of adults sold (>1 year old)			E4. Number of young stock sold (<1 year old)		
	Males	Females	Total annual value of sales (currency:.....)	Males	Females	Total annual value of sales (currency:.....)
			PKR			
Cattle	(E3a)	(E3b) 1	(E3c) 40,000	(E4a)	(E4b)	(E4c)
Yaks/yak crossbreeds	(E3d)	(E3e)	(E3f)	(E4d)	(E4e)	(E4f)
Buffaloes	(E3g)	(E3h)	(E3i)	(E4g)	(E4h)	(E4i)
Horses	(E3j)	(E3k)	(E3l)	(E4j)	(E4k)	(E4l)
Mules	(E3m)	(E3n)	(E3o)	(E4m)	(E4n)	(E4o)
Donkeys	(E3p)	(E3q)	(E3r)	(E4p)	(E4q)	(E4r)
Sheep	(E3s) 2	(E3t)	(E3u) 6,000	(E4s)	(E4t)	(E4u)
Goats	(E3v)	(E3w)	(E3x)	(E4v)	(E4w)	(E4x)
Camel	(E3y)	(E3z)	(E3aa)	(E4y)	(E4z)	(E4aa)
Other (please specify)	(E3ab)	(E3ac)	(E3ad)	(E4ab)	(E4ac)	(E4ad)
Other (please specify)						

E5. Who is primarily responsible for selling milk and animal products (wool, etc.) (Please tick the appropriate one)?

E5a. Man:..... E5b. Woman: E5c. Both:

E6. Milk and other unprocessed livestock products sold during the last 12 months

Products sold	Yoghurt	Cheese	Ghee	Kurut	Other products (please specify)	Other products (please specify)	Other products (please specify)
Unit							
Quantity sold	(E6a)	(E6b)	(E6c)	(E6d)	(E6e)	(E6f)	(E6g)
Price per unit	(E6p)	(E6q)	(E6r)	(E6s)	(E6t)	(E6u)	(E6v)

Products sold	Meat	Wool	Cashmere	Goat hair	Yak hair	Skins	Hides	Manure
Unit		Kg						
Quantity sold	(E6h)	(E6i) 10	(E6j)	(E6k)	(E6l)	(E6m)	(E6n)	(E6o)
Price per unit	(E6w)	(E6x) 300	(E6y)	(E6z)	(E6aa)	(E6ab)	(E6ac)	(E6ad)

E7. Sale of value-added products made from animal fibres and skins/hides during the last 12 months: *None such products sold.*

Value-added products	Woollen yarn	Cashmere yarn	Other products (please specify)	Other products (please specify)	Other products (please specify)	Pullovers
Unit						
Quantity sold	(E7a)	(E7b)	(E7c)	(E7d)	(E7e)	(E7f)
Price per unit	(E7l)	(E7m)	(E7n)	(E7o)	(E7p)	(E7q)

Value-added products	Socks	Kilims	Carpets	Other products (please specify)	Other products (please specify)
Unit					
Quantity sold	(E7g)	(E7h)	(E7i)	(E7j)	(E7k)
Price per unit	(E7r)	(E7s)	(E7t)	(E7u)	(E7v)

E8. How does your family sell the livestock products (multiple response possible)?

E8a. Through local markets: ✓

E8b. Through vendors:

E8c. Through the internet:

E8d. Through friends: ✓

E9. Total annual income from other uses of livestock: *None*

	Pack animals	Draught animals	Tourism	Breeding services	Others (please specify)	Others (please specify)
Currency						
Total annual income	(E9a)	(E9b)	(E9c)	(E9d)	(E9e)	(E9f)

F. Other income sources

F1. Other sources of income during the last 12 months

Sources	Amount (currency..P.K.R.)
Fruit crops <i>Food crops</i>	(F1a) <i>90,000</i>
Vegetables	(F1b)
Forestry products	(F1c)
Medicinal and aromatic plants	(F1d)
Salaries	(F1e) <i>800,000</i>
Remittances	(F1f)
Rent	(F1g)
Transfer income (pension, scholarship, government subsidy)	(F1h)
Shares from investment/tourism development	(F1i)
Others (Please specify)	

G. Ownership of assets

G1. What area of cropland and number of each of the following assets do you own?

