Food and Agriculture Organization of the United Nations

APPLICATION OF THE PARTICIPATORY RANGELAND AND GRASSLAND ASSESSMENT (PRAGA) METHODOLOGY IN KYRGYZSTAN

Baseline analysis, remote sensing, field assessment and validation report

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Abbreviations and acronyms

EAEU	Eurasian Economic Union
ESA CCI LC	European Space Agency Climate Change Initiative Land Cover
FAO	Food and Agriculture Organization of the United Nations
GEF	Global Environment Facility
GDP	Gross domestic product
GI	Green index
GIPROZEM	Kyrgyzgiprozem – state land survey institution
GIS	Geographic Information System
IUCN	International Union for Conservation of Nature
LD	land degradation
LDN	land degradation neutrality
LU	livestock unit
NDVI	normalized difference vegetation index
NPP	net primary productivity
PC	pastoral committee
PRAGA	participatory rangeland and grassland assessment
PUA	pasture users association
RS	remote sensing
SDGs	Sustainable Development Goals
SLM	sustainable land management
SOC	soil organic carbon
UNCCD	United Nations Convention to Combat Desertification

Background

As rangelands support one-seventh of the world's population and occupy one-third of its land area, there is increasing focus on their economic, environmental and nutritional roles, together with a growing understanding of their potential in climatic regulatory systems and biodiversity conservation (Lund, 2007; MOA and IUCN, 2015). However, rangelands and grasslands are complex, dynamic systems which make assessment and management difficult, given the many interacting biophysical elements, drivers and objectives of those that use them. Facilitating and developing tools to monitor rangeland and grassland complexity, and clearly demonstrate how management influences ecosystem processes, is an important component of improving rangeland management practices, regulatory systems and economic development (Liniger and Mekdaschi Studer, 2019; FAO and IUCN, 2022).

"The Participatory assessment of land degradation (LD) and sustainable land management (SLM) in grassland and pastoral systems (PRAGA) project", funded by the Global Environment Facility (GEF), was developed with the primary objective of:

> strengthening the capacity of local and national stakeholders in pastoral and agropastoral areas comprising of grasslands and rangelands to assess LD and make informed decisions to promote SLM in a way that preserves the diverse ecosystem goods and services provided by rangelands and grasslands (FAO and IUCN, 2015).

To achieve this objective, similar exercises have been undertaken in five pilot countries of Burkina Faso, Kenya, Kyrgyzstan, Niger and Uruguay, and documents outlining the findings and results are under preparation.

Key to project development was the creation, testing and refinement of an:

> integrated and participatory assessment process to estimate multiple benefits in grassland/pastoral areas (including mountain areas and agrosylvopastoral areas) and support policy and investment in decision-making and calibrate and test methods for LD and SLM assessment through pilot studies in mountain and lowland grassland/pastoral areas (FAO and IUCN, 2015).

As such, “the PRAGA project” was developed through a partnership between the IUCN and the Food and Agriculture Organization of the United Nations (FAO), and the completed methodology was captured in “The Participatory Rangeland and Grassland Assessment (PRAGA) methodology field guide” (FAO and IUCN, 2022).

This report represents a synthesis of the activities regarding the development and testing of the methodology in Kyrgyzstan, including a national and regional baseline review, large-scale assessment and RS, participatory mapping and indicator selection, field assessment results and validation workshops held to verify data, and the resulting conclusions that feed into the next steps and technical and policy recommendations. The lessons learned will also serve the global discussions centred on LD. The document is organized as follows:

- Brief introduction to the PRAGA methodology.
- Overview of LD and participatory approaches to its measurement and root causes.
- Baseline information on Kyrgyzstan and the national context, with emphasis on national pasture status and livestock production and markets.
- Presentation of baseline data and information on the oblast (region) of Naryn, where the majority of field plots and consultations were conducted during project activities.
- Analysis of RS trends and models based on Sustainable Development Goal (SDG) 15.3.
- Presentation of field results and their analysis following the draft PRAGA methodology.
- Validation of data.
- Conclusions and recommendations, including proposals for national policy and lessons learned.

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1 Introduction

1.1 PRAGA methodology

This report was developed in accordance with the PRAGA methodology. The PRAGA methodology was developed by the IUCN and FAO with funding from GEF and the support of ministries and governmental agencies of the five pilot countries: Burkina Faso, Kenya, Kyrgyzstan, Niger and Uruguay.

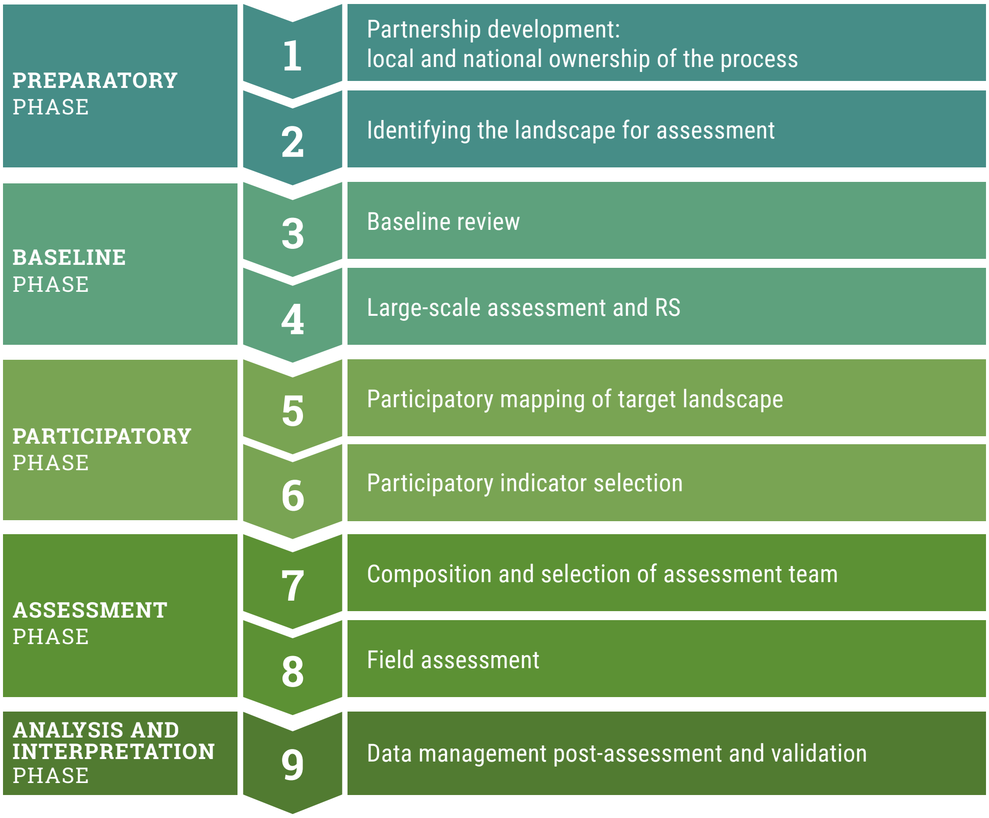
Figure 1 provides an overview of the nine principal steps of the PRAGA methodology. This document gives an overview of the PRAGA process, specifically Steps 3–4 (baseline review and large-scale assessment), Steps 5–8 (including field assessments, participatory mapping and stakeholder consultations) and Step 9 (analysis of the results of the process).[1]

This section briefly introduces the key steps in the PRAGA manual.

Initial discussions and workshops were held with project stakeholders in the country to understand the context and discuss objectives and proposals for project activities (Step 1 of PRAGA; see **Annex 1**). This was followed by the participatory selection of the landscape for assessment guided by land uses (Step 2 of PRAGA) through numerous meetings with stakeholders and land users over the course of 2018–19.

[1] For more information on the complete PRAGA methodology: FAO and IUCN. 2022. *Participatory rangeland and grassland assessment (PRAGA) methodology. First edition*. Rome, FAO and Gland, IUCN. https://doi.org/10.4060/cc0841en

Figure 1. Overview of the steps of the PRAGA methodology



Source: FAO and IUCN. 2017. *Participatory Rangeland and Grassland Assessment (PRAGA) methodology Field guide (first edition).* https://www.iucn.org/sites/dev/files/media-uploads/2018/12/prmp_methodology_021118.pdf

Once the pilot site areas and assessment landscapes were selected, the baseline report development process began. Information was gathered on national context and RS trends relating to pastoralism, livestock and socio-economics (Steps 3–4), and the study then focused on Naryn Oblast, where most of the field activities took place (Steps 5–8). The information and data obtained through this process were validated with stakeholders through workshops in the pilot site areas and then captured here as the final step (Step 9). It is important to note that the PRAGA methodology did not sequentially follow the nine steps outlined; in the interests of time, the assessment phase was completed before the baseline phase in order to access the field before the winter season.

1.2 Importance of pastoralism in the Kyrgyz agriculture sector

Although the cultural and economic importance of agriculture has declined in recent years, it continues to be a core sector of the economy, providing approximately 15 percent of the gross domestic product (GDP) and around 29 percent of national employment. Permanent pastureland accounts for 48 percent of land cover, whereas arable lands only account for 7 percent of land cover, which highlights the importance of extensive livestock production for the sector (FAO, 2012, 2015). Livestock ownership is still an important financial tool used by communities and most international remittances are invested in the purchase of animals (Mogilevskii *et al*., 2017). “Herding” (i.e. caring for another’s animals for a fee) is a refuge sector for the unemployed or impoverished communities. Pastoralism is also enshrined in local culture and represents an important part of the image that the country works to project to the international community.

The Soviet Union saw the opportunity for the development of the pastoral sector in the country and worked to create infrastructure and professionalize sedentary (cropping, dairy) and transhumance production systems (meat, dairy, fibre) in an attempt to optimize production through improved management and technology (Jamsranjav *et al*., 2018). Whether the system was sustainable and to what extent it aggravated LD is debatable and is still debated among herding communities today. However, most of those consulted during this work, through the process described in the following pages of this report consider the systems and techniques used during Soviet times to still be relevant and applicable today as means to revert degradation and maintain rangeland productivity.

Following the collapse of the Soviet Union, there was an ad hoc privatization process of land, especially arable land, machinery and livestock (Bussler, 2010; Isakov and Thorsson, 2015; Shigaeva *et al*., 2016). It was not a smooth process: the transfer procedures were poor and chaotic, and the situation was aggravated by the declining trade in agricultural goods, falling world prices for wool and a general breakdown of national transportation and marketing systems (Bussler, 2010). As a result, large groups of rural farm workers were left in poverty, with little access to services, suppliers and markets. Access to remote pastures was also affected as road maintenance was reduced and the cost of moving animals to these areas increased. Most producers at this time began to utilize local “winter pastures” year-round (Bussler, 2010; Hoppe *et al*., 2016; Isakov and Thorsson, 2015). Therefore, many remote pastures remain underutilized – another fact supported through the PRAGA baseline validation process.

With confusion also came opportunity. The economic and land reform policies implemented after independence strengthened the agriculture sector and significantly supported economic growth (Mogilevskii *et al*., 2017). Hailed as innovative and ground-breaking, they are often considered crucial to the early advances in agriculture and poverty reduction (CIAT and World Bank, 2018). The thinking at the time promoted processes of decentralization to return decision-making and management to local land user collectives. This led to a community-based approach to natural resource management. Two examples of the decentralization process that attempted to delegate power to local and regional decision makers are the Pasture Law of 2009 and the Water User Association Law which created 481 water user associations that operate and maintain the country's irrigation systems (CIAT and World Bank, 2018; Shigaeva *et al*., 2016). The Pasture Law of 2009 remains a celebrated piece of legislation, as it provides a legal framework for working with local pasture users to introduce SLM practices. Pasture users were key partners in the PRAGA project and were instrumental in defining how the PRAGA methodology could meet the country's needs and help improve management of the rangelands.

The United Nations Convention to Combat Desertification (UNCCD) (2018) estimated that LD costs Kyrgyzstan up to USD 601 million annually (equivalent to 16 percent of the GDP). This, together with other national social and ecological priorities, impelled Kyrgyzstan to direct part of the project development to working towards meeting its national voluntary land degradation neutrality (LDN) targets (see Chapter 2 for an explanation of the LDN framework). Kyrgyzstan has identified four priority areas and targets (UNCCD, 2018).

Land degradation neutrality: Voluntary targets for Kyrgyzstan (2017)

1. Improve environmental condition of pastures through introduction of pasture rotation system in at least 40 village districts (*ayil aimaks*).
2. Provide better access to 10 000 ha of pastures via improved pasture infrastructure (bridges/roads, water points).
3. Adopt SLM practices on 100 000 ha of land area (including both pastures and forests).
4. Conduct land improvement works on 10 000 ha.

Source: UNCCD. 2018. *Country Profile Kyrgyzstan: Investing in Land Degradation Neutrality: Making the case – An overview of indicators and assessments* [online]. Bonn, UNCCD. [Cited 27 April 2021]. https://www.unccd.int/actionsldn-programme/ldn-country-profiles

Therefore, Kyrgyzstan represented a unique opportunity for testing a methodology in a country characterized by:

- a strong tradition of pastoralism;
- experience and hands-on knowledge of pasture monitoring systems and indicators; and
- a legal framework with clear national LDN targets.

1.3 Pilot testing in Kyrgyzstan: Naryn Oblast

The Naryn Oblast was chosen as the primary focus of the project activities based on certain project objectives:

- First, there was a need for ongoing activities and initiatives by FAO or its partners on which the PRAGA methodology could build. This was important for achieving the GEF objective of incremental reasoning. CAMP Alatoo, the main project partner in Kyrgyzstan and a member of the Mountain Partnership Secretariat, has carried out substantial pasture management activities in the region. At the same time, Naryn is traditionally a focal point for other projects and initiatives, and therefore had an acceptable quantity of information available for developing the baseline scenario upon which PRAGA could build.
- Second, pastoralism is very important to the local and national economy. Naryn is central to most livestock activity within Kyrgyzstan, providing seasonal pastures for surrounding regions, setting standards and influencing terms of trade for rest of the country (Hoppe *et al.*, 2016; Isakov and Thorsson, 2015).
- Third, as a gathering point for different pastoral communities, Naryn allows for greater understanding and provides opportunities for consultations and the transfer of SLM practices to locals who seasonally use the Naryn alpine pastures before returning to their homes in neighbouring regions.
- Finally, the socio-economic conditions and situation of Naryn Oblast allowed for greater access to field and social indicators, which enabled the analysis of more field plots.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Introduction to land degradation and its assessment, quantification and monitoring

2

Definitions of LD and the associated indicators vary widely, though the Millennium Ecosystem Assessment's definition is the most commonly cited:

> "long term failure to balance demand for and supply of ecosystems goods and services" (MEA, 2005; Orr and Cowie, 2017).

UNCCD defines LD as:

> the reduction or loss of the biological or economic productivity and complexity of rainfed cropland, irrigated cropland or range, pasture, forest and woodlands, resulting from land uses or from a process or combination of processes arising from human activities (UNCCD, 2016).

What is clear is the economic, social and ecological loss that improper land management and LD cause communities around the globe. An estimated 25 percent of land is highly degraded, 36 percent moderately degraded though stable, while 10 percent is seen to be improving in terms of land potential indicators (Orr and Cowie, 2017). However, there are still discrepancies regarding the true extent of LD globally. Nkonya *et al*. (2015) calculate the annual economic loss of LD at USD 231 billion – that is, about 0.41 percent of global GDP (2007), affecting an estimated 3.2 billion people

and leading to food insecurity, damage to ecosystem processes and compromised livelihoods. As there is a fixed amount of dry land on Earth, degradation inhibits productivity and reduces the opportunities that fully functioning ecosystems can provide for growing human populations.

However complex the situation may appear, studies have shown that investments in arresting or addressing LD often have high rates of return benefiting multiple economic sectors. It is not uncommon to see returns of up to 200 percent within the first five years, and for long-term approaches (> 30 years) this can mean a return of five dollars for every dollar invested (Wilkinson and Hawken, 2017; Nkonya *et al*., 2015).

Recognizing the opportunities and possibilities that restoration of ecosystem health and function can provide, the United Nations General Assembly adopted LDN as SDG 15.3 (Orr and Cowie, 2017), defining LDN as:

> a state whereby the amount and quality of land resources necessary to support ecosystem functions and services and enhance food security remain stable or increase within specified temporal and spatial scales and ecosystems" (UNCCD, 2015, Decision 3/COP.12).

The SDGs are global and agreed upon by all United Nations member countries and although legally non-binding, countries are obligated to report on progress in targets. LDN has been promoted as a means to "a world where nations individually strive to achieve land degradation neutrality" on their own terms (Orr and Cowie, 2017).

Discussions on rangelands often include contradictory statements and differing opinions on their contribution and value as ecosystems (Liniger and Mekdaschi Studer, 2019), although the challenges they face have led some authors to list rangelands as among the land types most at risk (Carbutt, Henwood and Gilfedder, 2017; Jamsranjav *et al*., 2018; Sala *et al*., 2000). There have been changes to vegetation composition and growth patterns throughout global rangeland systems due to misguided management approaches (Carbutt, Henwood and Gilfedder, 2017). Seasonal use of fire and other forms of land clearing (often supported by government subsidies), overgrazing, bush encroachment, conversion to arable cropland, habitat fragmentation, wildlife poaching and climate change have all contributed to substantial losses in biodiversity and resilience (ibid.; Sala *et al*., 2000; Savory and Butterfield, 1999). Increasing demands are made on rangeland systems as populations continue to grow in Africa and Central Asia, in some cases leading to conflict and displacement of local communities

(Sulieman, 2018). Changes in cultural perceptions and production objectives have also led to the introduction of "modern" livestock breeds and productive models that are poorly adapted to local conditions. Ambiguous land tenure systems, which in some cases have been carried over from colonial times or following the collapse of the Soviet Union, have further complicated attempts to introduce SLM options and reduce biodiversity loss.

In spite of their importance, rangelands have not tended to receive the interest and study that other landform systems have enjoyed; as a global society, there is still much to understand. For instance, estimates on the extent of degraded area shift with time, not only as rangelands transform under different management and driver scenarios, but as changes occur in the definitions, indicators and tools used for measurement (Jamsranjav *et al*., 2018; Liniger and Mekdaschi Studer, 2019; Livine *et al*., 2017; Sabyrbekov, 2019). For instance, studies in the first global rangeland assessment undertaken placed 73 percent of the world's rangeland in the "degraded" category, though these estimates have fallen significantly in recent decades (Jamsranjav *et al*., 2018).

The reasons for these discrepancies are varied, but are typically due to the following issues:

- **Differences in defining degradation.** This can be especially apparent when older reference conditions are compared to current field conditions. Some of the changes observed are reversible or form part of the rangeland's dynamic features; others are permanent, irreversible changes in ecological structures and/or functions (Isakov and Thorsson, 2015; Jamsranjav *et al*., 2018). The two are often difficult to separate, even more so in studies that are limited in both time and funding.
- **Limited spatial scope of most national LD assessments targeting rangelands.** This is principally due to the costs of assessment, with results being correlated to similar areas. Isolation of drivers and the impact of livestock become less accurate as the results from small test sites are scaled up to regional, national or international levels.
- **Over-reliance on large data generation mechanisms.** Such mechanisms include the use of satellite imagery and may be misleading when not coupled with ground-truthing of the data.
- **Lack of engagement and communication with land users.** It is important to develop more complete models and gain a better understanding of rangeland

dynamics, and many experts argue for the need to increase communications with pastoralist communities in order to understand how rangelands change seasonally or following precipitation events (Isakov and Thorsson, 2015; Sabyrbekov, 2019). PRAGA was in part developed in response to these calls for more participatory approaches and methodologies.

- **Complexity of rangeland systems.** Complex systems are by definition governed by non-linear aspects, feedback loops, emergence events and adaptive abilities (FAO, 2021a; Savory and Butterfield, 1999). They can also have properties and behaviours that are distinct from those of their parts and, as such, can be extraordinarily difficult to model, influence or manage (FAO, 2021a; Savory and Butterfield, 1999).

On local or landscape scales, other issues and management objectives can also lead to confusion and debate about what constitutes LD, how it is measured and how it should be approached. For example, pasturelands that are rapidly being overtaken by forest and woody species can maintain ecological functions and supply ecosystem services, although the goods and services provided will be different from those stemming from former pasturelands. Given the current deforestation and climatic concerns, questions of whether this constitutes “degradation” have been raised. A similar debate concerns the conversion of forests and pasturelands to sustainable agro-ecosystems that continue to support vital ecological functions.

The issue of biodiversity and protected ecosystems can also lead to differences in opinion. Many protected areas are remnants of areas that have undergone important species loss and changes in ecological functions and structures. If improvements in ecological productivity and the consequent successional process lead to changes in vegetation structure and animal species using the area, should the previous conditions be maintained in order to preserve this ecosystem even when it is clear that the system has the potential to move towards a more “productive” (not so much in the ecological sense as in the anthropolgical – that is, the productive value given to the goods produced) land cover class or ecosystem?

According to SDG indicator 15.3.1 and the *scientific conceptual framework for land degradation neutrality*, “changes in land cover should be defined as degradation”; they should be identified and considered as communities come to terms with their

LAND DEGRADATION NEUTRALITY

LDN is:

> *a state whereby the amount and quality of land resources, necessary to support ecosystem functions and services and enhance food security, remains stable or increases within specified temporal and spatial scales and ecosystems.*
> *(Orr and Cowie, 2017)*

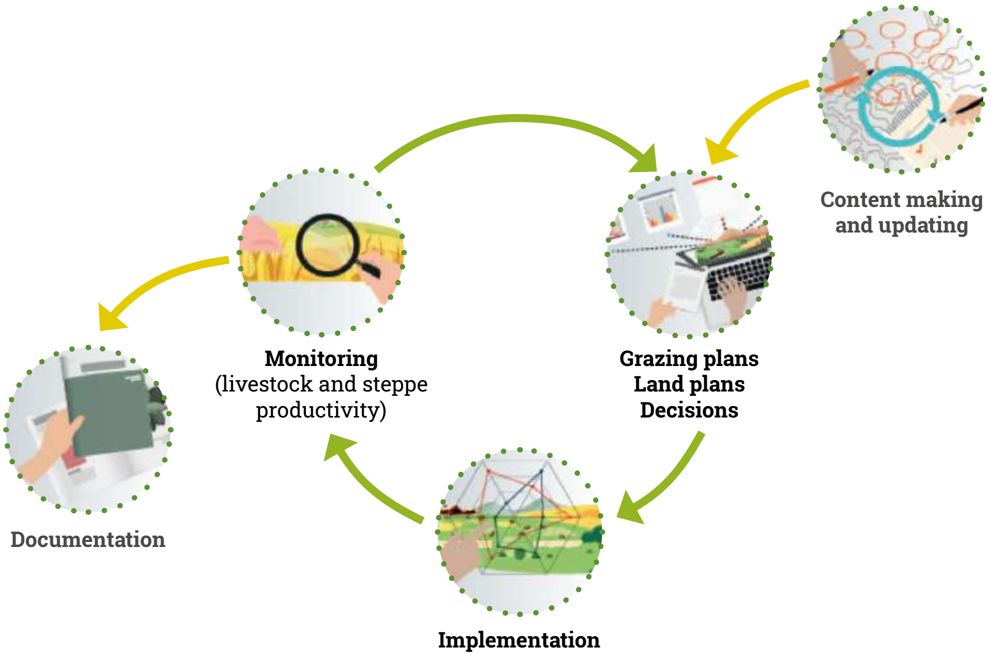
LDN represents a paradigm shift in land management practice and policies by counterbalancing losses in land productivity with gains in recovery of degraded areas; it strategically places measures to conserve, manage and restore land within land planning processes.

management decisions through the use of the framework. The LDN framework identifies three key indicators to determine LD: land cover, land productivity and carbon stores (Orr and Cowie, 2017). These three key indicators are believed to qualify as a monitoring baseline against which accounting for losses and gains in degraded areas can be undertaken. Such accounting depends on the total hectares of a land cover class and the amount of this class that is degrading, stable or improving. Therefore, monitoring of these simple indicators provides a quantitative, peer-reviewed methodology that takes into account not only rangeland complexity, but also what activities or industries are being applied and how the biophysical conditions of the land are responding to this management approach.

Figure 2 shows how ecological monitoring of LD through participatory, land user processes based on a group of basic indicators provides a means of measuring the success of current practices and allows for a more adaptive, real-time management approach. This is key to improving productivity and the flow of ecosystem services in systems as complex and dynamic as rangelands and grasslands.

Extensive grazing systems typically utilize strategies associated with livestock mobility, as seasonal context provides spatially diverse resource opportunities (Liniger and Mekdaschi Studer, 2019). How to best utilize these resources and the intensity of use should be monitored to avoid degradation of the productive base. Ecological

Figure 2. Grazing management cycle and monitoring component



Source: FAO. 2021a. Conservation and Sustainable Management of Turkey's Steppe Ecosystems. Project GCP/TUR/061/GFF. In FAO and the GEF – Partnering for Sustainable Agriculture and the Environment [online]. Rome. [Cited 27 April 2021]. http://www.fao.org/gef/projects/detail/en/c/1057041/

monitoring systems therefore act as feedback mechanisms to ensure that the proper response is given to unsustainable use of natural resources (FAO, 2021b).

The PRAGA methodology outlined in the previous section addresses the obstacles to understanding LD drivers and processes by establishing a line of communication with land users and decision makers, providing a participatory approach and framework to measure and provide solutions to LD while establishing a baseline for monitoring and a contextual framework for decision-making.

Chapter 3 explores the Kyrgyz national baseline context before presenting the socio-economic and environmental conditions and context of Naryn Oblast.

Kyrgyzstan, a pastoral perspective

3

3.1 National baseline context

Officially known as the Kyrgyz Republic, the country of Kyrgyzstan is a landlocked country located in Central Asia between latitudes 39° and 44° N, and longitudes 69° and 81° E (FAO, 2015). Kyrgyzstan was formed following independence from the former Soviet Union in 1991 and today the country occupies a surface area of 199 949 km² bordering with Kazakhstan to the north, China to the east, Tajikistan to the southwest and Uzbekistan to the west and southwest (FAO, 2011). Its capital and largest city is Bishkek, with a population of approximately 1 million. Key socio-economic indicators are provided in the factsheet below.

KYRGYZSTAN FACTSHEET

TOTAL POPULATION: 6 202 500 (2016)

TOTAL AREA: 199 949 km²

POPULATION DENSITY: approximately 25 people per km²

GDP: USD 8 093 million (2018) - **GDP per capita:** USD 1 204 (2016–2018)

RANK IN WORLD TRADE: **Merchandise >** Exports: 141 - Imports: 131 **Commercial >** Exports: 135 - Imports: 145

HUMAN DEVELOPMENT INDEX (highest = 1): 0.615 (2011)

ACCESS TO BASIC NEEDS: **Water >** 89% (85% rural areas) - **Electricity >** 100% - **Literacy rates >** 99%

EMPLOYMENT IN AGRICULTURE: 29.3% (60% men / 40% women)

POVERTY LEVELS: 32% below poverty line (37% in rural areas)

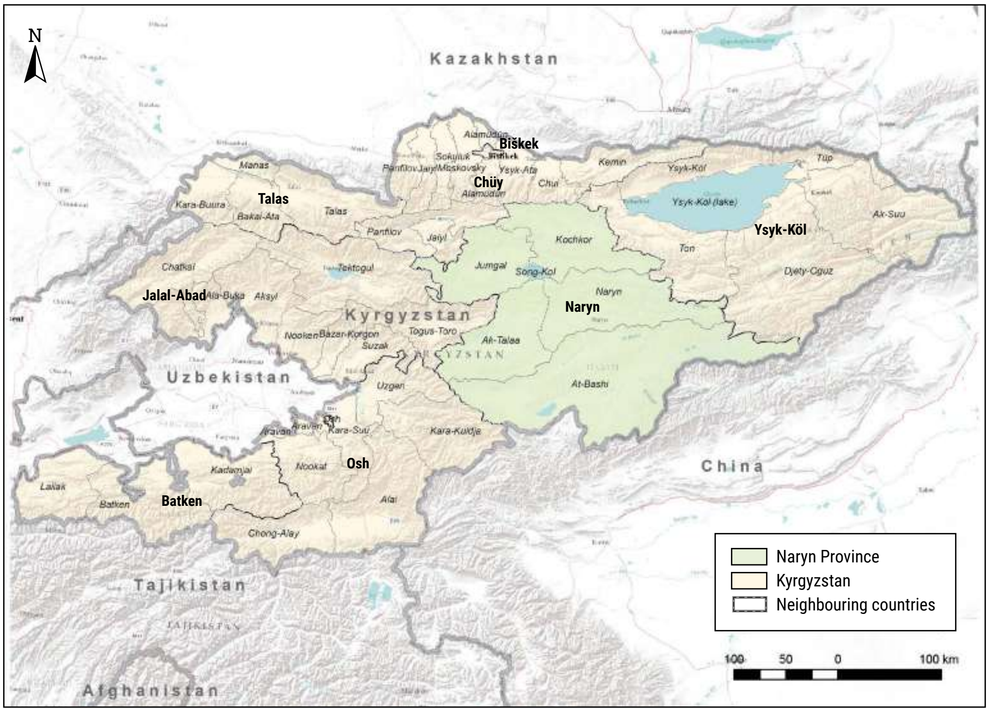
PERCENTAGE OF INCOME SPENT ON FOOD: 48%

Memberships: Commonwealth of Independent States, Eurasian Economic Union, Collective Security Treaty Organization, Shanghai Cooperation Organisation, Organization of Islamic Cooperation, Turkic Council, International Organization of Turkic Culture, United Nations.

Sources: FAO. 2018. *The Kyrgyz Republic: Socio-economic context and role of agriculture.* Country fact sheet on food and agriculture policy trends. (also available at http://www.fao.org/3/I8701EN/i8701en.pdf); National Statistical Committee of the Kyrgyz Republic (NSC). 2015. *Women and men in the Kyrgyz Republic: 2010–2014.* Department of Social Statistics. [online]. Bishkek.[Cited 27 April 2021]. http://stat.kg/en/publications/sbornik-zhenshiny-i-muzhchinykyrgyzskoj-respubliki/; World Bank. 2018. *Kyrgyz Republic – From vulnerability to prosperity: Systematic Country Diagnostic* (English) [online]. Washington, DC. [Cited 26 April 2021]. http://documents.worldbank.org/curated/en/516141537548690118/Kyrgyz-Republic-From-Vulnerability-to-Prosperity-Systematic-Country-Diagnostic; World Trade Organization (WTO). 2019. *Profile of the Kyrgyz Republic. Statistical Database for 2019* [online]. [Cited 27 April 2021].

Administratively, the country is divided into seven “oblasts” or regions: Batken, Chuy, Djalal-Abad, Issyk-Kul, Naryn, Osh and Talas. These are further subdivided into “rayons”, which are then divided at the municipal level into “ayil Okrug” (Isakov and Thorsson, 2015). **Figure 3** shows a map of Kyrgyzstan, depicting its principal administrative units and geopolitical position.

Figure 3. Naryn Oblast, Kyrgyzstan (2019)

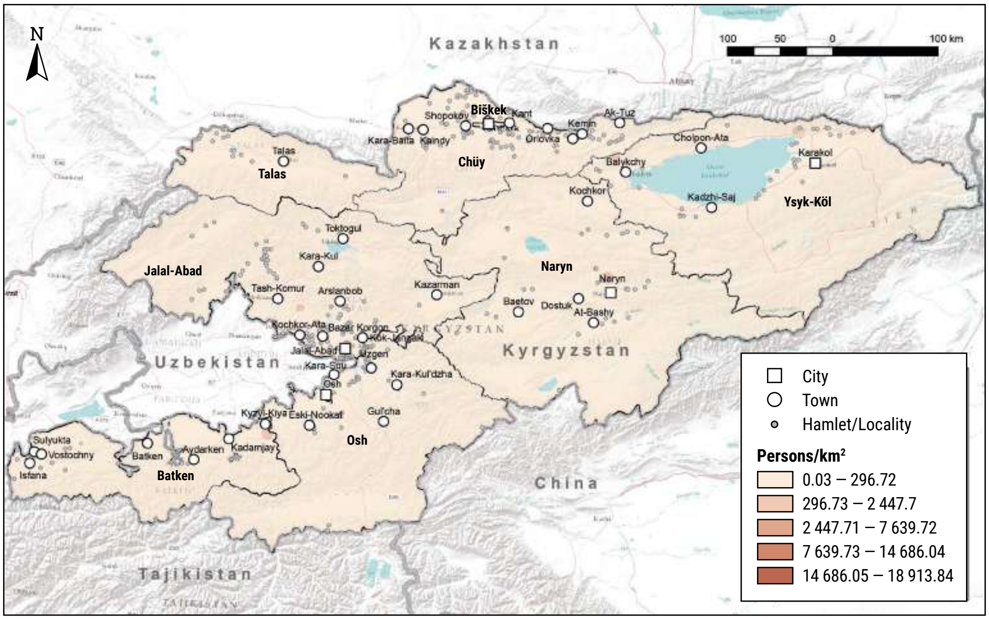


Source: Global Administration Database Mapping (GADM). 2019. Naryn Oblast, Kyrgyzstan (2019). Cited 10 November 2019. https://gadm.org/download_country.html. Modified to comply with UN, 2020

Demographics

As for other aspects of life in Kyrgystan, settlement patterns are influenced by the topography, with most towns and villages located in the lower valleys near reliable sources of water (**Figure 4**).

Figure 4. Settlement patterns and population distribution, Kyrgyzstan (2019)



Source: The NASA Socioeconomic Data and Applications Center (SEDAC), Gridded Population of the World, Version 4 UN WPP adjusted. 2015. Settlement patterns and population distribution, Kyrgyzstan. Cited 10 November. https://sedac.ciesin.columbia.edu/data/set/gpw-v4-population-density-adjusted-to-2015-unwpp-country-totals-rev11. Modified to comply with UN, 2020

Kyrgyzstan can be considered a "young country" – 33 percent of the population are below working age, 60 percent of working age and 7 percent above working age (NSC, 2015). The proportion of men and women is equal until the age of 35, after which women begin to account for a greater share of the population, culminating in a situation where in the > 65 age group, the number of women is double that of men (NSC, 2015).

In 2014, life expectancy was 66.5 years for men and 74.5 years for women; the fertility rate increased from 3.1 children in 2010 to 3.2 in 2014, with an increasing number of young women (15–19) having children as well as more women bearing in their late 30s (NSC, 2015). This is above the average of 2.1 children that has been maintained in the other Commonwealth of Independent States countries that comprised the former Soviet Union. The increase in early motherhood rates also impacts gender equality as it decreases access to education and increases the risk of poverty and food insecurity among young mothers.

Literacy rates are high: 99 percent have completed some type of formal schooling or education. There are 77 public schools in the capital Bishkek and more than 200 throughout the rest of the country. In addition, there are 55 higher education institutions and universities, 37 of which are state-run. In 2016, the University of Central Asia was launched in the oblast of Naryn.

The majority of the population is ethnic Kyrgyz, together with significant Uzbek and Russian minorities. The language and culture have Turkic roots, with Persian, Mongolian and Russian influences; Russian is also an official language given the decades under the Soviet system. The majority practise non-denominational Islam with strong Sunni influences, while a small minority of Russian Orthodox Christians also remain active. An estimated 3.8 million (64 percent of the total population) live in rural areas (CIAT and World Bank, 2018).

Human and economic development

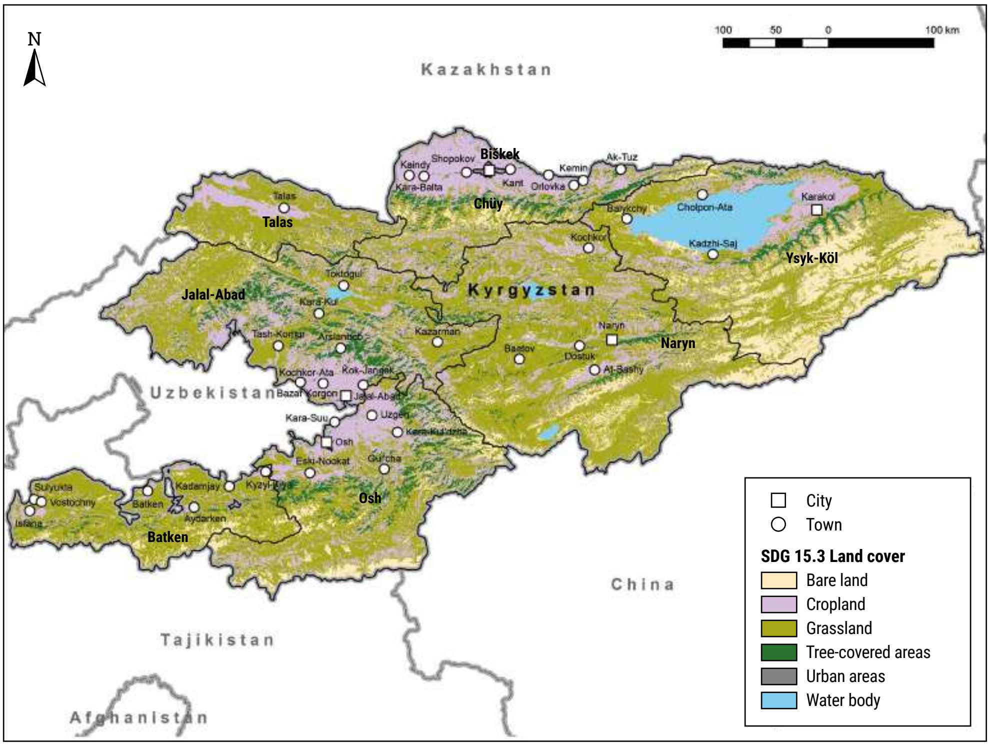
Classified as a lower middle-income country, Kyrgyzstan was ranked 120 out of 180 in the 2016 human development index (CIAT and World Bank, 2018). In the same year, the country was also classified as a low-income food-deficient country (LIFDC) (FAO, 2018) with one out of 15 people suffering from malnutrition (CIAT and World Bank, 2018). However, Kyrgyzstan successfully reached the Millennium Development Goal and the World Food Summit goal of halving the number of hungry people by 2015 (FAO, 2018). In just three years, the poverty level was reduced from 37 percent in 2013 to 25.4 percent in 2016 (CIAT and World Bank, 2018; Mogilevskii *et al*., 2017), with the most significant results in the oblasts of Naryn and Issyk-Kul (NSC, 2015). Since the turn of the century, there has also been progress in the reduction of childhood malnutrition; on the other hand, obesity and the increase in non-communicable diseases have become causes for concern, with more than half of men and women over the age of 40 overweight or obese. Of all deaths, 80 percent are now attributable to cardiovascular ailments, diabetes, cancer or chronic respiratory diseases (FAO, 2018; NSC, 2015).

Since gaining independence from the Soviet Union in 1991, the country has experienced political and social unrest, including ethnic conflicts, revolts, natural disasters and economic downturns (FAO, 2018; WFP, 2013). Economic prosperity is interlinked with that of the Russian Federation and its neighbour Kazakhstan, and the top productive sectors include agriculture, mining and external remittances, with the latter comprising 30 percent of GDP from 2011 to 2015 (FAO, 2018; WFP, 2013).

Land cover

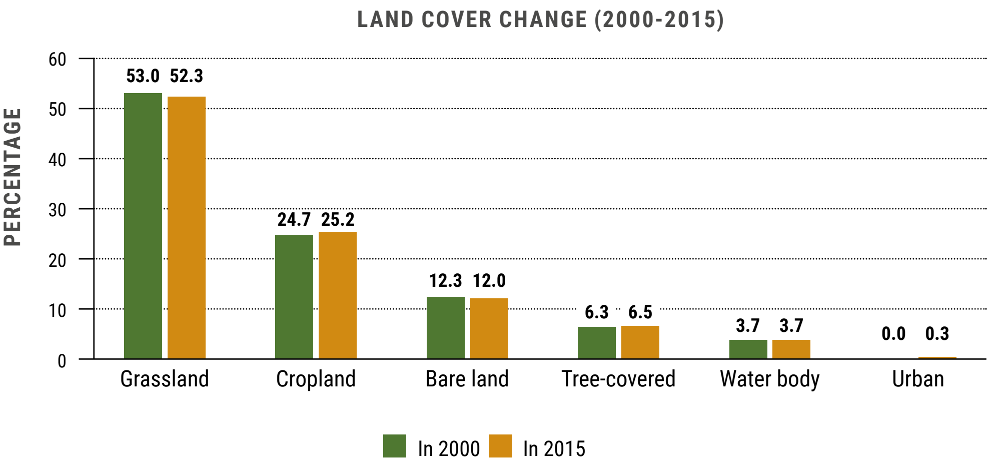
Land cover falls primarily under agricultural use. The land is commonly subdivided into permanent pastureland (48 percent), arable cropping land (7 percent) and forestry (4 percent); the rest comprises other land cover types, mostly non-productive lands in the higher altitudes, rocky outcrops, glaciers, snowfields and urban areas (FAO, 2012, 2015). However, the project team recorded different results when applying the protocols for land cover measurement as established by UNCCD based on the aggregation of the European Space Agency Climate Change Initiative Land Cover (ESA CCI LC) 300 m data set (UNCCD and CSIRO, 2017). The land cover classes can be seen in **Figure 5**, while **Figure 6** shows variations in their percentages between 2000 and 2015.

Figure 5. Land cover classification, Kyrgyzstan (2019)



Source: European Space Agency, Climate Change Initiative (ESA, CCI). 2019. Land cover classification, Kyrgyzstan (2019). Cited 11 November 2019. https://www.esa-landcover-cci.org/. Modified to comply with UN, 2020

Figure 6. Percentages for land cover classification, Kyrgyzstan (2019)



Source: Mwangi P. K. 2019. Percentages for land cover classification, Kyrgyzstan year 2000 and 2015.

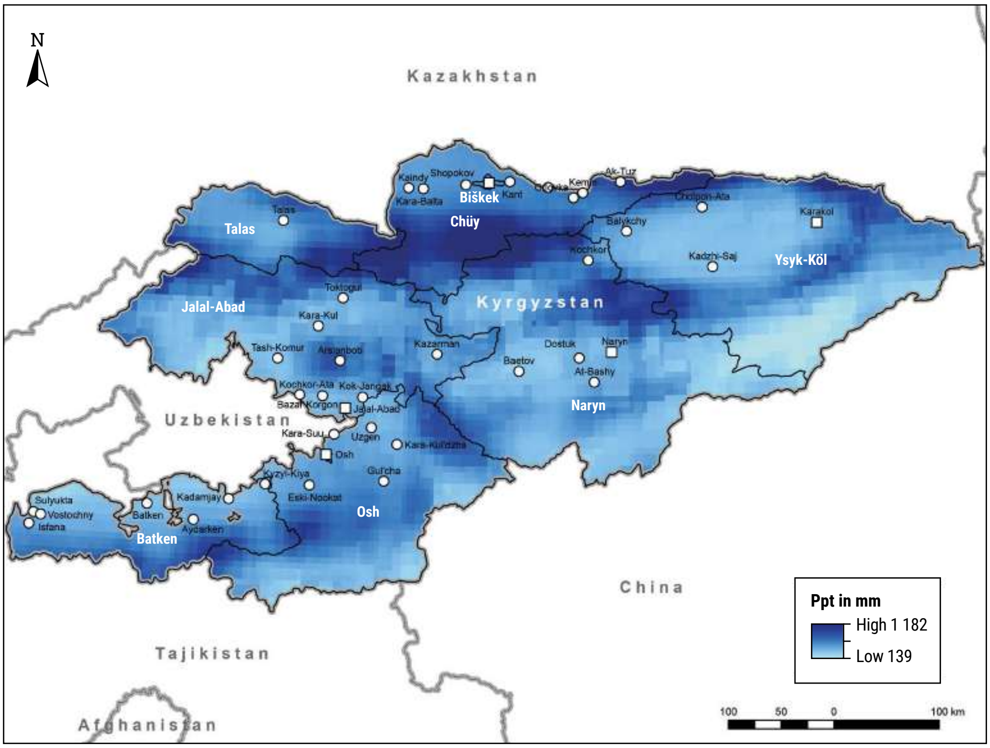
Kyrgyzstan is considered a mountainous country, with the Tian Shan range occupying around 90 percent of the land area (CIAT and World Bank, 2018; Shigaeva *et al*., 2016). Around 94 percent of the land area is above 1 000 m and 40 percent is above 3 000 m (FAO, 2012), and the two highest mountains are Lenin Peak (7 439 m) and Khan Tengri Peak (6 995 m). The remaining land cover comprises valleys and river basins that tend to follow a latitudinal direction and reach 500–600 m at their lowest points, the Fergana and Chui valleys (FAO, 2015). The majority of the mountains have an asymmetric slope; the northern ranges are wider and flatter, while the southern ranges are steeper and narrower.