	Land for crops	Car	Small truck	Television	Tractor	Cream separator	Telephone
Unit	<i>Kanal</i>	<i>Number</i>		<i>Number</i>			
	(G1a)	(G1b)	(G1c)	(G1d)	(G1e)	(G1f)	(G1g)
	<i>10</i>	<i>1</i>		<i>1</i>			

	Refrigerator	Motor cycles	Computers/ PCs	Bicycles	Solar panels	Bio-digester	Others (please specify)
Unit		<i>Number</i>					
	(G1h)	(G1i)	(G1j)	(G1k)	(G1l)	(G1m)	(G1n)
		<i>1</i>					

H. Feeds purchased for livestock

H1. How much compound feed/grains/oil seed cakes did you purchase during the last 12 months?

.....600.....unit (.kg.)

H2. What is the current price of

H2a. Compound feed: / unit (.....)

H2b. Feed grains: PKR 100 / unit (kg.)

H2c. Oil seed cakes: / unit (.....)

H3. How much compound feed/grains did you purchase 10 years ago for a 12 months period?

...2000... unit (.kg)

I. Crop production and value of crop products

Production and sale of different crops and crops purchased from market during the last 12 months

Name of crop	Area (unit)	Total production (unit)	Sale of crop (unit)	Price of crop (currency/unit)	Crop purchased (unit)
I1. Food crops					
Wheat	(I1a) 1 (kanal)	(I1b) 800 (kg)	(I1c)	(I1d) 13 (PKR/kg)	(I1e) 720 (kg)
Rice	(I1f)	(I1g)	(I1h)	(I1i) 150 (PKR/kg)	(I1j) 100 (kg)
Potato	(I1k) 0.2 (kanal)	(I1l) 4000 (kg)	(I1m) 3,050 (kg)	(I1n) 30 (PKR/kg)	(I1o)
Pulses (total)	(I1p)	(I1q)	(I1r)	(I1s)	(I1t)
Others (please specify)	(I1u)	(I1v)	(I1w)	(I1x)	(I1y)
Others (please specify)	(I1z)	(I1aa)	(I1ab)	(I1ac)	(I1ad)
I2. Fodder crops					
Alfalfa	(I2a) 2 (kanal)	(I2b) 600 (kg)	(I2c)	(I2d)	(I2e)
Barley	(I2f)	(I2g)	(I2h)	(I2i)	(I2j)
Oats	(I2k)	(I2l)	(I2m)	(I2n)	(I2o)
Others (please specify)	(I2p)	(I2q)	(I2r)	(I2s)	(I2t)
I3 Orchards					
Others (please specify)	(I3a)	(I3b)	(I3c)	(I3d)	(I3e)
Others (please specify)	(I3f)	(I3g)	(I3h)	(I3i)	(I3j)

J. Trends of Change in rangeland ecosystem over the last 10 years:

From 2005 Year to 2016 Year

J1. What is your perception of the changes in the quantity and quality of rangeland resources your households use (Please tick the appropriate one)?

	a. Decreased	b. Increased	c. No change	d. Not certain	Remarks
J1.1. Quantity (area/fodder productivity) of rangeland resources	✓				
J1.2. Quality of rangelands	✓				
J1.3. Availability of fuelwood from rangelands	✓				
J1.4. Medicinal plants				✓	
J1.5. Invasion of non-fodder species				✓	
J1.6. Edible vegetables				✓	
J1.7. Foods and fruits				✓	
J1.8. Drinking water			✓		
J1.9. Any other (Specify)					

J2. What is your perception of the changes in livestock management in your household (Please tick the appropriate one)?

	a. Decreased	b. Increased	c. No change	d. Not certain	Remarks
J2.1. No. of animals	✓				
J2.2. Body size of animals				✓	
J2.3. Relative importance of livestock in the household	✓				
J2.4. Use of purchased feeds	✓				Decrease in no. of animals
J2.5. Animal health care		✓			Improved veterinary services
J2.6. Animal nutrition			✓		
J2.7. Ease of marketing		✓			
J2.8. Profit from selling livestock	✓				High competition
J2.9. Livestock products purchased from the market		✓			

Format for collecting information on the contribution of rangelands in household economy