Climate

The ruggedness of the land is in contrast with a diverse climate that ranges from subtropical in Fergana Valley, to temperate in the northern foothills, and from dry continental to polar in the upper alpine regions of the Tian Shan. Solar radiation oscillates between 2 500 and 2 750 hours per year – less in enclosed valleys or canyons. The average hours of sunlight range from nine in December to 15 in July, though some authors state that actual sunlight hours are less (between 5.5 and 12) (FAO, 2015).

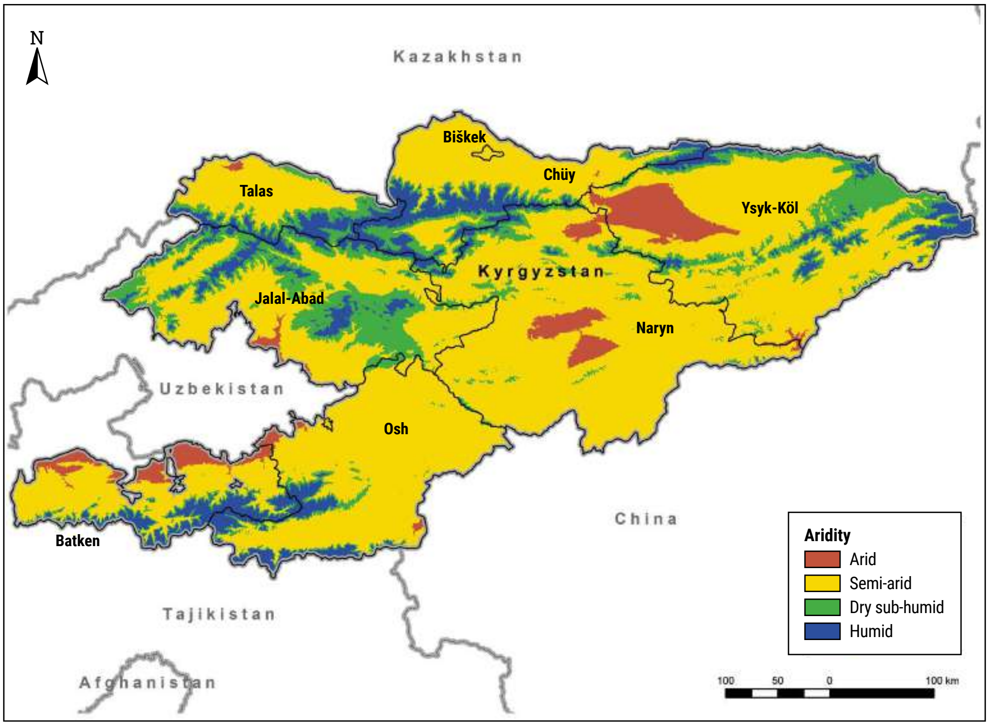
Average annual temperatures vary between −18 °C in winter and 28 °C in high summer in the valleys; however, absolute temperatures can reach −54 °C and 43 °C (FAO, 2012). The altitude and terrain contribute to microclimate development and rainfall varies with altitude (see **Figure 7** and **Figure 8**). For instance, precipitation rates range from 150 mm in the Fergana Valley to 1 000 mm in the surrounding mountains (FAO, 2015). Precipitation occurs more frequently in the winter months (October–April) and much of it is therefore snow (FAO, 2012). Frosts are also commonplace and can limit crop production and even cause losses. Frost-free areas are infrequent in the inner mountainous areas of the Tian Shan ranges above 2 800 m (FAO, 2015).

Figure 7. Average annual precipitation rates, Kyrgyzstan, 2009–2019 (2019)



Sources: Climate Hazards Group InfraRed Precipitation with Station (CHRIPS) Database version 2, USGS & NOAA. 2019. Average annual precipitation rates, Kyrgyzstan, 2009–2019. Cited 12 November 2019. https://data.noaa.gov/dataset/dataset/chirps-version-2-0-precipitation-global-0-05-5-day-1981-present. Modified to comply with UN, 2020

Figure 8. Aridity index, Kyrgyzstan (2019)

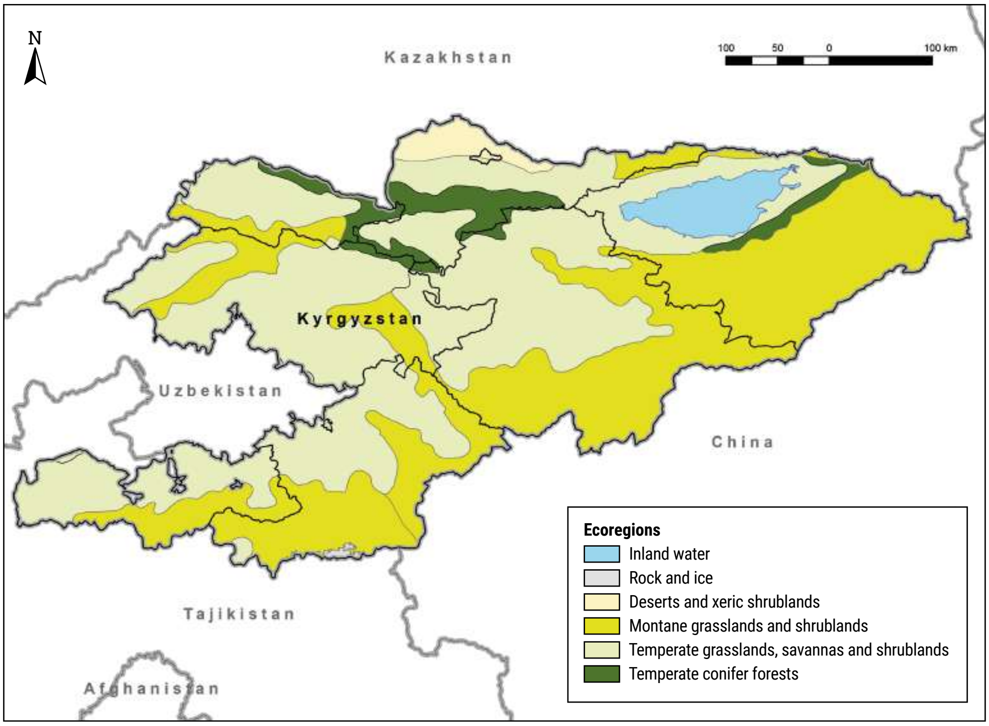


Source: Climate Database version 2. 2019. Aridity index, Kyrgyzstan 2019. Cited 12 November 2019. https://cgiarcsi.community/2019/01/24/global-aridity-index-and-potential-evapotranspiration-climate-database-v2/. Modified to comply with UN, 2020

Ecoregions

Three broad ecoregions (**Figure 9**) may be described as: the Fergana Valley area, including the Osh, Jalal-Abad and Batken Oblasts; the central mountainous zone, including Naryn; and the northern areas around the Chui and Talas rivers and Issyk-Kul Lake (CIAT and World Bank, 2018; FAO, 2012).

Figure 9. Principal terrestrial ecosystem classifications, Kyrgyzstan (2019)



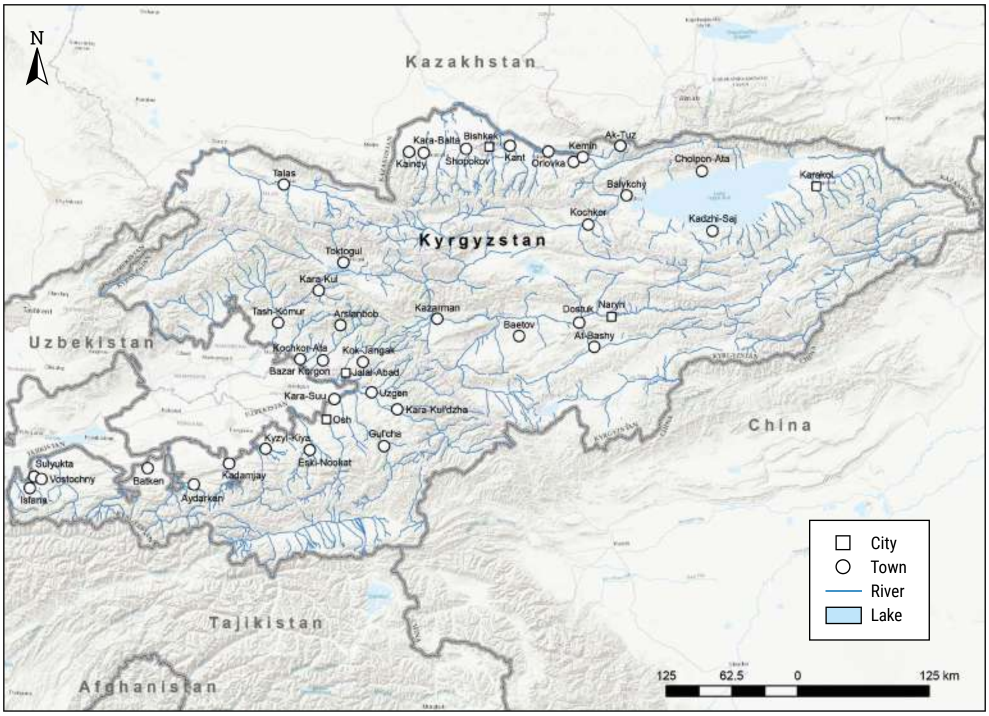
Source: Terrestial Ecoregions, The Nature Conservancy. 2009. Principal terrestrial ecosystem classifications, Kyrgyzstan. Cited 12 November 2019. https://geospatial.tnc.org/datasets/b1636d640ede4d6ca8f5e369f2dc368b/about. Modified to comply with UN, 2020

Hydrology

The country is often divided into two principal hydrological zones: the flow generation zone covering 171 800 km^2 (87 percent of the national territory); and the flow dissipation zone estimated at 26 700 km2 (13 percent) (FAO, 2012). Most streams and secondary rivers are fed by glaciers or snowmelt and have the typical features of young mountain streams, that is, single streams directed by ledge rocks, with significant drops in height and strong river currents (FAO, 2015). Peak stream and river flow are therefore associated with temperature increases occurring from April to July. The main river systems are the Kara Darya, which flows west through the Fergana Valley into Uzbekistan, and the Naryn; these two rivers form the Syr Darya, or Syr River catchment, which historically flowed into the Aral Sea before the demand for irrigation and hydroelectric projects in neighbouring countries reduced the flow to a minimum. The Chu River also passes briefly through the country. Interestingly, most of Kyrgyzstan's main rivers flow east to west and all the rivers flow into internal closed basins (FAO, 2015).

Due to its glacial and tectonic past, Kyrgyzstan has around 2 000 small lakes and several large ones, including the internationally renowned Issyk-Kul, Chatyr-Kul and Son-Kul; indeed, Issyk-Kul is the world's second largest mountain lake after Lake Titicaca (FAO, 2015). **Figure 10** shows the principal rivers and lakes of Kyrgyzstan.

Figure 10. Principal water bodies and their relation to human settlement, Kyrgyzstan (2019)



Source: Humanitarian OpenStreetMap (HOTOSM). 2018. Principal water bodies and their relation to human settlement, Kyrgyzstan. Cited 12 November 2019. https://data.humdata.org/dataset/hotosm_kgz_waterways. Modified to comply with UN, 2020

Soil

In Kyrgyzstan, the soil characteristics are typically determined by their parent geology, their location in the landscape, their exposure to time, weathering and biological activity, and the presence, past or present, of glacial activity. As such, the soils of Kyrgyzstan typically fall into two principal groupings: soils formed in valleys and lower drainage areas; and soils on the mountain slopes and upper alpine areas (FAO, 2015). **Table 1** shows the principal soil types in the country.

TABLE 1. Principal soil groupings for Kyrgyzstan

LANDFORM/LOCATION IN LANDSCAPE	COMMON SOIL TYPES
Intermountain, closed valleys	Grey semi-desert soils (sierozems), grey-brown desert-steppe stony soils, black earths (chernozems), light brown and chestnut soils
Lower slopes, ridges, low plateaus (*Syrt*)	Takyr desert, brown desert-steppe, steppe chestnut soils
Dry steppe and steppe	Grey-brown, brown, chestnut soils
Forest meadow steppe	Mountain chernozems, mountain forest black-brown, brown (under *Juniperus*), mountain forest brown
Subalpine	Mountain-meadow-steppe alpine soils
High-altitude heathlands	Skeletal carbonate under *Leucopoa*, half-peaty *Kobresia* heathland and polygonal tundra peat soils

Source: FAO. 2015. *Endemic and rare plant species of Kyrgyzstan (Atlas)*. 2nd edition. Ankara. (also available at http://www.fao.org/3/i4914bb/i4914bb.pdf).

Vegetation

The relief, climate and location of Kyrgyzstan have all contributed to highly complex vegetation types and structures, often considered among the richest in the region, containing 70 percent of the genera and 90 percent of the families represented in Central Asia (FAO, 2015; Fisher *et al*., 2004). There are an estimated 4 100 plant species present in the country, comprising 850 genera from 140 families. They have been classed within 30 vegetation types, of which the most representative are: mountain taiga, lowland forest, meadows and steppe meadows, mesophilic mountain grasses, deciduous forests and shrublands, tall grasslands, juniper-dominant forests, steppe, xerophilous deciduous Eastern Mediterranean forests, open woodlands and shrublands, semi-savannas, semi-shrubland desert, and petrophylic vegetation (FAO, 2015).

Forest cover is commonly commonly considered to be roughly 4–5 percent of land cover and accounts for a total area of 700 000–800 000 ha depending on the measurement methodology. Prior to 1930, forest cover was estimated at 7 percent of land cover, but over-exploitation during the Second World War and subsequent decades resulted in a gradual reduction to today's 4 percent (Fisher *et al*., 2004). Despite reorganization of the forestry sector and the implementation of ambitious reforestation programmes in response to concerns for the future of this resource, forest cover has still not been restored to its pre-twentieth century levels.

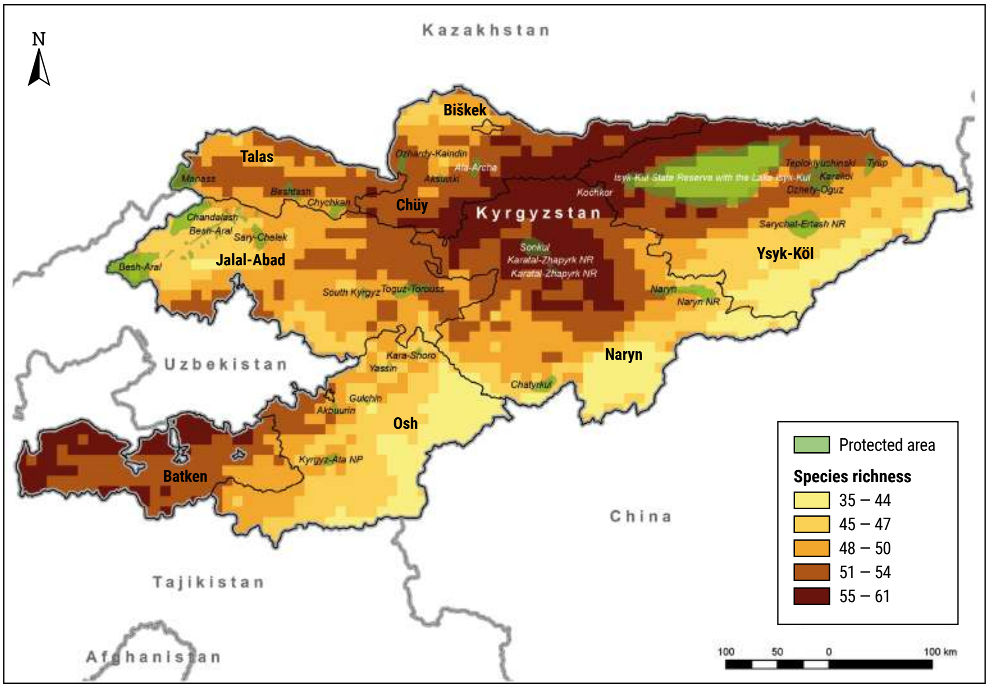
Fisher *et al*. (2004) proposed four broad classifications of the principal forest cover classes:

- **Spruce forest (*Picea schrenkiana* Fisch. et May.).** These forest types are typically found in the west, centre and higher ranges of the northern part of the Fergana Valley, between 1 700 m and 3 000 m. The spruce can be found together with the endemic semenov fir tree (*Abies semenovii* B. Fedtch) in the western extremes of the country.
- **Walnut–fruit forest.** These forests show clear anthropogenic influences as woody, fruit-bearing species were favoured over other local species, giving rise to today's forest communities. They are rich in walnut (*Juglans regia* L.), apple (*Malus* spp.), hawthorn (*Crataegus* spp.), plum (*Prunus* spp.), rose (*Rosa* spp.), almond (*Prunus amygdalus* Stokes) and pistachio (*Pistacia vera* L.), and occupy valleys, foothills and slopes between 800 m and 2 400 m, with almond and pistachio occupying the drier, lower reaches of the hills. The walnut forests of Kyrgyzstan are highly valued conservation areas, containing the largest remaining remnants of this forest type in the world.
- **Juniper forest (*Juniperus* spp.).** Junipers and their associated plant communities tend to be located on arid sites or high alpine areas up to 3 500 m. They typically form open stands or ground-hugging shrubs in areas of high winds.
- **Riparian forest.** These forest types are closely associated with watercourses and wetlands. They typically comprise willow (*Salix*), poplar (*Populus*), birch (*Betula*) and tamarix (*Tamarix*), and on occasion also sea buckthorn (*Hippophae rhamnoides* L.).

Forests are wholly owned by the state and managed by the State Forest Service – the state body responsible for the implementation of national forest policy, including forest management, hunting, management of national parks and other protected areas, and biodiversity conservation.

Given the array and importance of the country's plant communities, it is not surprising that the country is a biodiversity hotspot (**Figure 11**).

Figure 11. Terrestrial species distribution, Kyrgyzstan (2019)

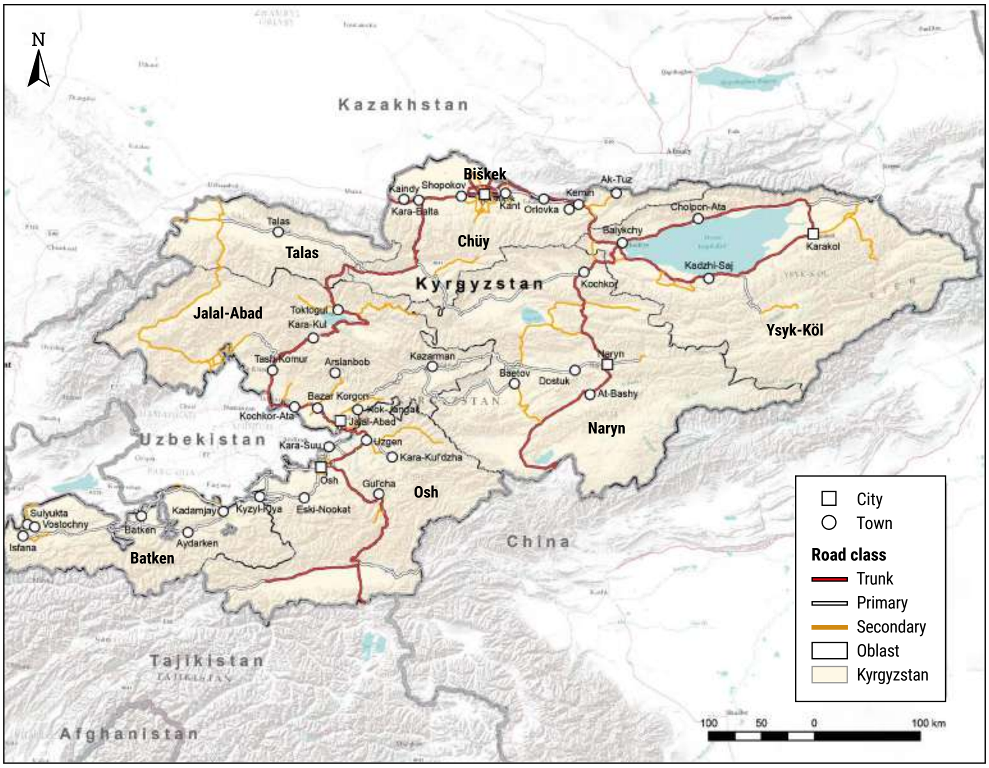


Source: International Union for Conservation of Nature (IUCN) red list species & World Database of Protected Areas. 2018. Terrestrial species distribution, Kyrgyzstan. Cited 13 November 2019. https://data.humdata.org/dataset/hotosmkgz_waterways. https://www.iucnredlist.org/; https://www.iucn.org/theme/protected-areas/our-work/world-database-protected-areas. Modified to comply with UN, 2020

Infrastructure

Infrastructure tends to be conditioned by the limited options imposed by the country's terrain. Roads often cross low valleys or mountain passes at 3 000 masl and are subject to recurrent extreme climatic events (CIAT and World Bank, 2018). Travel and supply lines are especially fragile during winter months when heavy snowfall, extreme temperatures and the risk of avalanches are high (Mogilevskii *et al*., 2017. In addition, many of the roadways were constructed during the Soviet era and crossing today can require official documents and protocols. The current road network is also not extensive, as can be seen in **Figure 12**. Given these difficulties, horses are still a favoured transport option in the more rural and isolated areas.

Figure 12. Map of principal motorways, Kyrgyzstan



Source: Humanitarian OpenStreetMap (HOTOSM). 2018. Map of principal motorways, Kyrgyzstan. Cited 12 November 2019. https://data.humdata.org/dataset/hotosm_kgz_roads. Modified to comply with UN, 2020

3.2 Agriculture sector overview

The agriculture sector contributes roughly 15 percent to GDP – a dramatic decrease since the turn of the century when it contributed 34 percent (FAO, 2018). The same trend is evident in employment in the sector: in 2000, agriculture accounted for 52.4 percent, while official data for 2015 cites the sector as accounting for just 29.3 percent of employment (NSC, 2015). There are also differences between the various oblasts in the country: for example, in 2015, agriculture accounted for 62.1 percent of employment in Talas Oblast compared with just 21.5 percent in Chuy Oblast.

International trade in agricultural goods

Kyrgyzstan has several subsector agricultural products targeted for export (see Overview on following page), the most significant of which include vegetables, dairy products, fruits, tobacco and cotton (CIAT and World Bank, 2018). Exports currently make up 11.3 percent of total exports, and in the last two decades, agricultural products have contributed 10–20 percent to total exports (WTO, 2019; Mogilevskii *et al*., 2017). With the transition to more market-oriented products, cotton and tobacco have been gradually replaced with vegetables, fruits, dairy and pulses. The principal markets for agricultural goods are Kazakhstan, the Russian Federation and Turkey.

OVERVIEW OF LEADING AGRICULTURAL IMPORTS AND EXPORTS

TOTAL EXPORTS: USD 119 million

PRINCIPAL AGRICULTURAL PRODUCTS:
Dried beans: 38% – Raw milk: 7% – Shelled walnuts: 5% – Apricots: 5% – Apples: 5%

TOTAL IMPORTS: USD 231 million

PRINCIPAL AGRICULTURAL PRODUCTS:
Wheat: 32% – Raw chicken: 16% – Raw pork: 5% – Raw beef: 4% – Rice: 4%

TRADE DEFICIT: USD -112 million USD (2018)

Sources: FAO. 2018. *The Kyrgyz Republic: Socio-economic context and role of agriculture.* Country fact sheet on food and agriculture policy trends. (also available at http://www.fao.org/3/I8701EN/i8701en.pdf).; CIAT & World Bank. 2018. *Climate-smart agriculture in the Kyrgyz Republic.* CSA Country Profiles for Asia Series. Washington, DC. 28 pp.

However, certain limiting factors, such as the amount of arable land, the climate and high production costs, have meant that the country is largely reliant on food imports (FAO, 2012). Demand for processed foods, grain and flour, as well as luxury items, has grown as the country's living standards have increased. Internal demand outmatches production, a situation that is likely to intensify given demographics and the stagnation in agricultural output (FAO, 2012).

Imports involve more complex trade routes and sources than do exports, even though most goods are imported from neighbouring countries, in particular former Soviet partners and China (Mogilevskii *et al*., 2017). Principal commodity imports include wheat flour, vegetable oils and sugar.

In 2015, Kyrgyzstan joined the Eurasian Economic Union (EAEU), resulting in better protection for migrant workers and increased access to EAEU member states and large-scale infrastructure investments. However, companies wishing to export face other important barriers and technical obstacles (Mogilevskii *et al*., 2017; WFP, 2013). The lack of funding for veterinary and agrochemical control systems has made access to most markets problematic – a situation further complicated by a lack of uniformity in terms of processing, ingredients and packaging of products from smallholder farms. Moreover, Kyrgyz enterprises tend to be small, and exportation would require improved trade flows of raw materials, greater processing and storage capacity of the company, and upgraded transport infrastructure on regional, national and international scales. These issues were also dealt with in the EAEU agreement, which established that the country would receive financial aid for improved laboratories for food testing and that customs obligations would be relaxed on the Kyrgyzstan–Kazakhstan border (Mogilevskii *et al*., 2017). However, many of the investments are yet to materialize.

3.3 National context: agricultural development following independence and the current state

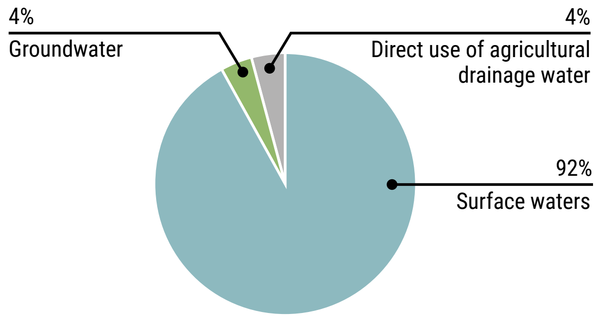
Although agricultural reforms led to early gains, recurrent natural disasters, economic issues and political instability have led to a reduction in investment and innovation in the sector over the last decade. Dependence on small-scale, subsistence farming models, lack of investment in infrastructure and human capital, high production costs and LD have all contributed to the decline of the sector, according to most experts (Mogilevskii *et al*., 2017).

Following independence, the agriculture sector underwent a gradual transformation towards more market-oriented strategies and products (CIAT and World Bank, 2018; Mogilevskii *et al*., 2017). During Soviet rule, Kyrgyzstan was involved in more technically focused production activities, such as the breeding of sheep for wool, tobacco and cotton (ibid.). However, food security issues affected production, as potatoes, vegetables and legumes began to occupy more land and food production shifted to cover basic alimentary needs following the collapse of the Soviet Union.

Irrigation capacity

Today, around 2 250 000 ha (76 percent) of agricultural land have irrigation capacity, with 93 percent of the water withdrawn used for agricultural purposes (**Figures 13 and 14**) (CIAT and World Bank, 2018; FAO, 2012; Shigaeva *et al*., 2016). Kyrgyzstan has traditionally had sufficient, internally produced water resources for its needs, with an estimated average natural surface water flow of 46.46 km^3/year (FAO, 2012). However, as most water comes from glaciers and snow, the flow can be low and unreliable in August and September when crops are completing their growing season. Improved regulation of these flows has been recommended to ensure adequate water supplies throughout the cropping period (FAO, 2012; Mogilevskii *et al*., 2017).

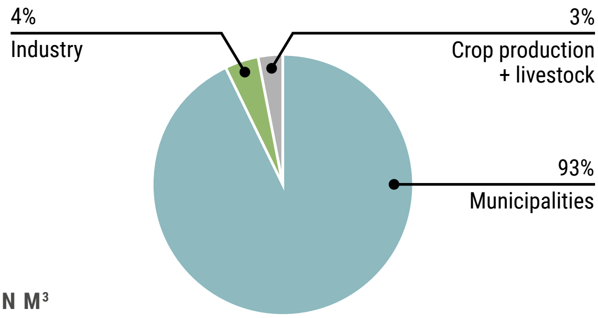
Figure 13. Water withdrawal by source, 2006



TOTAL 8 007 KM³

Source: FAO. 2012. *Irrigation in Central Asia in figures. AQUASTAT Survey – 2012.* FAO Water Reports 39. Rome. (also available at http://www.fao.org/3/i3289e/i3289e.pdf).

Figure 14. Water withdrawal by sector, 2006

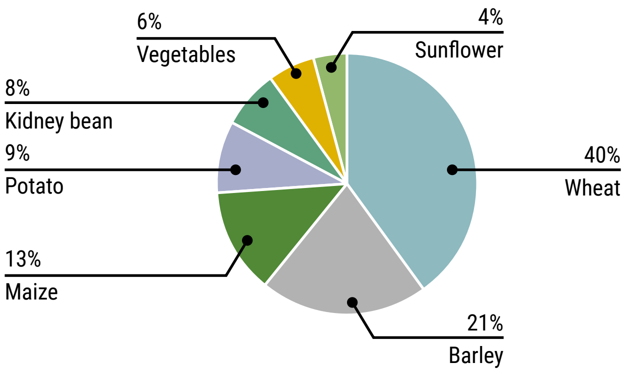


TOTAL 8 007 MILLION M³

Source: FAO. 2012. *Irrigation in Central Asia in figures. AQUASTAT Survey – 2012.* FAO Water Reports 39. Rome. (also available at http://www.fao.org/3/i3289e/i3289e.pdf).

Figure 15 shows the crop production per harvested land area. Wheat production reached its peak in 1997–2000, but has since gradually lost ground to other more lucrative crops such as kidney bean and melon (Mogilevskii *et al*., 2017). Cotton production has become a secondary crop for farmers in those areas where it once was dominant; tobacco has also lost importance as a crop due to production costs (CIAT and World Bank, 2018).

Figure 15. Crop percentages as harvested area (FAO, 2012)



Source: FAO. 2012. *Irrigation in Central Asia in figures. AQUASTAT Survey – 2012.* FAO Water Reports 39. Rome. (also available at http://www.fao.org/3/i3289e/i3289e.pdf).

While there have been changes in the type and area of crops, overall yields have remained relatively consistent during the last 30 years (CIAT and World Bank, 2018; Mogilevskii *et al.*, 2017). This stagnation in crop yield is commonly blamed on Kyrgyz farmers' lack of knowledge and failure to apply best practices, together with use of low-quality seed, abandonment of soil fertility practices and inefficient pest control measures (Mogilevskii *et al.*, 2017). Annual fertilizer use is estimated at 138 kg/ha – slightly higher than the 127 kg/ha Central Asian average (CIAT and World Bank, 2018). Most small farms do not purchase fertilizers or other agricultural inputs due to costs and low returns on investment (Shigaeva *et al.*, 2016).

Principal cropping areas

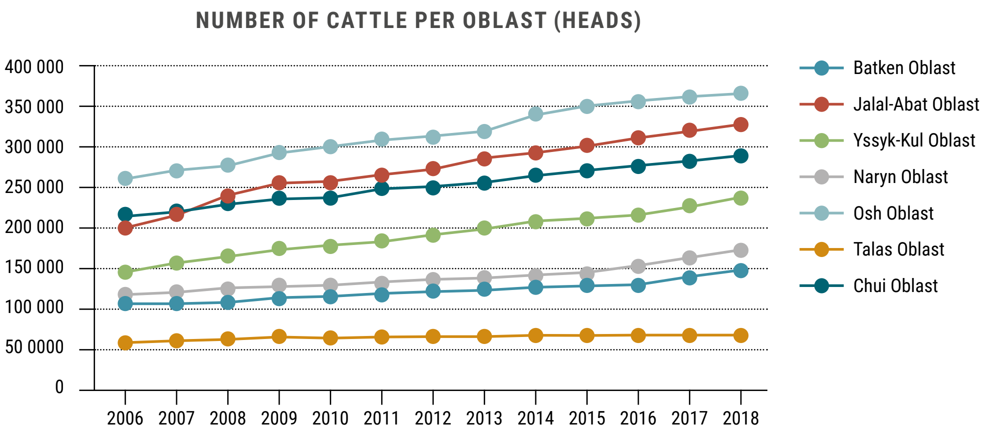
The Chui, Issyk-Kul and Fergana river valleys, together with some areas in the Naryn and Talas Oblasts, represent the principal areas of crop production (Mogilevskii *et al.*, 2017). Given its agricultural potential, the Fergana Valley has a higher population density and smaller farm sizes; the principal crops traditionally included cotton and tobacco, although melon, fruits and vegetables are more common today. In the north of the country, Talas Oblast produces the majority of kidney beans grown and exported, while sugar beet is the main crop in the Chui Valley. The climatic conditions around the Issyk-Kul Lake enable apples and other fruits to be marketed almost year round (CIAT and World Bank, 2018).

Importance of pastoralism

The climatic and topographical features of the areas outside the principal agricultural river valleys have made animal husbandry an essential component of local livelihood strategies (CIAT and World Bank, 2018). Production is centred mainly on cattle, sheep, horses, goats and poultry, in addition to marginal production of yak and camel (Mogilevskii *et al*., 2017; Sabyrbekov, 2019). Livestock rearing and production is for the most part located in the populous Chuy and Osh Oblasts, while the Issyk-Kul, Jalal-Abad and Naryn Oblasts also support large local and migratory herds thanks to the nutritious mountain pasture available (Mogilevskii *et al*., 2017). The most important livestock products include meat (beef is most common, followed by mutton, horse and other), cow milk, wool and eggs (CIAT and World Bank, 2018).

There were significant changes in livestock numbers following independence, according to national data (NSC, 2015): there has been a gradual but steady increase in cattle (**Figure 16**) and horses since the 1990s, while the numbers of sheep, goats, poultry and pigs have fallen dramatically and are yet to recover to pre-independence levels. The sheep industry has seen production change from a strong focus on wool to a focus on meat, with wool production at less than one-third of its former level (Mogilevskii *et al*., 2017). Mutton remains in high demand, as it is the preferred dish for social and religious celebrations.

Figure 16. Evolution of cattle numbers per oblast, 2006–2018 (2019)



Source: NSC. 2019. *Livestock and bird yield by territory of Kyrgyz Republic: 2006–2018.* Department of Social Statistics. Bishkek.

Although official data indicate that livestock numbers fell following independence (NSC, 2015), consultations held with national experts and herders have called into question the validity of the national statistics and the livestock numbers cited in the available literature. Herders and official representatives consulted have repeatedly said that following independence, livestock numbers remained stable throughout the transition period from 1991 to 2010 and then began to increase, dramatically in some areas, during 2010–2019. Isakov and Thorsson (2015) state that total livestock units (LU), as opposed to heads, rose from 9.5 million LU in 1997 to 13.8 million LU in 2011 (an increase of 45.3 percent) as declining sheep numbers made way for cattle. This fact was further supported by the PRAGA workshops held over the course of 2019.

There are various reasons for which herders do not provide in the official census the actual number of animals owned, summarized as follows:

- distrust of authority carried over from Soviet times;
- confusion and inefficient data collection following independence;
- chaotic redistribution of state-owned resources following independence;
- fear of taxation associated with livestock ownership;
- attempt to pay lower pasture fees for grazing (payments are based on number of heads);
- misunderstanding of Pasture Law and pasture users' rights and obligations under the law; and
- community politics and long-standing familial disagreements.

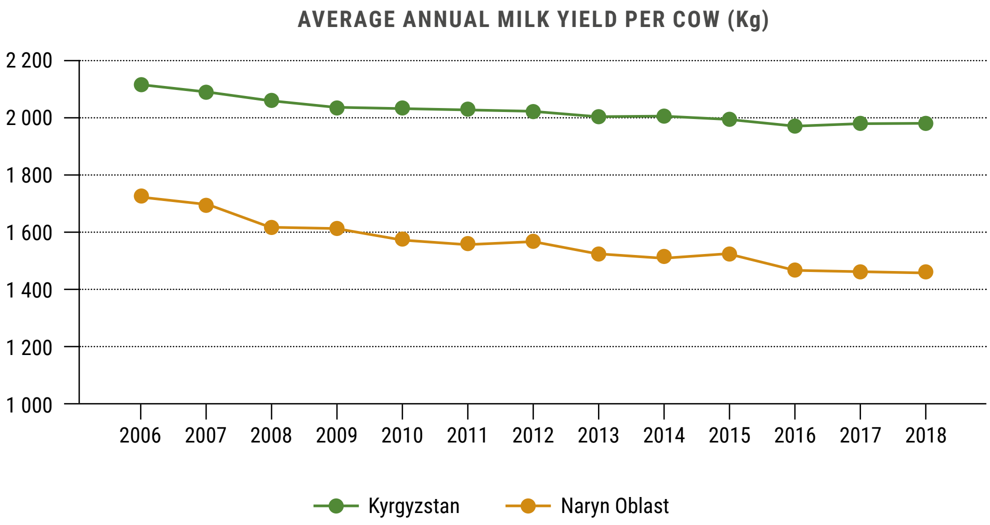
Therefore, animal numbers presented as official statistics (both past and present) must be viewed with caution (Isakov and Thorsson, 2015; Mogilevskii *et al*., 2017). Given the inconsistency in the evolution of livestock numbers over the last 30 years, it is difficult to establish a link between national herd numbers and the ecological state of the nation's pastures. Various authors have stated that pasture biomass is declining due to LD (Bussler, 2010; Mogilevskii *et al*., 2017; Sabyrbekov, 2019), while Isakov and Thorsson (2015) present data claiming that some rangeland systems have suffered permanent changes in their biophysical condition.

Other issues affecting livestock production and sustainable rangeland management were mentioned in the literature and consultations. The techniques and practices introduced by the Soviets – for example, cultivated fodder supplies, outfitting of high mountain pastures with herder huts and entertainment, water distribution and road networks, and improvement in local breeding stock – were disregarded or no

longer possible to maintain in the new reality following independence (Bussler, 2010; Mogilevskii *et al*., 2017; Sabyrbekov, 2019). Veterinary services and animal disease control have also been affected by lack of investments and public financing (CIAT and World Bank, 2018).

Following the decline in infrastructure maintenance and pasture improvement works, animal production per head decreased. Animal weights are below what is considered optimum for the region and the amount of milk produced per cow has fallen (**Figure 17**), though the increase in total cattle numbers often hides these facts (Mogilevskii *et al*., 2017). Local herders confirm the fall in milk production over the years.

Figure 17. Annual milk yield per cow, Kyrgyzstan and Naryn Oblast



Source: NSC. 2019. *Livestock and bird yield by territory of Kyrgyz Republic: 2006–2018.* Department of Social Statistics. Bishkek.

The cause of the increase in cattle and horse numbers over other livestock types is clear, according to local livestock owners and herders. The human population is increasing, and ownership of these livestock types offers social standing and employment opportunities within rural communities for expanding families. The use of cattle or horses as cash and as savings also allows for families to have financial options and reserves on hand in times of need (Mogilevskii *et al*., 2017; Sabyrbekov, 2019). They are unlike species such as sheep and goats in this regard, and given the advantages they offer, their numbers will continue to rise, according to producers.

The current farm model also differs greatly from that prior to independence. The Soviet model relied on several hundred large collective farms (> 1 000 ha) to provide materials and goods for the entire Soviet Union. This is in stark contrast to the 400 000 subsistence smallholdings (rarely > 2 ha) that comprise the majority of farms today. Large, corporate farms are now rare exceptions, meaning that the country is largely dependent on small family farms for its agricultural production (**Table 2**).

TABLE 2. Number and type of farm and their national representation

	NUMBER OF FARMS ('000)		ARABLE LAND AREA (% OF TOTAL)		TOTAL AGRICULTURAL OUTPUT	
	2002	2015	2002	2015	1996	2015
State and collective farms	0.8	0.6	22.3	5.5	19.8	1.7
Peasant farms	251.5	400.8	67.7	87.2	26	60.2
Household plots	726.6	726.6	10.2	7.3	54.1	38.1

Source: NSC (adapted from Mogilevskii *et al.*, 2017).

As mentioned earlier, these changes also affected the role of peasant and smallholder farms within the livestock context, as they became more dynamic and market-oriented, with households continuing to keep a small number of animals for household consumption (Mogilevskii *et al*., 2017; Sabyrbekov, 2019).

Excessive labour has been a feature of the Kyrgyzstan rural environment since the Soviet era, when migration from rural to urban areas was not administratively permitted (Mogilevskii *et al*., 2017). Following independence, most farms maintained their production rates and land size, while reducing the number of employees. Driven by a lack of opportunity, the rural exodus to urban areas followed a pattern similar to those seen in other developing countries in Central Asia. The oil booms in Russia and Kazakhstan and the economic success at the beginning of the twenty-first century also attracted migrant workers from Kyrgyzstan. International remittances from migrant workers were often invested in livestock, especially cattle and horses, which were forms of savings and items of social prestige.

Gender and its role in Kyrgyz agriculture

As is commonplace in the region, women face significant obstacles and inequalities compared to men, and the gender inequality index of 0.4 implies that effort is required to reduce inequalities in the areas of health, employment and access to resources and legal status (CIAT and World Bank, 2018).

According to official data, only half of Kyrgyz women aged 15–64 are economically active, and those that do work earn on average 30 percent less than their male counterparts (NSC, 2015). Not surprisingly, average wages are highest in the capital of Bishkek at KGS 13 572 and lowest in Osh Oblast at KGS 6 551 (NSC, 2015). Interestingly, Naryn Oblast has the lowest pay gap between men and women (23 percent). The gap in monthly pension payments has also improved: women's pensions were 88.7 percent of the average male pension rates in 2010 and had risen to 92.7 percent by 2014.

Employment opportunities are highest for Kyrgyz women in the services sector (83 percent), especially in healthcare and social services, followed by education (79 percent), hotels and restaurants (64 percent) and manufacturing (52 percent) (NSC, 2015).

The proportion of women in urban areas is higher than men, representing 52.6 percent of the total urban population (NSC, 2015), while in rural areas men are slightly more dominant (50.5 percent). As such, rural areas follow more traditional, patriarchal social systems, with women having less access to resources and rights; for instance, only 13 percent of agricultural holdings are owned by women (NSC, 2015). Fewer girls than boys attend primary school; however, those that do go to school often complete their training, with women comprising a slightly higher percentage of students in institutions dedicated to higher education. Women account for a higher proportion of unemployed youth than do men. Households headed by men are typically at greater risk of extreme poverty than those headed by women.

Both Kyrgyz men and women spend around 11 hours a day in meeting primary physiological needs (such as sleep or selfcare), regardless of place of residence (NSC, 2015). However, they spend time on different activities: men spend more time on work-related activities and women on daily household chores and childcare. On average, women dedicate 4.5 hours (18.8 percent of their time) to household-related activities – compared to 6.5 percent of men's' time dedicated to similar household and child-related chores. For rural women, this total time increases to 5 hours. As such, men typically have more free time than women, whose total daily free time rarely amounts to more than 60 minutes. Men in rural areas also spend more time than their urban counterparts on activities other than work. Free time for rural populations is usually divided between watching television and social interaction with others.

Those populations most at risk from food insecurity and economic hardship live primarily in remote areas, where lack of infrastructure, education, healthcare options and participation in decision-making are exacerbated by the harsh climate and terrain, which further limit opportunities and reduce living standards.

Climate change scenarios for Kyrgyzstan

Kyrgyzstan is considered to be one of the countries most at risk of climate change-related impacts within Central Asia, principally due to the vulnerability of its agricultural systems (CIAT and World Bank, 2018).

From 1960 to 2010, annual temperatures rose by 2.4 °C in all climate zones and current climate change models indicate that temperatures will continue to rise over this century, reaching a total increase since 1960 of 2.7 °C by 2050 and 3.1 °C by 2070 (CIAT and World Bank, 2018). Little variation seems to exist within different climatic zones, with all areas seeing temperature rises of similar magnitudes.

In contrast with other areas in Central Asia, average rainfall rates increased during 1960–2010 – a pattern that is predicted to continue with average rainfall rates expected to rise by 6 percent by 2050 and 7.1 percent by 2070 (CIAT and World Bank, 2018). However, this could have negative impacts for the agricultural and economic sectors. Given its terrain, Kyrgyzstan is prone to natural disasters such as mudslides, flooding, landslides and avalanches. Although total rainfall is set to increase, rainfall erraticism is also predicted to increase, giving rise to more destructive climatic scenarios that damage infrastructure and cropping areas. Losses due to climatic impacts are currently considered high by experts and these events are predicted to escalate (CIAT and World Bank, 2018; Mogilevskii *et al*., 2017).