Date of Survey: 23/09/2017		Location: Immit		
1. Name of village	Immit			
2. Total population	490			
3. Number of households	81			
4. Types of animals raised	Cattle, yak, sheep, goat			
5. Income sources of the population	Rangeland based income sources (includes livestock and their products)	Ghee, kurut, woollen yarn		
	Non-rangeland based income sources	Food crops, non-farm labor, salary, vegetables		
6. Degree of dependency of population on rangeland based income sources [Level of dependency] High: >65% of total income comes from rangeland based income sources; Medium: >35% & <65% of total income comes from rangeland based income sources; Low: <35% of total income comes from rangeland based income sources	1. Ghee	High		
		Medium	15 (15)	
		Low		
	2. Kurut	High	1 (15)	
		Medium	14 (15)	
		Low		
	3. Woollen yarn	High		
		Medium	2 (15)	
		Low	13 (15)	
	4.	High		
		Medium		
		Low		
	7. Market price of livestock products Note: Price and unit can be local; facilitator needs to confirm their conversion factor with USD and standard unit	Rangeland products (includes livestock and their products)		Price per unit
		a. Ghee		75 PKR/kg
		b. Kurut		110 PKR/kg
		c. Woollen yarn		1500 PKR/kg
d.				
e.				
8. Name of market	Pash			
9. Distance between market and village	10km			
10. Challenges for production and selling rangeland products (includes livestock and their products)	Lack of labor, fodder scarcity, high transportation cost			
11. Opportunities for production and selling rangeland products (includes livestock and their products)	Increasing demand for milk and wollen products			

Format for collecting information on gender roles in livestock and rangeland management

Date of Survey: 23/09/2017		Location: Immit				
1. Name of village	Immit					
2. Population	Social groups	Number of men	Number of women			
	Ethnic group	256	234			
	Non-ethnic group	-	-			
3. Labour division in livestock and rangeland management	Activity	Who? (Man or woman/ Both)	Hours/day			
	a. Herding	Man	8-10			
	b. Milking cow	Woman	3-5			
	c. Milk processing	Woman	2-3			
	d. Fetching water	Woman	2-3			
	e. Caring of young animals	Both	Not applicable			
	f. Consulting veterinary services	Man	Not applicable			
	g. Sheep shearing	Man	3 (in summer)			
	h. Wood processing	Both	3-5 (in summer)			
	i. Selling of milk products	Woman	2-3			
	j. Selling of woollen yarn	Man	2-3			
4. Decision making power	Activity	Degree of power of women				
	a. Livestock selection	High <input type="checkbox"/>	Medium <input checked="" type="checkbox"/>	Low <input type="checkbox"/>		
	b. Selection of grazing pasture	High <input type="checkbox"/>	Medium <input type="checkbox"/>	Low <input checked="" type="checkbox"/>		
	c. Selling of livestock products: Ghee	High <input checked="" type="checkbox"/>	Medium <input type="checkbox"/>	Low <input type="checkbox"/>		
	d. Selling of livestock products: Kurut	High <input checked="" type="checkbox"/>	Medium <input type="checkbox"/>	Low <input type="checkbox"/>		
	e. Selling of livestock products: Woollen yarn	High <input type="checkbox"/>	Medium <input type="checkbox"/>	Low <input checked="" type="checkbox"/>		
	f. Selling of rangeland products: -	High <input type="checkbox"/>	Medium <input type="checkbox"/>	Low <input type="checkbox"/>		
	g. Selling of rangeland products: -	High <input type="checkbox"/>	Medium <input type="checkbox"/>	Low <input type="checkbox"/>		
	h. Selling of rangeland products: -	High <input type="checkbox"/>	Medium <input type="checkbox"/>	Low <input type="checkbox"/>		
	i. Spending money for daily goods and services	High <input type="checkbox"/>	Medium <input type="checkbox"/>	Low <input checked="" type="checkbox"/>		
	j. Investments	High <input type="checkbox"/>	Medium <input type="checkbox"/>	Low <input checked="" type="checkbox"/>		
	5. Ownership	a. Agricultural land	Man <input checked="" type="checkbox"/>	Woman <input type="checkbox"/>	Joint <input type="checkbox"/>	Not Applicable <input type="checkbox"/>
		b. House	Man <input checked="" type="checkbox"/>	Woman <input type="checkbox"/>	Joint <input type="checkbox"/>	Not Applicable <input type="checkbox"/>
c. Pasture		Man <input type="checkbox"/>	Woman <input type="checkbox"/>	Joint <input type="checkbox"/>	Not Applicable <input checked="" type="checkbox"/>	
d. Livestock		Man <input type="checkbox"/>	Woman <input type="checkbox"/>	Joint <input checked="" type="checkbox"/>	Not Applicable <input type="checkbox"/>	
6. Participation	i. In percent, representation of women in the executive committee of local association/groups	Not applicable (there are no local associations)				
	ii. In percent, membership of women in local association/groups	Not applicable (there are no local associations)				
	iii. In percent (average), attendance of women in local meetings	< 10%				