As mentioned earlier, Kyrgyzstan is a supplier of water to neighbouring countries, with 4 percent of its land area covered by glaciers and permanent snowfields (FAO, 2011). The 20-percent reduction in glacier sizes together with increasing temperatures is predicted to increase water scarcity given the lack of continued investment in and maintenance of irrigation infrastructure and hydroelectric power generation (Mogilevskii *et al*., 2017). Water scarcity is predicted to worsen, especially in the semi-arid lowlands, reducing farm income by up to 15 percent

(CIAT and World Bank, 2018). However, most experts agree that water scarcity is driven by lack of planning and investment (ibid.; Mogilevskii *et al*., 2017).

In addition to other impacts, mass livestock losses – *Jut* – may become more common due to climate change. A *Jut* is a mass loss of livestock caused by icing of pastures or heavy snowfall that makes grazing difficult, or by long winters when the pastoralists' stocks of food for animals are exhausted. In a *Jut*, it is estimated that 10–30 percent of livestock perish, with young and weakened animals typically the first to die. The only remedy is to move to another area or buy additional feed. *Jut* can occur due to long periods of cold or heavy snowfall, when deep snow prevents sheep from reaching the grass. At other times, *Jut* are the result of rain that may have thawed in winter, followed by a sudden cold spell; the ice crust covers the snow surface with a thick layer that animals are not effectively able to break through to fulfil their nutritional needs. Furthermore, horses whose legs are covered with sharp ice wounds become victims, and a significant proportion of young, sick and old animals die.

The socio-economic role of native, rainfed pastures and their current state

In Kyrgyzstan, 55.4 percent of the land area is under agricultural land use; of this, 48 percent is permanent pasture, 7 percent is arable land and 4 percent is classified as forestry (CIAT and World Bank, 2018). This figure gives a clear indication of the importance of native pasture and meadows for rural communities and the country's collective mindset (Hoppe *et al*., 2016; Isakov and Thorsson, 2015; Sabyrbekov, 2019).

According to the Kyrgyzstan Pasture Department's study on the state of pastures published in 2015, around 70 percent of the nation's pastures are degraded

DEFINITIONS OF LD: The breakdown in grazing cycles

One of the most significant potential impacts of LD on local areas and communities is that it interrupts and disturbs the traditional grazing cycles. When a pasture area can no longer support the same animals it has for years, both people and animals are driven to other areas.

This increase in pressure also leads to prolonged and intense grazing periods on surrounding pastures, often outside of seasonal patterns. This pushes the system towards collapse, and pastoralists are forced to move even earlier, leading to a continuous cycle of LD and conflict over remaining pasture resources.

(Sabyrbekov, 2019). However, several authors have questioned the validity of these data and have stated that the means by which “degradation” is defined in different contexts has led to an overestimation of degraded areas (CIAT and World Bank, 2018; Livine *et al*., 2017). CIAT and World Bank (2018) place the figure at 49 percent based on 2012 data, while Shigaeva *et al*. (2016) cite 33 percent based on USAID data from 2007 (USAID, 2007). Hoppe *et al*. (2016) state that at least 30 percent of pastureland is affected by degradation. However different these figures may be, RS data principally centred around the use of normalized difference vegetation index (NDVI) have supported claims of degradation in the form of lost pasture productivity (Sabyrbekov, 2019).

Sabyrbekov (2019) also cites data from the state land survey institution Kyrgyzgiprozem (GIPROZEM),[2] which regularly collects and weighs dry matter on 275 monitoring sites distributed throughout the country; the data show that degradation exists at a national level, though its severity varies depending on the area. According to the data prepared by GIPROZEM and presented in the interim report (CAMP Alatoo, 2019), 1 661 000 ha (8.3 percent of the total territory) are highly degraded. The report also concludes that 1 906 000 ha (9.5 percent) are at threat from bush encroachment, 1 689 000 ha (8.4 percent) have been occupied by non-palatable grasses and 1 458 000 ha (7.3 percent) are in good condition. It claims that overall fodder productivity for the country’s pastures decreased by 36 percent in the last five years due to a decrease in the total pasture area and an increase in LD processes.

Sabyrbekov (2019) goes on to show that the concern around pasture degradation by land users is highest in areas that receive migratory livestock. For instance, Naryn residents and land users showed higher perceptions of and concerns about LD than did those migrating to Naryn to use their pastures. The same was found in other areas receiving transhumance graziers.

[2] GIPROZEM is the authorized state institution in the sphere of land survey operations, mapping, and cadastre on the whole national territory and regulates its relations with natural and legal persons by contracts.

The legislative and regulatory framework regulating pasture use in Kyrgyzstan

The Pasture Law of 2009 and its amendment in 2011 were formulated on the basis of the same decentralization and power-sharing ideals as many other agricultural reforms following independence. The basic approach was to devolve decision-making processes regarding the use and maintenance of infrastructure and natural resources and their management to local communities and municipal institutions ("*aiyl okrug*"). The law has been recognized internationally for its decentralization of decision-making processes and institutions (Shigaeva *et al*., 2016); moreover, it provides a platform for consultation on international frameworks such as LDN.

Following a previous reform and debate on long-term pasture leasing rights for individual leases, the law established that responsibility and control over the nation's pasturelands (not all grazed areas or pasture types were introduced) was to be delegated to a new institution, the pasture users association (PUA) (Isakov and Thorsson, 2015). A total of 454 PUAs were established nationwide, each with clear boundaries, autonomy and the authority to use and manage local and seasonal pastoral resources (Sabyrbekov, 2019; Shigaeva *et al*., 2016). The 2009 law establishes that all users of extensive pasture and rangelands – including those using the land for something other than livestock grazing (hunting, tourism etc.) – are required by law to be members of their local PUA. Each PUA member receives a pasture ticket (*jaiyt bilet*), which gives them the authority to use PUA resources within the designated areas. In theory, this access is gained once the corresponding fees have been paid (Isakov and Thorsson, 2015).

The newly formed PUAs had the authority to elect PC members to oversee pasture production and health issues as well as serve as a forum for conflict resolution and stakeholder decision-making (Shigaeva *et al*., 2016). PC members are accountable to PUA members and are required to present results ahead of annual elections. The PCs have the legal capacity to enforce rules and legislation and collect fees and fines; however, it is debatable just how effective and fair this collection process is (Shigaeva *et al*., 2016).

The PC's obligations also include monitoring pasture health and productivity. A scoring system developed by the Pasture Department in theory allows PC members to evaluate pasture health and status using field-based indicators and then make decisions based on this information. These decisions should be incorporated into a general grazing management plan, where possible responses to low scores on the pasture monitoring sheets include: reduced stocking rates during times of drought;

rest of certain pasture areas to rebuild the native pasture base; encouragement of users to optimize grazing of isolated pasture areas through improved road access; and improved vigilance of outsider herders entering the area. In any case, the law intended a more communal and sustainable use of resources with a holistic approach to decision-making (ibid.).

The 454 PUAs manage a variety of pastoral resources, often with "winter" and "summer" pasture areas plus transitional areas and rights and access to water and other resources associated with pastoral livelihoods. These areas may be located in other oblasts or municipalities. To facilitate management and productivity, the PCs have at their disposal large, high-quality maps of their pastoral areas, in addition to the technical and administrative support they might need from local authorities.

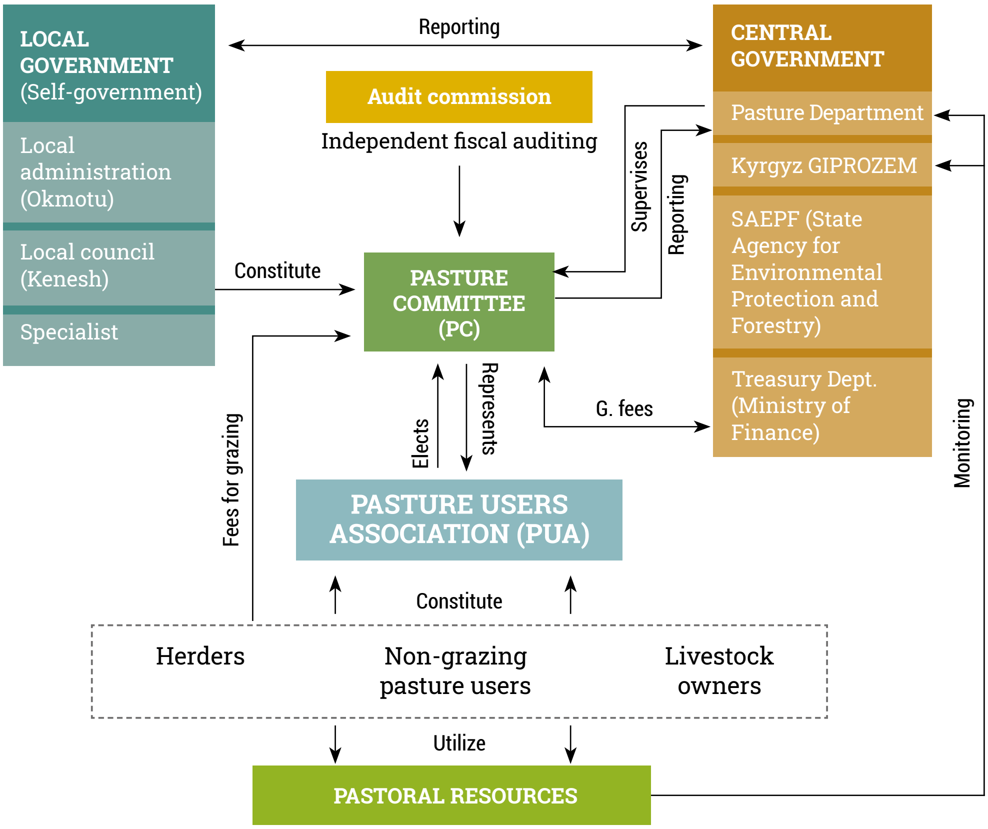
The Kyrgyzstan Pasture Law sought to provide a more adaptable, flexible management and decision-making institutional structure that was accessible to the diverse pasture uses and users and provided timely solutions to problems without excessive bureaucracy (**Figure 18**). It envisioned a landscape-scale management system wherein producers are grouped within larger, communal units (*jalioe*). This landscape approach allows a spatial and governance system that better adapts to the biophysical and climatic conditions where variability of pasture conditions is common (ibid.). The law was also designed to introduce more sustainable stocking rates based on more accurate field-based indicators, increase transparency and improve pasture ecological health and biodiversity indicators (Isakov and Thorsson, 2015).

Critique of the Pasture Law 2009 (2011)

Shigaeva *et al*. (2016) conducted an in-depth review of the law and reached important conclusions on gaps and areas for improvement. The review was validated by project staff in workshops and consultations, which highlighted the following:

- **Disconnect between pasture users (grouped under PUAs) and their executive bodies (PCs).** According to PUA members, PCs are viewed as the same bureaucratic, top-down decision-making structures that were common in Soviet times, and decisions do not take their needs into account. However, the report also noted that most PUA members are not aware of their rights and obligations within the Pasture Law and do not hold their PCs accountable for their actions and track records.
- **Continued influence and control over PCs by district and regional authorities.** This in turn motivates the herders' view that the PCs do not represent them or their interests.

Figure 18. Social-ecological system institutionalized through the Pasture Law



Source: adapted from Shigaeva, J., Hagerman, S., Zerriffi, H., Hergarten, C., Isaeva, A., Mamadalieva, Z., & Foggin, M. 2016. Decentralizing governance of agropastoral systems in Kyrgyzstan: An assessment of recent pasture reform. *Mountain Research and Development*, 36(1): 91–101 [online]. [Cited 27 April 2021]. DOI: 10.1659/MRD-JOURNAL-D-00023.1

- **Continued conflict over PUA boundaries.** The PUA boundary maps do not always correlate with the traditional or social boundaries that exist. Overlapping claims on resources are still common.
- **Mismatch between state or condition of pastoral resources and rules and regulations.** The PUAs, through the decisions of the PCs, have the capacity and obligation to collect fees from resource users, set stocking rates to pasture capacity, design management plans and deliver sanctions to those not respecting rules and regulations.

Although the Kyrgyzstan Pasture Law of 2009 (2011) has had some setbacks, overall it offers clear benefits and opportunities compared with the situation in neighbouring countries where pastures are often relegated to secondary subdivisions or units under the ministries of agriculture or forestry. Public and private investment tends to be lower than in cropping and forestry industries; this leads to confusion regarding their condition, the actors involved and regulations, in addition to overlaps between the different administrative levels.

The overall framework is appreciated by pasture users who understand the system because it provides a readily accessible mechanism for negotiation and agreement (Bussler, 2010; Shigaeva *et al*., 2016). Project consultations have revealed that the framework successfully monitors exactly who is using the resource as the herders come and go over the summer grazing season. Despite this, rule enforcement is apparently lax: although disputes may still exist, the delineation of boundaries and the role of the PCs as the supervising authority of pastoral resources in theory provide a local organizational structure with regulatory and sanctioning capacity and which is accountable for its decisions. As autonomous and authoritative entities, they greatly reduce the administrative overlap and confusion that exist in most governments when it comes to grasslands and rangelands and the pastoralists that use them. This in itself is a significant feat and represents an opportunity rarely found in similar legal contexts in the region.

The PCs are also required to monitor their grasslands and pastoral resources using a scoring system to assign values to key indicators (ibid.). The data are collected and overseen by the country’s Pasture Department, a division of the Ministry of Agriculture, Food Industry and Melioration. While this is cause for complaint among PC members, it does require some of its members to observe pasture conditions at micro and macro levels and record the results. This provides the opportunity for debate on current management practices and enables members a record of growth in past seasons, should this be of interest.

The division of areas into different seasonal uses based on traditional transhumance movements, while not optimum, does allow for seasonal recovery and rest for the pastures (Bussler, 2010; Isakov and Thorsson, 2015; Shigaeva *et al*., 2016). This has led to summer pasture areas having higher above-ground biomass, species diversity and richness than would be expected under continuous grazing regimes as seen in neighbouring countries (Hoppe *et al*., 2016).

The Pasture Law was also instrumental in reducing land privatization by powerful community members. Due to a loophole in the legislation, lands termed “unproductive” were reclassified under other “productive land uses”, which allowed for a de facto privatization. The law established a precedent under which no grassland areas could be reclassified under other land uses, thus halting the erosion of community-managed, state-owned pastureland to private land tenures.

However, it emerged during stakeholder consultations that local PC members were not happy with recent changes to the law, in particular the grazing fee collection and routing mechanisms under the new Financial Code introduced in 2016. Fees collected are now turned over to the Ministry of Finance and later released to the PCs for PUA-associated costs and activities. This delay accessing the funds, together with accusations of inaccuracy in reporting and appropriation on both sides, has meant that PCs are less capable of planning and implementing pasture and infrastructure improvements, adding further strain to the delicate PUA–PC relationship. Likewise, while income from other activities such as hunting may be generated, the procedure is unclear when the activity occurs across various pasture and forestry units.

The PCs interviewed also spoke of significant limitations in their ability to enforce rules and regulations, in addition to difficulties associated with pasture fee collection. Few PUA members understand how the fee is to be used and see it as simply another government-endorsed tax on producers. However, PC members have spoken at length about a new national Penal Code currently being drafted (December 2019) that would facilitate the enforcement of pasture obligations and regulations either by PC members or law enforcement officials.

Grazing practice and management under the Pasture Law 2009 (2011)

The PCs described above have been instrumental in promoting the movement of animals from the “winter” pastures to the highland pastures overseen by the PUA/PCs. At present, the most practised production model relies on long winter periods grazing local community pastures, transition to high-altitude pastures, an extended period grazing alpine pastures, an autumn transition period and wintering in lower community areas. This is outlined in **Table 3**.

TABLE 3. Overview of seasonal pasture movements and those responsible for livestock care

	SPRING	SUMMER	AUTUMN	WINTER
WHERE	Transitional, mid-altitude pastures and slopes	High-altitude pastures, steppes and alpine meadows	Transitional mid-altitude pastures and slopes	Lower-altitude, peri-urban and community pasturelands
WHO	Hired herders	Hired herders	Hired herders	Animal owners
FEED SOURCE	Native pastures and woody forage plants	High-altitude native pastures and forbs	Native pastures and woody forage plants	Local, peri-urban native pastures, crop and hayfield residues, purchased/grown feed in some cases
LENGTH OF STAY (days)	30–45	120–150	30–45	150–180

Source: the authors

Animal owners themselves rarely take the animals to the highland pastures (*jailoo*). This is typically done by "herders" who provide the service of caring for the animals during the annual transhumance migrations. These entrepreneur herders are typically family units with low to moderate income and a herding background. The majority are middle-aged, although the profession has a highly varied age structure as it involves whole families.

This arrangement is different in the winter months. Livestock owners care for the animals during this time for an average of 5–6 months when they are housed near the communities. "Community herding" is often practised during this time under the *kezuu* and *bada* systems, where a local herder is paid by different owners to graze groupings of animals. Animals under these systems are often housed for the night in the family barn or shed.

Temperature is often a limiting factor for growth over these months and the forage available at the end of the winter season is sparse and of low quality. Those that can afford to do so provide feed to maintain their animals during this time, especially cattle. Wealthier livestock owners hire families to care for their animals year round and in some cases may even own large farms where the animals spend the winter.

To better understand grazing perspectives and the pastoralist mindset, refer to **Table 4**, which lists Kyrgyz pastoral terminology. As with other Central Asian countries, altitude often dictates land use and grazing intensity and timing; this is apparent in the local terminology used to convey pasture types, aspects, movements and livestock states.

TABLE 4. Selected Kyrgyz pastoral terminologies

TERM	COMMONLY ACCEPTED MEANING
OPP	Pasture users' association
Jayt komitet	Executive branch of the PUA – pasture committee
Jaiyt bilet	Document granting the right to use pastures for grazing and giving the pasture user the status of a member of a PUA – pasture ticket
Sharttuu maldyn bashy	A unit used to compare or combine the numbers of different species and categories of livestock (equivalence is determined based on the feed requirements of the livestock) – livestock unit
Mal kochuu	The transfer of livestock from animal owners to herders for the growing season transhumance movements (movement to summer pasture areas)
Skotoprogon	Pasture areas defined by the pasture committee for the disposition or movement of livestock between pastures
Jurt/Konush	Nomad camp – a temporary shepherd's camp where a yurt or a tent is set up near a watering hole and a paddock for livestock to graze in a specific season
Ayil okmotu	Village government – the executive-administrative body of local self-government that, within the limits of its powers, manages the affairs of life support and vital activities of the local community
Kyrkyn	Communal gathering to shear animals (sheep, occasionally goats). It mainly takes place between May and the end of June
Bodo mal	Cattle
Kezuu	Grouping of animals of different owners into one herd, often according to species
Bada	Grouping of remaining village dairy cows into one herd and payment of a herder to take them to and from local pasture areas during the day
Subai mal	Cattle that have not given birth during the business year, including young females, heifer and sheep
Jailoo	Summer/remote pasture
Jazdoo-kuzdoo	Spring and autumn/intensive pasture
Kyshtoo	Winter pasture
Juusha	A domesticated animal when full, standing or lying down, taking a nap. It means they are "satisfied"
Jut	Mass livestock mortality, commonly associated with long winters with heavy snowfall (lack of pasture is often more deadly than temperatures)
Kungoi	Southern exposition

TERM	COMMONLY ACCEPTED MEANING
Teskei	Northern exposition (not the sunny side)
Kuut	Management of herds in order to plan pregnancy and birth cycles
Tuut	Agricultural livestock births
Tol	Livestock breed (offspring)
Koroo koi	Flock of sheep, about 500 head
Uiur jylky	Herd of horses
Anyz	Act of harvesting of crops or hay
Tort tuluk	All livestock species in general (cattle, goat, sheep, horse, camel)
Chop chabyndy	Hayfield
Saratan	Hot summer days
Tezek	Dry livestock manure
Josho	Type of red clay found on the grassland – used to mark animals and colour wool
Jylga	Gently sloping lands or valleys – prized for having few rocks or steep areas hindering herding and grazing of animals
Jaka/too etegi	Foothills of the mountains
Tilke	Pasture corral or plot

Legal framework for pasture monitoring in Kyrgyzstan

In Kyrgyzstan, several bodies are responsible for monitoring of pastures, each with a unique function. According to the 2009 Pasture Law, Article 14, paragraph 2, the authorized state body, the Pasture Department, is responsible for determining the standards and methods of assessment of pasture conditions and quality at the local level, and for supporting, collecting and processing the data coming from the PC field plots and evaluations. The Pasture Department has an active, local role to play in working with herders, PCs and Forestry Management Unit supervisors to monitor and respond to LD issues.

Another authorized body with a long history of pasture monitoring and assessment in the country is the state land survey institution Kyrgyzgiprozem (GIPROZEM). Historically, the organization was a state structure working to collect and record data on the landholdings of all enterprises in the territories of former state and collective farms (from rural committee heads for the annual land register).

GIPROZEM is also responsible for collecting data on rangeland health and has data going back as far as 1926 (although currently only in hard-copy format). There are 275 permanent monitoring sites using pasture height, species composition, factual coefficient of grazing, weed population, harvest yield and soil surface indicators. GIPROZEM is a scientific body rather than a regulatory or extension service, providing advice and indicators on national rangeland health issues and trends.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4

Baseline assessment for Naryn Oblast

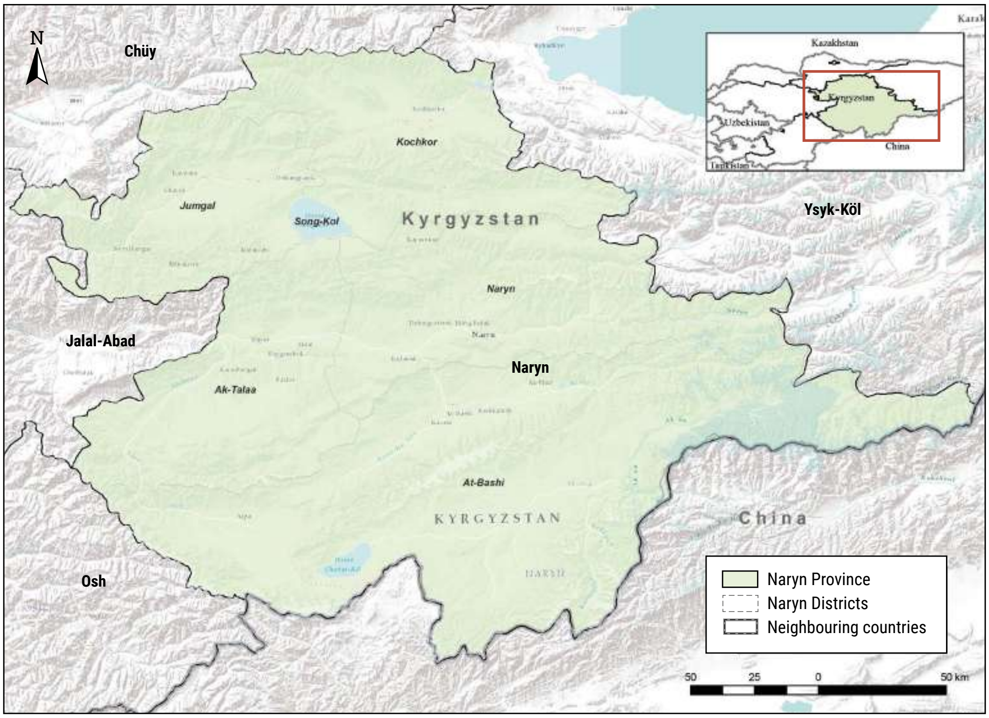
4.1 Overview of the region

The oblast (region) of Naryn was selected as the principal focus of the project activities based on the selection criteria outlined in the Introduction (Chapter 1). However, the lessons learned and conclusions reached through the PRAGA process are relevant for the surrounding regions and for Kyrgyzstan in general.

Naryn Oblast is a remote region in central Kyrgyzstan, situated in the centre of the Tian Shan Mountains (FAO, 2012; Shigaeva *et al*., 2016). The largest region in the country, it borders with Chuy Oblast in the north, Issyk-Kul Oblast in the northeast, the Xinjiang Uyghur Autonomous Region of China in the southeast, Osh Oblast in the southwest, and Jalal-Abad Oblast in the west (**Figure 19**).

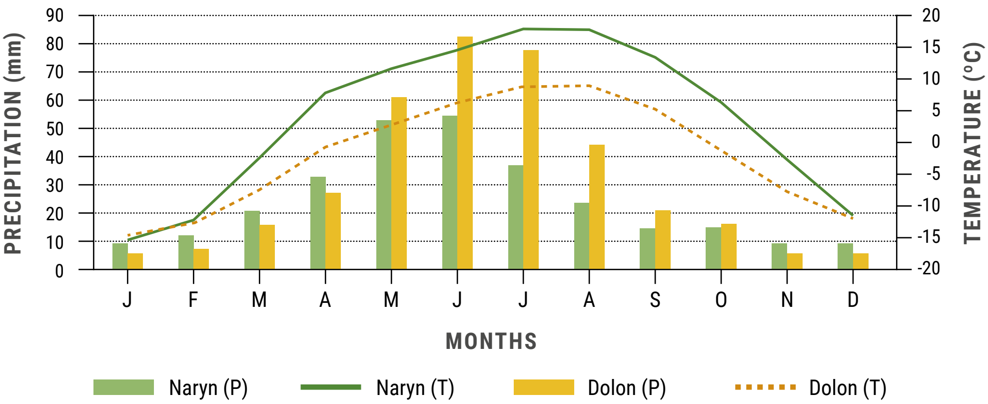
The regional climate is continental, with a mean annual temperature of 3.8 °C, 298 mm of precipitation and a predominance of cold, dry winters and warm, wet summers (**Figure 20**) (Isakov and Thorsson, 2015). Of the seven oblasts, Naryn is the least susceptible to landslides, hurricane winds, floods and other climatic extremes (Ilyasov *et al*., 2013).

Figure 19. Naryn Oblast (2019)



Source: Global Administration Database Mapping (GADM). 2019. Naryn Oblast (2019). Cited 10 November 2019. https://gadm.org/download_country.html. Modified to comply with UN, 2020

Figure 20. Mean monthly precipitation (P) and temperature (T) for two different pasture areas of Jerge Tal Aiyl Okrug, 1985–2006

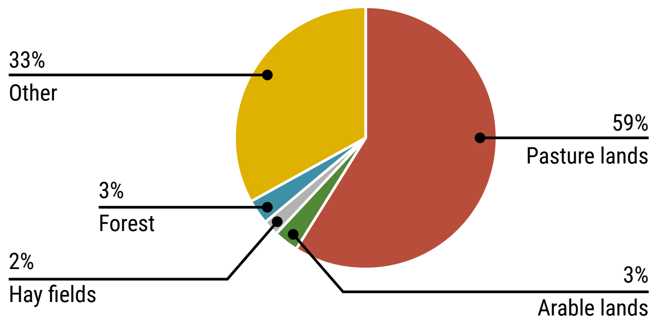


Note: Naryn is at 2 200 masl and Dolon at 3 000 masl.

Source: adapted from Isakov, A. & Thorsson, J. 2015. Assessment of the land condition in the Kyrgyz Republic with respect to grazing and a possible development of a quoting system on the local governmental level. B.: V.R.S. Company Ltd. 48 pp.

Together with Talas Oblast, Naryn has the highest national birth rate: 3.9 children per woman (Ilyasov *et al*., 2013). Once part of the Silk Trade Route, Naryn remains an important access point for goods moving along Asian and European trade routes (Shigaeva *et al*., 2016). **Figure 21** shows the land uses for the region.

Figure 21. Total area and land cover, Naryn Oblast (2019)



TOTAL AREA 4.41 MILLION HA

Source: NSC. 2019. *Livestock and bird yield by territory of Kyrgyz Republic: 2006–2018.* Department of Social Statistics. Bishkek.

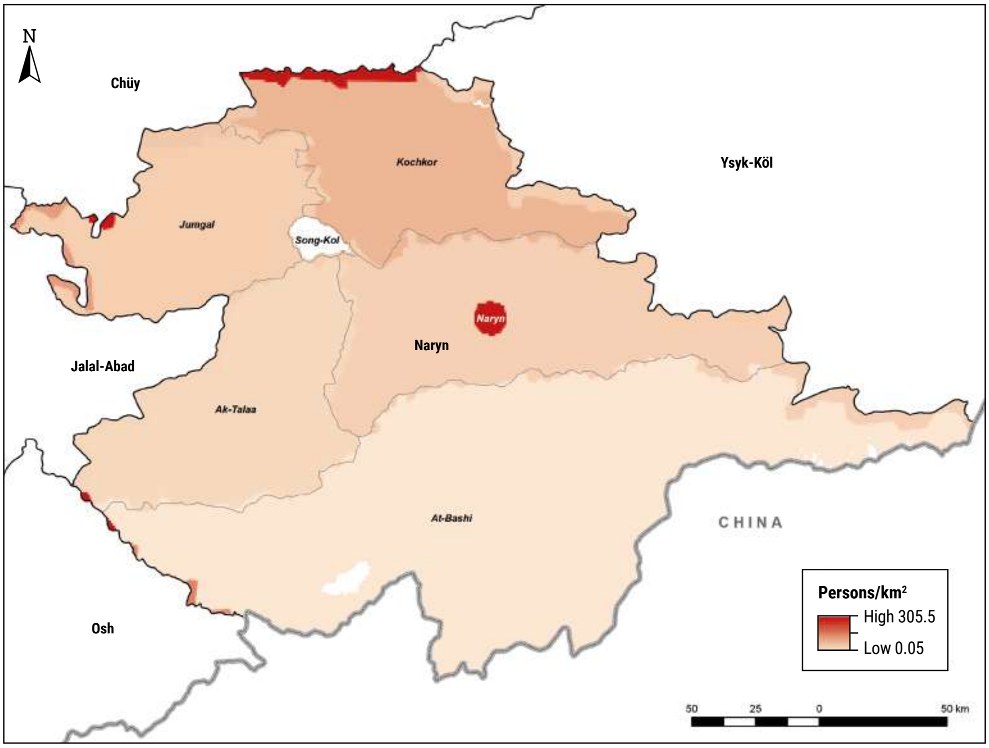
In spite of the significant social and economic transformations experienced over the last century, livestock husbandry has remained an integral part of Naryn culture and traditions (Isakov and Thorsson, 2015). A total of 29 percent of the national pasture area and 15 percent of total livestock are found within this oblast (ibid.). Agriculture, including livestock rearing, continues to be the central economic activity of the oblast, employing over 80 percent of those outside the provincial capital of Naryn and comprising 65 percent of the region's economic productivity (Shigaeva *et al*., 2016). The population figures per district are listed in **Table 5**, while **Figures 22 and 23** show the population density.

TABLE 5. Naryn Oblast census, 2019

DISTRICT	POPULATION
Ak-Talaa	32 563
At-Bashy	54 851
Zhymgal	44 254
Kochkor	66 214
Naryn	49 101
Naryn city	40 065
Total	**287 048**

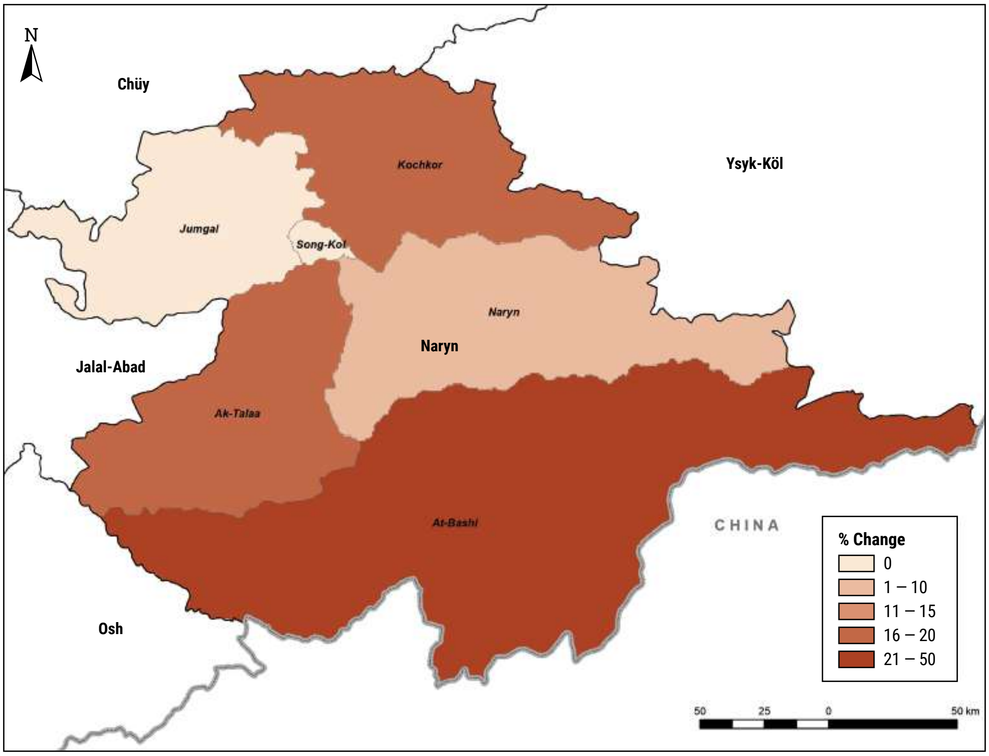
Source: NSC. 2019. *Livestock and bird yield by territory of Kyrgyz Republic: 2006–2018.* Department of Social Statistics. Bishkek.

Figure 22. Population density, Naryn Oblast, 2015 (2019)



Source: The NASA Socioeconomic Data and Applications Center (SEDAC), Gridded Population of the World, Version 4 UN WPP adjusted. 2015. Population density, Naryn Oblast, 2015. Cited 10 November. https://sedac.ciesin.columbia.edu/data/set/gpw-v4-population-density-adjusted-to-2015-unwpp-country-totals-rev11. Modified to comply with UN, 2020

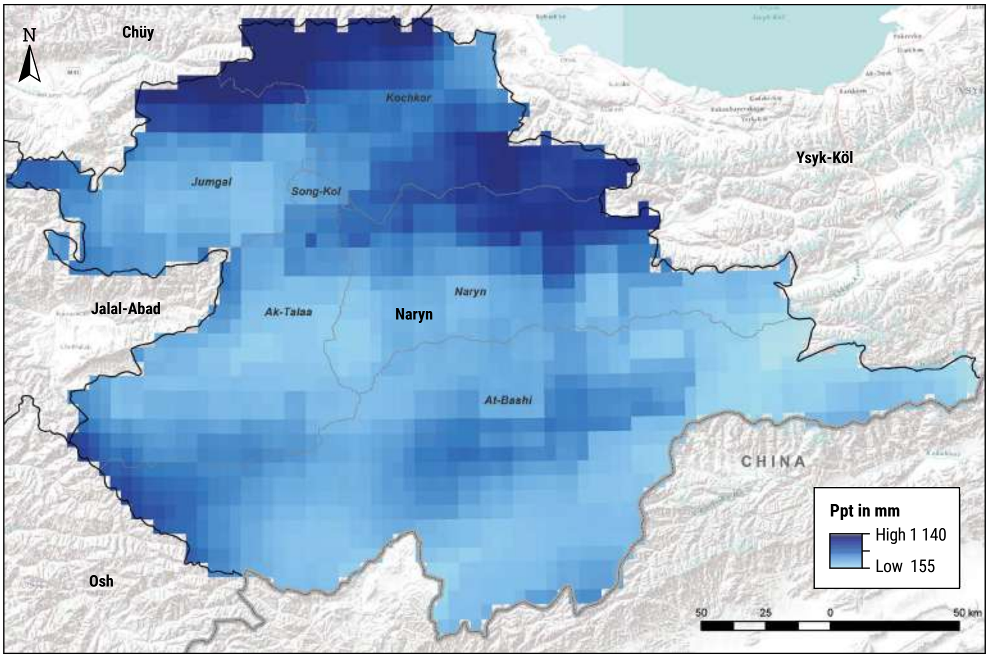
Figure 23. Population density change, Naryn Oblast, 2000–2015 (2019)



Source: Mwangi P.K. and The NASA Socioeconomic Data and Applications Center (SEDAC), Gridded Population of the World, Version 4 UN WPP adjusted. 2015. Population density change, Naryn Oblast, 2000–2015. Cited 10 November. https://sedac.ciesin.columbia.edu/data/set/gpw-v4-population-density-adjusted-to-2015-unwpp-country-totals-rev11. Modified to comply with UN, 2020

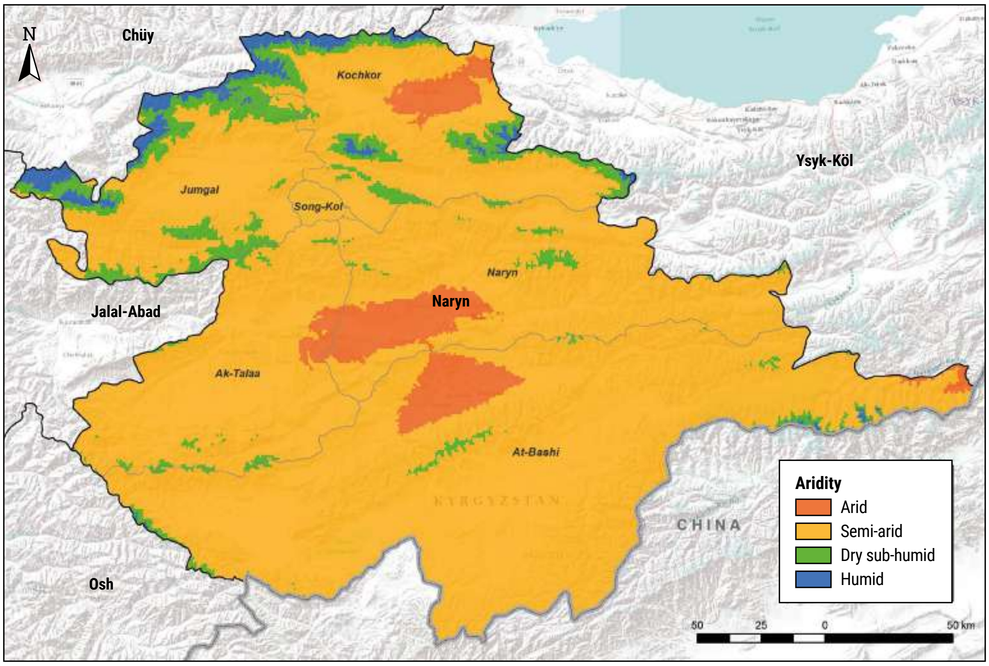
The terrain and climate limit crop production opportunities; growing seasons are short (120–140 days/year in the Naryn Valley), precipitation is on average low and concentrated in the higher altitudes in the northern part of the region (**Figures 24, 25 and 26**). The lower, flatter areas are classified as arid and semi-arid land (**Figures 27 and 28**), while mountainous areas are characterized by high variability in diurnal temperatures. However, these limitations do not deter the locals from attempting to grow crops more suited to temperate climates (FAO, 2012; Shigaeva *et al*., 2016).

Figure 24. Average annual precipitation, Naryn Oblast, 2009–2019 (2019)



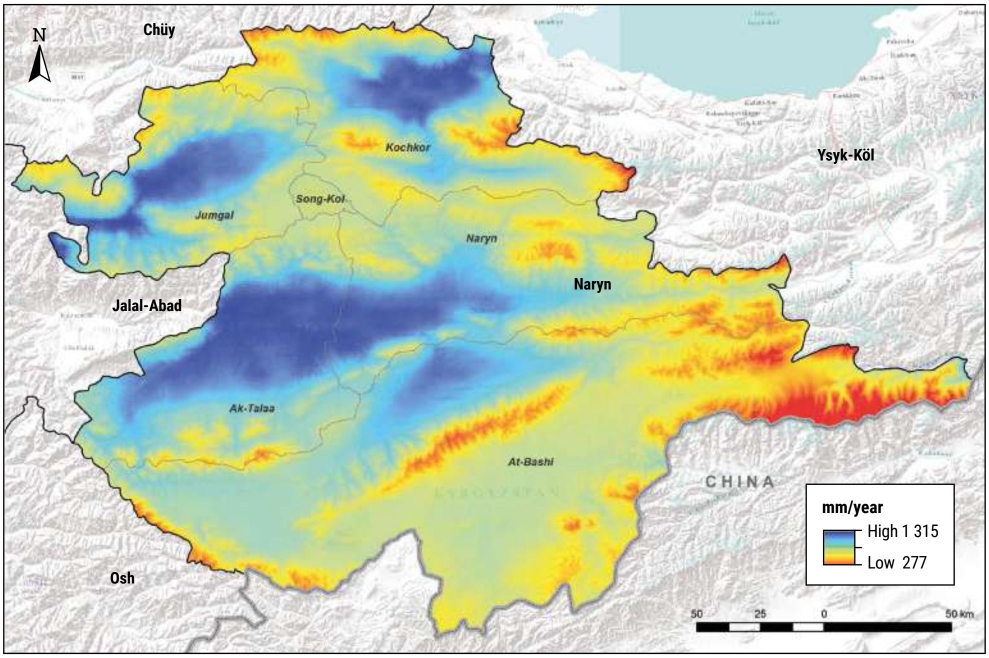
Source: Climate Hazards Group InfraRed Precipitation with Station (CHRIPS) Database version 2, USGS & NOAA. 2019. AveAverage annual precipitation, Naryn Oblast, 2009–2019. Cited 12 November 2019. https://data.noaa.gov/dataset/dataset/chirps-version-2-0-precipitation-global-0-05-5-day-1981-present. Modified to comply with UN, 2020

Figure 25. Aridity index, Naryn Oblast (2019)



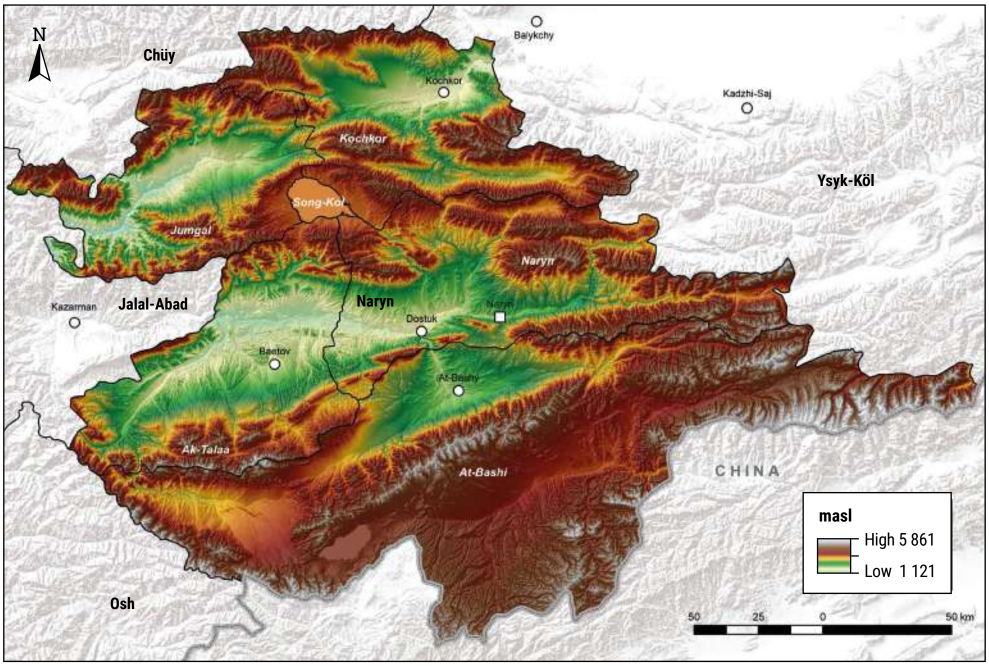
Source: Climate Database version 2. 2019. Aridity index, Naryn Oblast (2019). Cited 12 November 2019. https://cgiarcsi.community/2019/01/24/global-aridity-index-and-potential-evapotranspiration-climate-database-v2/. Modified to comply with UN, 2020

Figure 26. Potential evapotranspiration, Naryn Oblast (2019)