Functions and responsibilities of formal and informal institutions at different levels

Table 5.2 Functions and responsibilities of formal and informal institutions at different levels

S.N.	Name of organization	Type of organization (government, non-government, associations, private sector, academic institutions)	Level of operation (local, district, national, or any other level)	Functions and responsibilities (Act, Guideline, Directives)	Programmes (objective and activities)
1.	Livestock and Dairy Development Department	Government	National	Not available	Plan, promote, facilitate and coordinate development and investment in dairy, meat, poultry and livestock sectors.
2.					
3.	Aga Khan Rural Support Program	Non-government	National	Not applicable	Support in marketing of livestock products
4.					





Glossary

Glossary

- Alpine desert** Barren area in the alpine zone with little or no soil, either with or without scant vegetation.
- Alpine meadow** Alpine meadows are found on flat areas or gentle slopes and moist places dominated by grasses, sedges, and other herbs in the alpine zone.
- Alpine steppe** Alpine steppe is found under colder conditions, arid or semi-arid, with little precipitation and barren soils.
- Canopy cover** The proportion of the ground area covered by the canopy when viewed vertically.
- Carrying capacity** The average number of livestock and/or wildlife that may be sustained on a management unit compatible with management objectives for the unit.
- Grassland** Land on which the vegetation is dominated by grasses, grass like plants, or forbs. Land that is not currently a grassland but was originally or could become a grassland through natural succession may be classified as a potential natural grassland.
- Pasture** A grazing area devoted to the production of forage, native or introduced.
- Rangeland** Land on which the indigenous vegetation (climax or natural potential) is predominantly grasses, grass-like plants, forbs, or shrubs and is managed as a natural ecosystem. Rangeland includes natural grasslands, savannahs, shrublands, many deserts, tundras, alpine communities, marshes and meadows.
- Seasonal grazing** Grazing restricted to one or more specific seasons of the year.



About ICIMOD

The International Centre for Integrated Mountain Development (ICIMOD), is a regional knowledge development and learning centre serving the eight regional member countries of the Hindu Kush Himalaya – Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan – and based in Kathmandu, Nepal. Globalisation and climate change have an increasing influence on the stability of fragile mountain ecosystems and the livelihoods of mountain people. ICIMOD aims to assist mountain people to understand these changes, adapt to them, and make the most of new opportunities, while addressing upstream-downstream issues. We support regional transboundary programmes through partnership with regional partner institutions, facilitate the exchange of experience, and serve as a regional knowledge hub. We strengthen networking among regional and global centres of excellence. Overall, we are working to develop an economically and environmentally sound mountain ecosystem to improve the living standards of mountain populations and to sustain vital ecosystem services for the billions of people living downstream – now, and for the future.

REGIONAL MEMBER COUNTRIES



Corresponding authors

Yi Shaoliang
yi.shaoliang@icimod.org

Srijana Joshi
srijana.joshi@icimod.org

Supported by



ICIMOD gratefully acknowledges the support of its core donors: the Governments of Afghanistan, Australia, Austria, Bangladesh, Bhutan, China, India, Myanmar, Nepal, Norway, Pakistan, Sweden, and Switzerland.

© ICIMOD 2019

International Centre for Integrated Mountain Development
GPO Box 3226, Kathmandu, Nepal
T +977 1 5275222 | **E** info@icimod.org | **www.icimod.org**
ISBN 978 92 9115 687 0 (electronic)