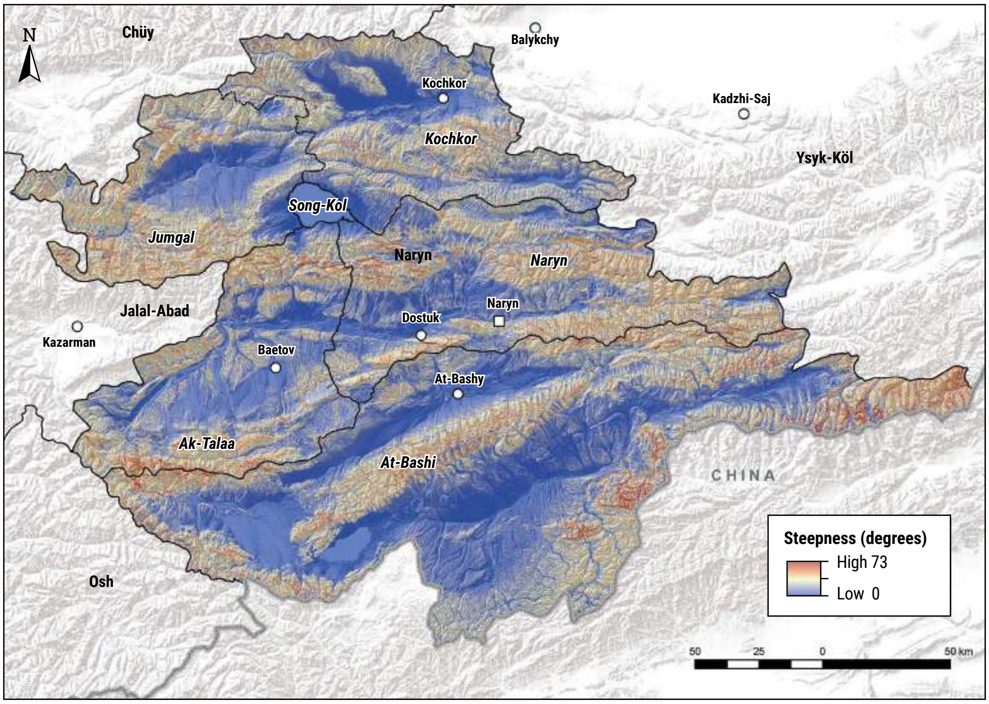
Source: Climate Database version 2. 2019. Potential evapotranspiration, Naryn Oblast (2019). Cited 12 November 2019. https://cgiarcsi.community/2019/01/24/global-aridity-index-and-potential-evapotranspiration-climate-database-v2/. Modified to comply with UN, 2020

Figure 27. Elevation, Naryn Oblast (2019)



Source: United State Geologcal Survey, Shuttle Radar Topography Mission (USGS/SRTM) 90 meters. 2014. Elevation, Naryn Oblast. Cited 15 November 2019. https://earthexplorer.usgs.gov/. Modified to comply with UN, 2020

Figure 28. Steepness, Naryn Oblast (2019)



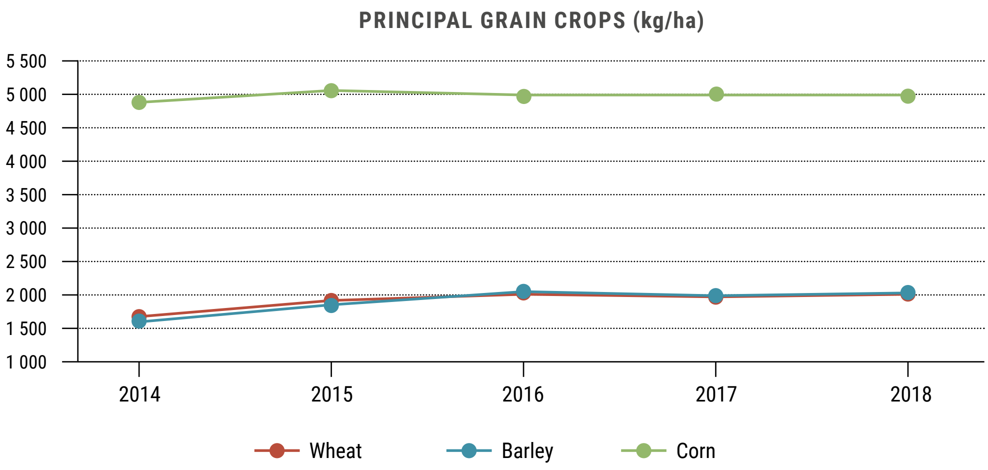
Source: Mwangi P.K. and United State Geologcal Survey, Shuttle Radar Topography Mission (USGS/SRTM) 90 meters. 2014. Elevation, Naryn Oblast. Cited 15 November 2019. https://earthexplorer.usgs.gov/. Modified to comply with UN, 2020

In general, the farm size and model are in line with the national characteristics described earlier (Section 3.3, Table 2). The majority of farms are smallholding plots that range from sustenance to commercial size. In contrast with the country's nomadic past, there is a gradual move towards more sedentary lifestyles and production strategies (Mogilevskii *et al*., 2017).

Wheat, barley and potatoes are the most common commercial crops, although the climate cannot be considered favourable and harvests are often below the national average (NSC, 2015; Shigaeva *et al*. 2016). **Figures 29 and 30** show crop types and yields. Options for rainfed agriculture are limited, and most crops rely on rudimentary irrigation systems located in the lower valleys, where cropping is typically located on river terraces and alluvial deposits on valley floors (Gareenda *et al*., 2016).

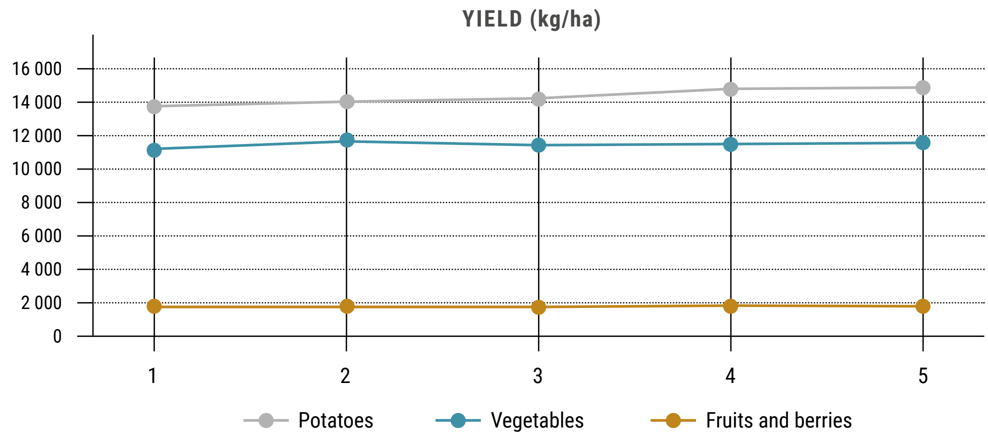
On the other hand, the terrain and climate are well suited to livestock production (Isakov and Thorsson, 2015). Therefore, grassland is the dominant land cover type,

Figure 29. Principal grain crop yields, Naryn Oblast (2019)



Source: NSC. 2019. *Livestock and bird yield by territory of Kyrgyz Republic: 2006–2018.* Department of Social Statistics. Bishkek.

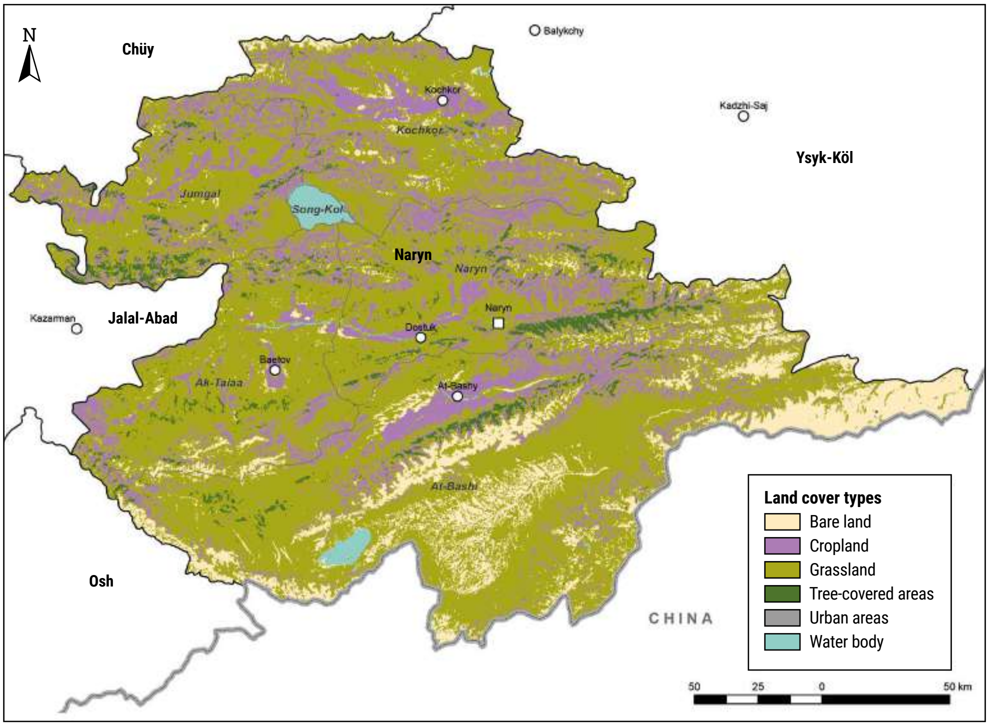
Figure 30. Potato, vegetable and fruit yields, Naryn Oblast (2019)



Source: NSC. 2019. *Livestock and bird yield by territory of Kyrgyz Republic: 2006–2018.* Department of Social Statistics. Bishkek.

followed by cropland, bare land (glaciers, snowfields and rocky slopes and peaks) and tree cover, with several natural lakes and water bodies which are the result of glacial activity and tectonic uplifting (see **Figures 31 and 32**).

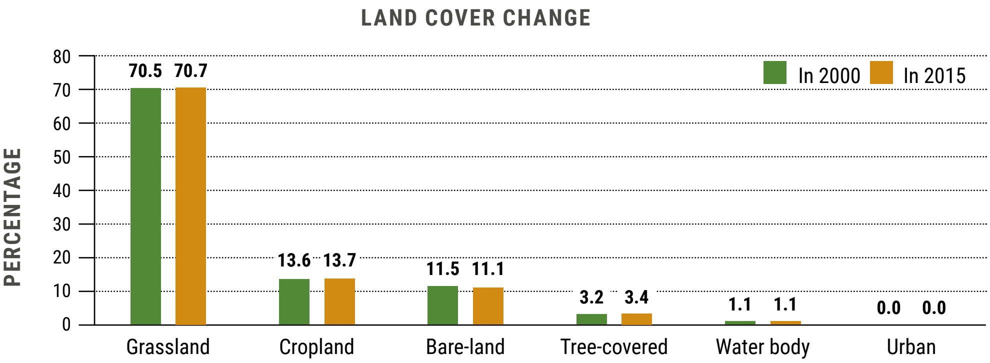
Figure 31. Land cover types, Naryn Oblast (2015)



Note: See Annex 4 for local adjustments made from the default UNCCD, SGD 15.3.1 land cover types.

Source: Mwangi P.K. and European Space Agency, Climate Change Initiative (ESA, CCI). 2015. Land cover types, Naryn Oblast (2015). Cited 15 November 2019. https://www.esa-landcover-cci.org/. Modified to comply with UN, 2020

Figure 32. Percentage change in land cover types, Naryn Oblast, 2000–2015

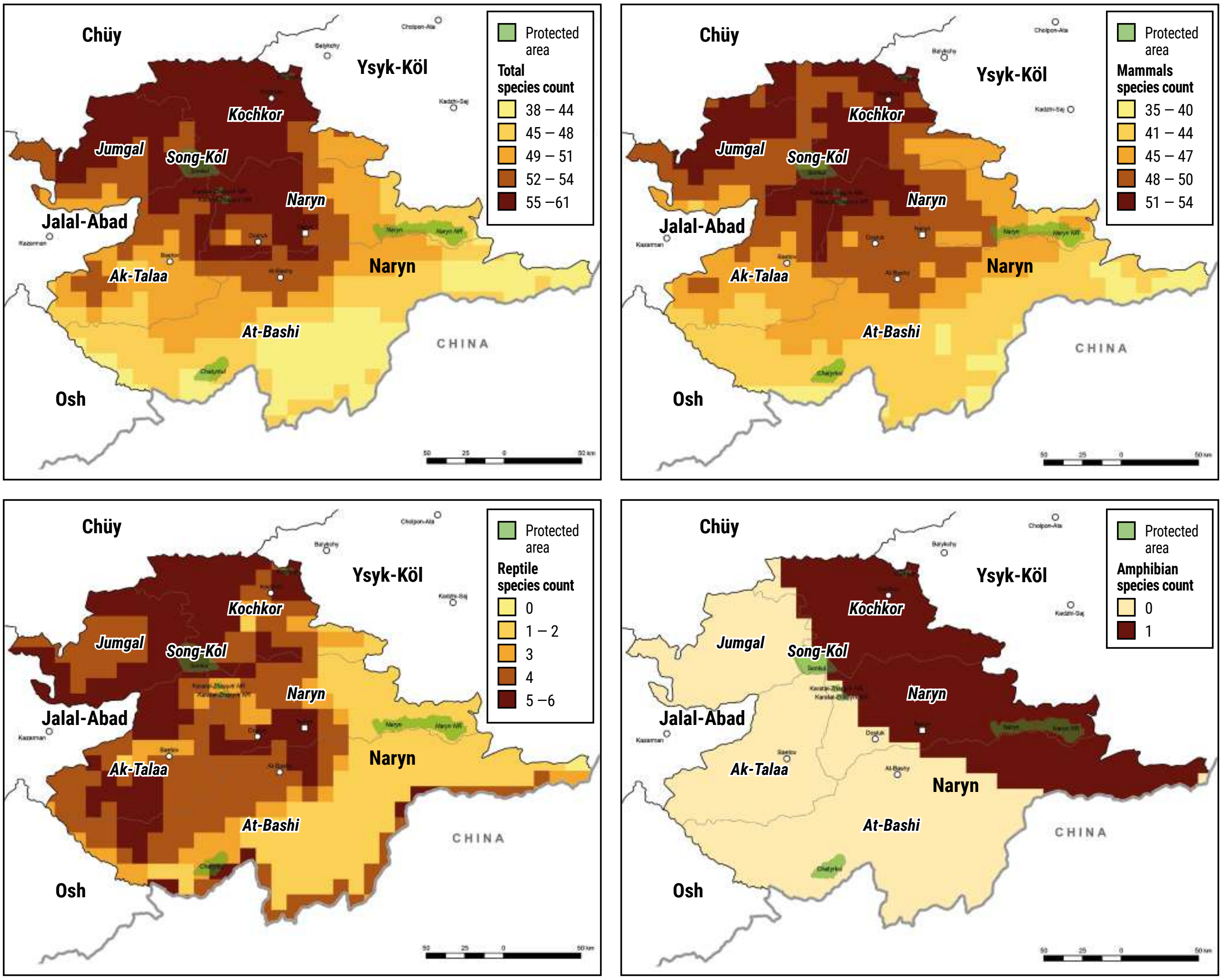


Note: The vegetation structure over the 15-year period seems intact with very little change.

Source: Mwangi P.K., November 2019. Percentage change in land cover types, Naryn Oblast, 2000–2015. Data Sourced from: European Space Agency, Climate Change Initiative (ESA, CCI). 2015.

There is a richness of terrestrial species at the national level and Naryn is a hotspot for biodiversity in the Central Asian region: it hosts Ramsar sites and is home to emblematic species such as the snow leopard and mid-Asian ibex. Figure 33 shows the distribution of animals according to their class and regional protected areas; most of the region's biodiversity is located in the northwestern mountain ranges and valleys, which also have the highest human population density and rainfall.

Figure 33. Terrestrial species count maps, Naryn Oblast (2019)



Source: International Union for Conservation of Nature (IUCN) red list species & World Database of Protected Areas. 2018. Terrestrial species count maps, Naryn Oblast. Cited 13 November 2019. https://www.iucnredlist.org/ and https://www.iucn.org/theme/protected-areas/our-work/world-database-protected-areas. Modified to comply with UN, 2020

Pasture issues in Naryn Oblast

Prior to settlement measures introduced during Soviet rule, the Naryn population was involved in animal husbandry and pastoral culture. Valleys and pasture areas were traditionally tribal, with community leaders assigning grazing areas to family units (Bussler, 2010; Isakov and Thorsson, 2015). Animals were rarely allowed to graze outside their assigned plots, although seasonal mobility was key for optimizing existing resources (Shigaeva *et al*., 2016). Tribal leaders organized herds so that the same areas were only grazed every third to fifth year – an apparently successful regulation method, since LD due to improper grazing was not considered an issue (Isakov and Thorsson, 2015).

This system was overturned when the Soviets imposed the permanent settlement of local populations and the conversion of tribally managed lands to intensive, state-owned collective farms known as *kolkhozes* (Bussler, 2010; Isakov and Thorsson, 2015; Mogilevskii *et al*., 2017). Transhumance and mobility remained part of the livestock production process. However, infrastructure and transport development, combined with the social and economic transformations introduced under Soviet rule, meant that animal migrations became more large-scale and logistically complex, involving trains, trucks and even air transport in some cases; there was less dependence on the family unit to move the herds (Bussler, 2010; Hoppe *et al*., 2016; Mogilevskii *et al*., 2017).

Some controversy remains over whether stocking rates in the area were higher during the Soviet era or today. In any case, what is clear is the immense scale of the management process and of the logistics and funding needed to maintain the system. Importation of winter feed, regular monitoring of pasture health, infrastructure development, transport of animals and animal veterinary care all allowed for the design and maintenance of an integral landscape management system focused solely on productivity (Sabyrbekov, 2019).

Pasture improvement programmes were commonplace within the Soviet system, with rudimentary pasture irrigation infrastructure development (**Figure 34**) and pasture fertilization and seeding. Pasture monitoring (**Figure 35**) was also routine in Soviet countries as part of the effort to maximize pasture productivity, although responses to perceived pasture degradation were often technical in nature and rarely included reductions in stocking rates or measures that would negatively affect total agricultural output.

Figure 34. Unmaintained pasture irrigation canal, near Song-Kul Lake (2019)

Figure 35. Small, unmaintained enclosure originally built for pasture monitoring, near Baetov (2019)

The extent to which this approach degraded the natural pasture base is debatable, although both Bussler (2010) and Hoppe *et al*. (2016) point to Soviet-era LD as commonplace and widespread in the wider region; they indicate that the winter forage delivered by other Soviet states resulted in an unsustainable number of livestock degrading pasture. However, the locals are divided about the proficiency and adequacy of Soviet land management (Liechti, 2012). In the case of Kyrgyzstan, the average productivity of summer pastures declined from 640 kg/ha to 410 kg/ha (a reduction of 36 percent) between the 1960s and the 1990s; the spring and autumn average pasture yield fell from 470 kg/ha to 270 kg/ha (a reduction of 43 percent) (Isakov and Thorsson, 2015). The productivity of winter pastures declined even more dramatically: from an average of 300 kg/ha to less than 100 kg/ha (a reduction of 67 percent).

Naryn households

A typical Naryn rural household has a small private plot, where a limited quantity of vegetables, legumes and fruits are grown; it will most likely own or have access to cropping land (approximately 0.5 ha per family unit, according to the locals). Fruits tend to be cold-tolerant species, such as apple, cherry and pear, as well as berries. Animal breeds are local, hardy species that have not undergone modern breeding selection methods (Mogilevskii *et al*., 2017).

The average household will also own around 20 small ruminants (principally sheep and some goats) and 10 cows. Goats are traditionally kept, but they attract lower prices than sheep, whose meat is used in celebrations. All residents either own or have access to cattle, which comprise the principal economic structure of the herd, act as an economic saving mechanism and provide social standing within the community. Those who can afford to do so often buy dry fodder to feed to their cattle during the winter months to maintain their condition ahead of the spring growth.

Households tend to depend mainly on animal sales for income, although youth who move away often send remittances and women in the family often use household gardens and rangeland foraging to provide other sources of income (cottage industries). When asked about investment opportunities in Naryn, a frequent answer was the purchase of horses, yaks or cattle – including for the diaspora population – although hunting is also becoming a noteworthy income stream for the more active community individuals and PC members. Community-based tourism is also becoming more common in Naryn districts and the regional capital and provides new income opportunities for locals.

Livestock and livestock products are sold mainly through travelling intermediary entrepreneurs who use their own vehicles to collect the livestock from the owner and transport them to sell in local community markets, or in other regions and the capital Bishkek. According to herders and local businessmen, an average of 40–50 percent of the animals sold go to other regions. Cattle prices are lower at the end of the growing season (September–October) and rise again in the spring before the fresh grass grows. Milk prices also depend on the availability of grass: prices are high in the non-growing season and fall in the growing season as grass becomes plentiful. Milk is increasingly used to make *koumiss* (fermented mare's milk) as it is in high demand; locals also report that demand for beef, and horse and yak meat is on the rise. There is little or no demand for wool and other animal-based fibres, though some producers in other regions are experimenting with Kashmir wool production and processing.

Herder communities

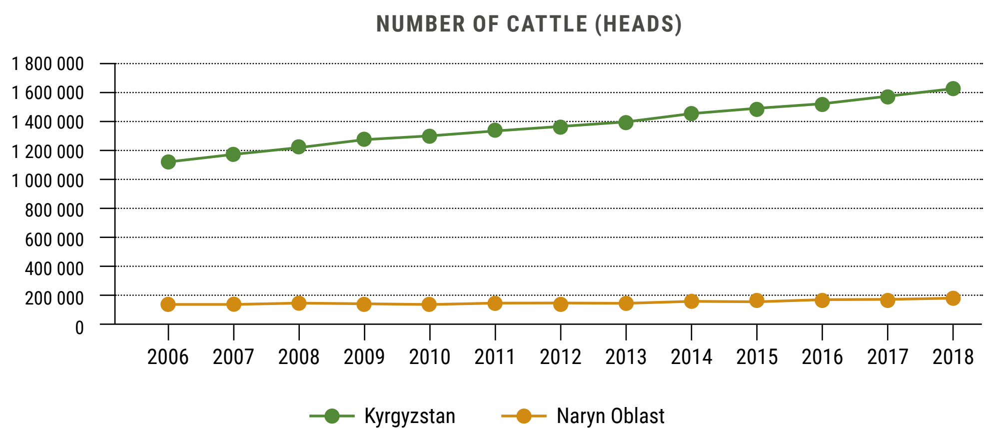
As explained in Section 3.3, herders care for animals not their own for a fee. Naryn herders and herders from other oblasts with access to Naryn seasonal pastures, typically depend on three income sources. The first is the fee the family charges for tending other people's livestock; this can either be a fixed salary or a charge per head (Sabyrbekov, 2019). The second revenue comes from the sale of livestock or livestock products. Most herders travel with their own small herd, and the sale of animals provides a source of cash. It should be noted that the milking season usually coincides with fresh grass growth in spring and summer, when animals are moved to remotely located summer pastures. The result is that most livestock owners do not enjoy the full benefits of animal ownership, because the majority of milk production is consumed or sold by the herder family.

The third source of revenue for herders is non-livestock related and increasingly associated with the community-based tourism trade. Tourist activities include guided horseback tours, accommodation in traditional yurts, cultural expositions on daily life, arts and crafts, and meal services. While some authors place this income stream on a par with more traditional livestock income streams (ibid.), locals report that tourism is only marginally important in the rural economy and only 1 percent of herder families have incorporated these practices into their seasonal routines. Families offering these services to the growing number of tourists in Naryn tend to be specialized and only manage a few animals for their or their guests' needs. For this reason, locals do not actually class them as "herders".

Naryn livestock herds

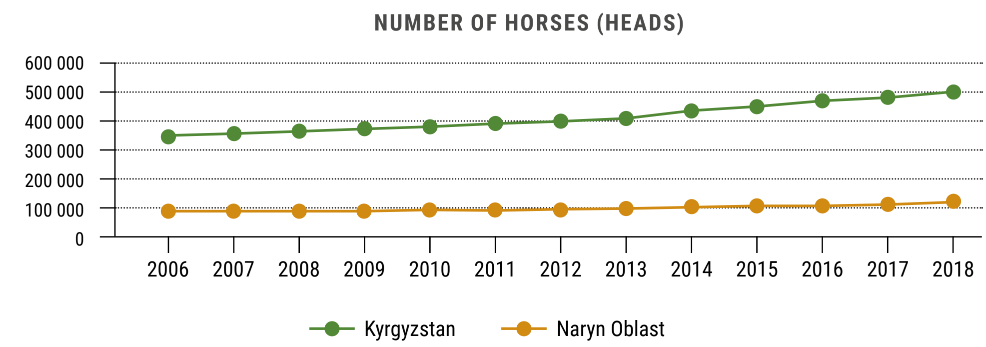
Figures 36 and 37 show that the official animal production numbers for the oblast are increasing, but at a slower rate than the national average. However, again, these official numbers should be viewed with caution (Isakov and Thorsson, 2015). Local herders and PC members claim that the numbers are currently the highest in decades and the landscapes have not experienced the decreases shown in the official census for the period following independence. Given that Naryn is a gathering point for pastoralists and their animals, increases in other oblasts will carry over and increase the annual livestock loads in local pastures.

Figure 36. Evolution of cattle numbers, 2006–2018 (2019)



Source: NSC. 2019. *Livestock and bird yield by territory of Kyrgyz Republic: 2006–2018.* Department of Social Statistics. Bishkek.

Figure 37. Evolution of horse numbers, 2006–2018 (2019)



Source: NSC. 2019. *Livestock and bird yield by territory of Kyrgyz Republic: 2006–2018.* Department of Social Statistics. Bishkek.

In order to better understand the importance of production types and output per district, Table 6 shows the meat, milk, eggs and wool output for 2018 and 2019.

TABLE 6. Output of meat, milk, eggs and wool per district, Naryn Oblast

DISTRICT	2018	2019	2019 in % to 2018
Meat (kg)			
Ak-Talaa	5 070	5 131	101.2
At-Bashy	6 184	6 256	101.2
Zhymgal	5 754	5 869	102.0
Kochkor	8 152	8 255	101.3
Naryn	6 772	6 872	101.5
Regional total	**32 458**	**32 914**	**101.4**
Milk (tonnes)			
Ak-Talaa	11 475	11 589	101.0
At-Bashy	16 362	16 792	102.6
Zhymgal	16 093	16 576	103.0
Kochkor	21 829	22 325	102.3
Naryn	20 800	21 200	101.9
Regional total	**87 806**	**89 742**	**102.2**
Eggs ('000)			
Ak-Talaa	725	744	102.6
At-Bashy	1 091	1 094	100.3
Zhymgal	1 076	1 086	100.9
Kochkor	1 262	1 279	101.3
Naryn	915	943	103.1
Regional total	**5 376**	**5 450**	**101.4**
Wool (tonnes)			
Ak-Talaa	286	301	105.2
At-Bashy	515	518	100.6
Zhymgal	388	396	101.9
Kochkor	550	561	102.2
Naryn	396	411	103.7
Regional total	**2 176**	**2 229**	**102.5**

Source: NSC. 2019. *Livestock and bird yield by territory of Kyrgyz Republic: 2006–2018.* Department of Social Statistics. Bishkek.

Pasture tenure and management in Naryn Oblast

While the majority of grazed lands fall under state tenure, they are managed by local community users through the PUAs created under the Pasture Law of 2009 (2011). In practice, the PCs make most decisions and are responsible for grassland management plans and monitoring. Herders may also have access to other grazing areas in the form of forestry lands, state reserves or protected areas (Isakov and Thorsson, 2015). These pasturelands that fall outside the PUA-managed lands are still leased from the authorities, yet confusion remains among land users regarding exactly where one ends and the other begins. Pastoralists – principally herders – therefore cross and deal with a mixture of land tenure and administrative or cultural systems when grazing, although they mainly graze within PUA boundaries.

4.2 Overview of vegetation, water and soil resources

In line with the PRAGA methodology, three broad families of indicators are presented and described for Naryn Oblast: vegetation, water and soil resources, as perceived through PRAGA consultations and workshops, RS and literary review.

Status of pasture health and productivity in Naryn Oblast

The composition of pasture species is often subject to location within the landscape, especially altitude, and land management history (ibid.). The principal pasture or dominant species per ecosystem type is summarized in Table 7, though it can be said that the herbaceous base of most of the Naryn Oblast pastures includes *Festuca, Poa* and *Stipa*, with sedges (*Carex*), forbs and other non-woody herbaceous plants interspersed between the grass species. The drier areas or those with constant grazing pressure are usually covered with *Artemisia, Carex, Cirsium, Coleophora, Phlomoides*or *Salsola* species (ibid.). Legumes are present albeit sparse and are typically represented by the Medicago family. Table 7 lists the principal species for the different ecosystem types.

TABLE 7. Ecosystem types and principal species composition

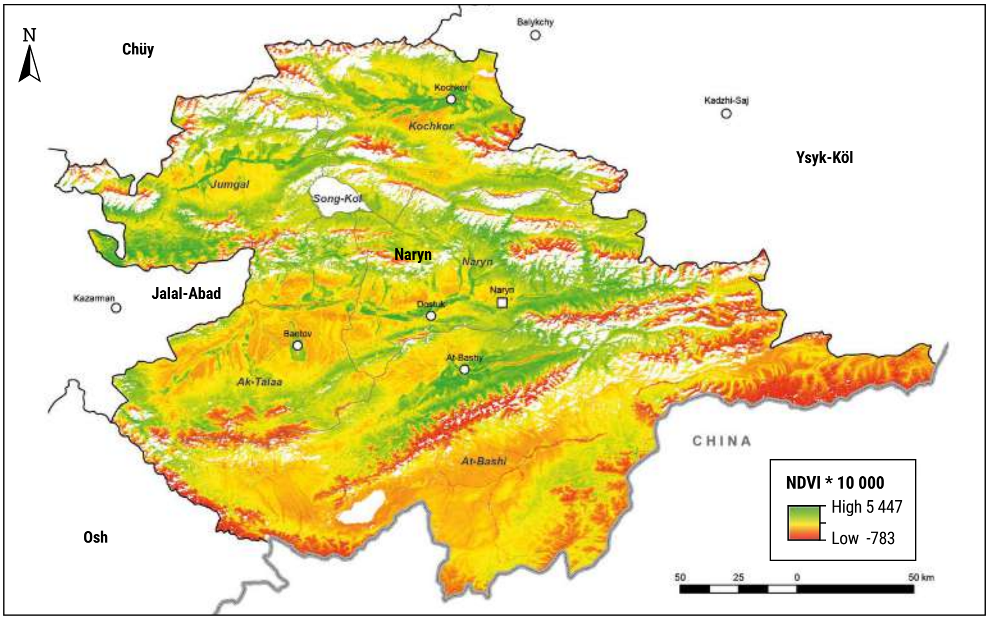
ECOSYSTEM TYPE	PRINCIPAL SPECIES
Alpine meadow	*Carex stenophylloides, C. stenocarpa, Poa pratensis, Ligularia alpigena*
Transition meadow to steppe	*Festuca valesiaca, Poa pratensis, Ligularia alpigena, Helictotrichon desertorum, Geranium collinum, Alchillea millefolium, Tarahacum officinale*
Steppe/Syrt	*Stipa caucasia, Festuca valesiaca, Agropyrum cristatum, Coleophora turkestanica, Artemisia tianschanica, A. serotina, Thymus vulgaris*
Semi-desert	*Stipa capillata, S. caucásica, Elytrigia repens, Festuca valesiaca, Artemisia tianschanica, Agropyrum cristatum*
True desert	*Salsola oppositifolia, Anisantha tectorum, Trigonella arcuata*
Spruce forest	*Picea schrenkiana*
Juniper forest	*Juniperus* spp.
Riparian forest	*Betula* spp., *Crataegus* spp., *Hippophaerhamnoides*, *Populus* ssp., *Salix* spp., *Tamarixramosissima*
Disturbed lands (fallow)	*Artemisia* spp., *Achillea millefolium*, *Crataegus* spp., *Cynodon dactylon*, *Eryngium* spp.

Source: Based on Isakov, A. & Thorsson, J. 2015. *Assessment of the land condition in the Kyrgyz Republic with respect to grazing and a possible development of a quoting system on the local governmental level*. B.: V.R.S. Company Ltd. 48 pp.

Trees are typically restricted to slopes, riparian areas and urban environments. Spruce forests are found on wetter, less exposed slopes and undisturbed alpine areas, while juniper trees are more prone to arid and exposed areas and do not typically form dense stands. Riparian zones are typically home to willow, poplar and other key riparian species. Common shrubs are *Crataegus* spp., *Hippophaerhamnoides* and *Tamarixramosissima*.

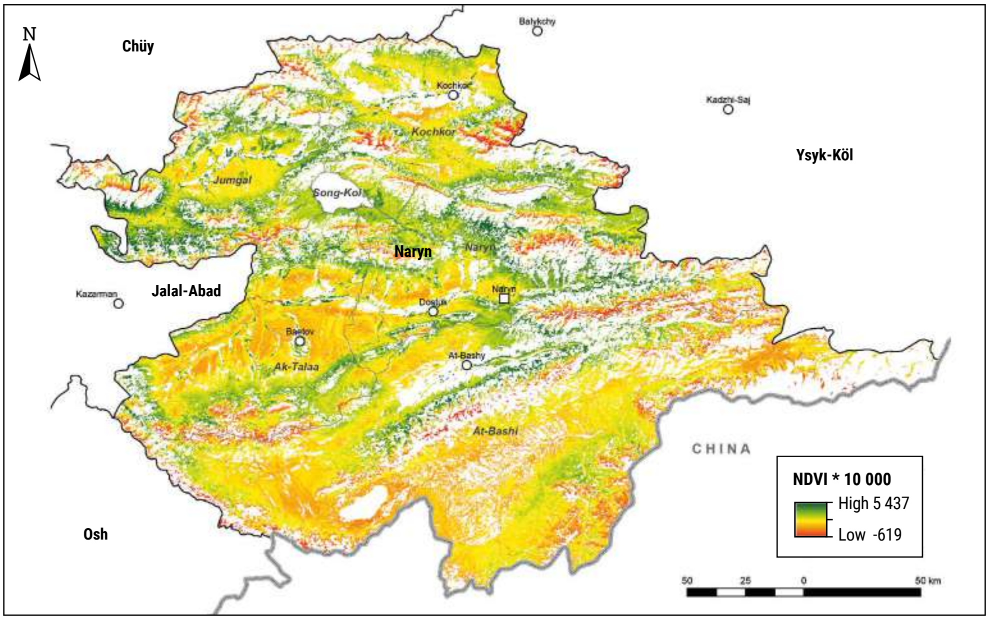
The importance of aspect and position in the landscape for net primary productivity (NPP) is also apparent from the NDVI for 2018 (see **Figure 38** for all land cover classes and **Figure 39** for the pastureland cover class only).

Figure 38. NPP as seen through NDVI, Naryn Oblast (2018)



Source: Terra Moderate Resolution Imaging Spectroradiometer (MODIS) Vegetation Indices (MOD13Q1) Version 6. 2018. Net Primary Productivity as seen through NDVI, Naryn Oblast (2018). Cited 05 November 2019. https://lpdaac.usgs.gov/products/mod13q1v006/. Modified to comply with UN, 2020

Figure 39. NPP for pasture (grass) land cover class, Naryn Oblast (2018)



Source: Terra Moderate Resolution Imaging Spectroradiometer (MODIS) Vegetation Indices (MOD13Q1) Version 6. 2018. Net Primary Productivity for pasture (grass) land cover class, Naryn Oblast (2018). Cited 05 November 2019. https://lpdaac.usgs.gov/products/mod13q1v006/. Modified to comply with UN, 2020

Conversations with local herders highlighted the role that aspect plays in the composition of pasture species and how herding can be adapted to time and season to take this into account. This "aspect-based" approach has been observed in other Central Asian and East European countries characterized by a rugged topography.

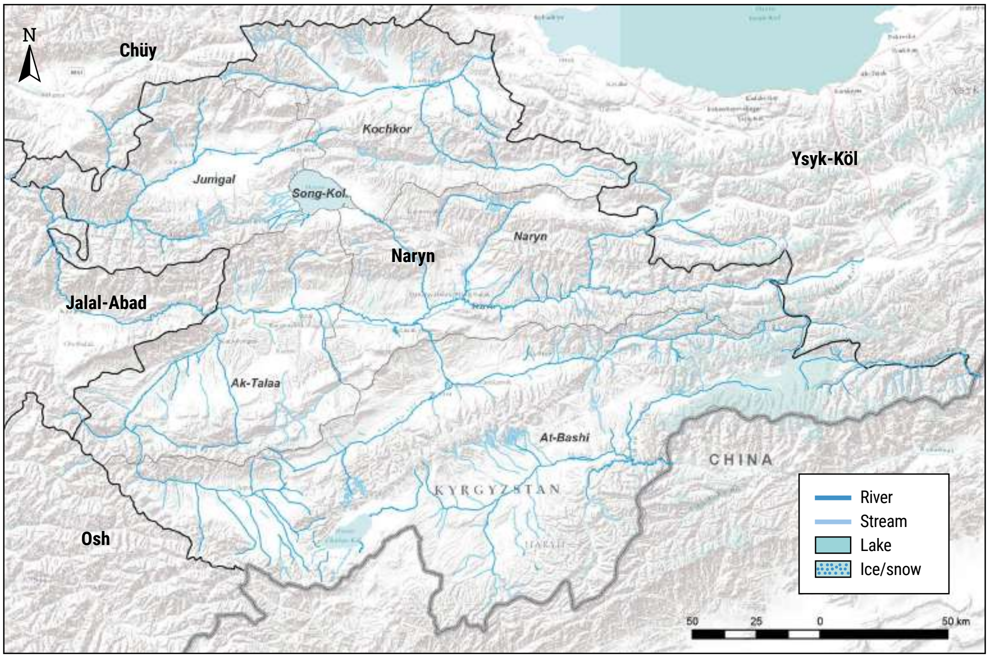
> "Ten years ago, you could not walk in Son Kul pastures in the early morning; the grass was high and the dew would get your feet and trousers wet. Today, you can walk easily in the morning… your feet stay completely dry. The grass is short and the dew does not gather."
>
> *Elder herder who has utilized the Son Kul Lake summer pastures his entire life*

Water resources and their status within Naryn Oblast

Water is not usually considered a limiting factor for livestock production in the region, at either the micro level (soil moisture) or the landscape level (watercourses) (CIAT and World Bank, 2018; FAO, 2012) – see **Figures 40 and 41**. Soil moisture for the most part is available for pasture growth, especially in early spring as the snow melts; upper altitude soils have high soil carbon levels, increasing soil water retention capacity (Hoppe *et al*., 2016). The many lakes, streams and ephemeral wetlands are fairly well distributed compared to conditions in neighbouring countries, and most of the oblast population can find water for stock and crop irrigation in normal seasons. Naryn also has the Orto-Tokoy Dam for irrigation; completed in 1956, it holds 470 million m^3 and irrigates 220 000 ha of land (FAO, 2012).

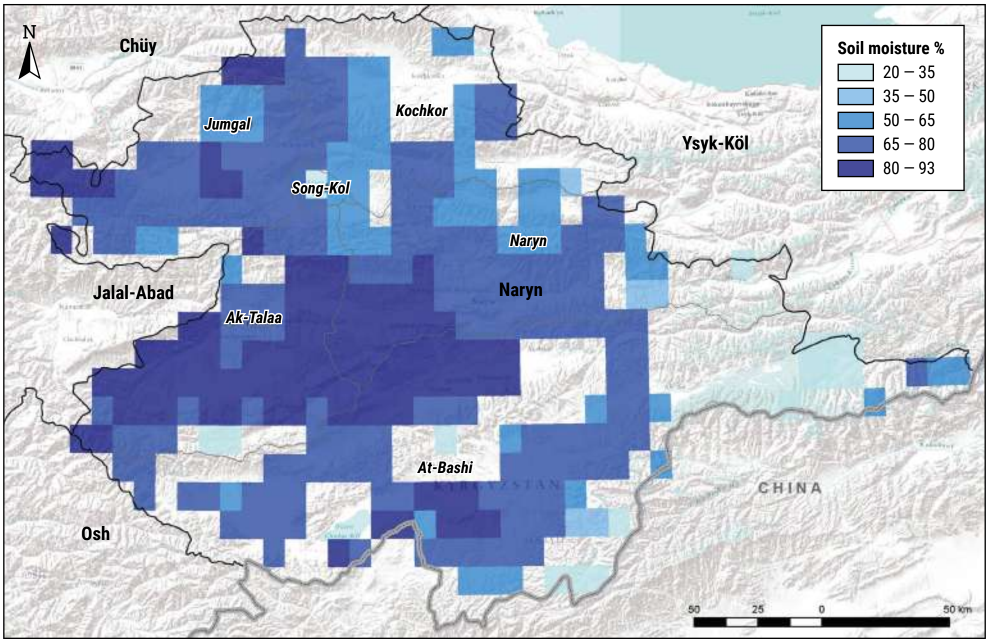
©FAO/CAMP Alatoo

Figure 40. Hydrological resources, Naryn Oblast (2019)



Source: Humanitarian OpenStreetMap (HOTOSM). 2018. Hydrological resources, Naryn Oblast (2019). Cited 12 November 2019. https://data.humdata.org/dataset/hotosm_kgz_waterways. Modified to comply with UN, 2020

Figure 41. Soil moisture map, Naryn Oblast (2019)

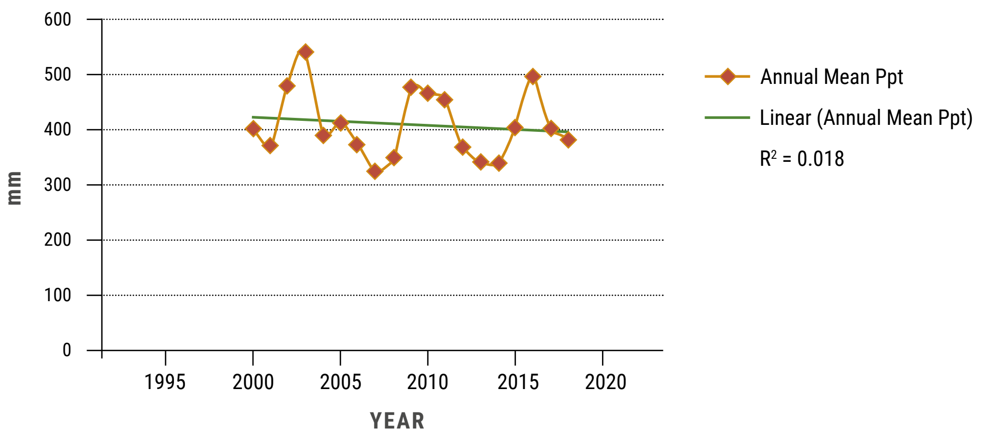


Source: Copernicus Global Land Service, Surface Soil Moisture. 2019. Soil moisture map, Naryn Oblast (2019). Cited 05 November 2019. https://land.copernicus.eu/global/products/ssm. Modified to comply with UN, 2020

However, Naryn local representatives disagreed strongly with the claims that water is sufficient for pasture growth and livestock watering, stating that soil moisture rates have fallen dramatically, rainfall has decreased or falls within shortened time frames, and springs and streams dry up earlier in the year than they did in the past. Warming temperatures are also melting the permafrost in higher alpine areas, leading to changes in the water tables. They blame the rising temperatures (in agreement regarding the 2.4 °C increase) for increasingly dry, erodible soils that fail to provide sufficient moisture for adequate grass growth. On the other hand, the locals do not agree with data showing an overall increase in total precipitation for the area, saying that precipitation (both rainfall and snowfall) has decreased dramatically.

According to **Figure 42** based on the CHIRPS data set, mean annual rainfall declined from 420 mm in 2000 to 390 mm in 2018 – that is, in line with the locals' claims of less total rainfall.

Figure 42. Annual mean precipitation, Naryn Oblast, 2000–2018 (2019)



Source: Climate Hazards Group InfraRed Precipitation with Station (CHRIPS) Database version 2, USGS & NOAA. 2018. Annual mean precipitation, Naryn Oblast, 2000–2018. Cited 12 November 2019. https://data.noaa.gov/dataset/dataset/chirps-version-2-0-precipitation-global-0-05-5-day-1981-present. Modified to comply with UN, 2020

> "We used to get up to two cuttings of hay a year in some of these fields, and still run stock on them. Now we are lucky if we get one. The soil is always dry now. It doesn't hold moisture."
>
> *At-Bashy livestock owner*

Soil types and characteristics

The mountains in the oblast are mostly from the Palaeozoic era, comprising granites and porphyries of igneous origin and limestones and schists (Gareenda *et al.*, 2016). Large glacial deposits (moraines, tills) of diverse origin also form an integral component of the landscape, although their value as agricultural or pastoral areas is limited due to their low fertility and massive soil structure (**Figure 43**).

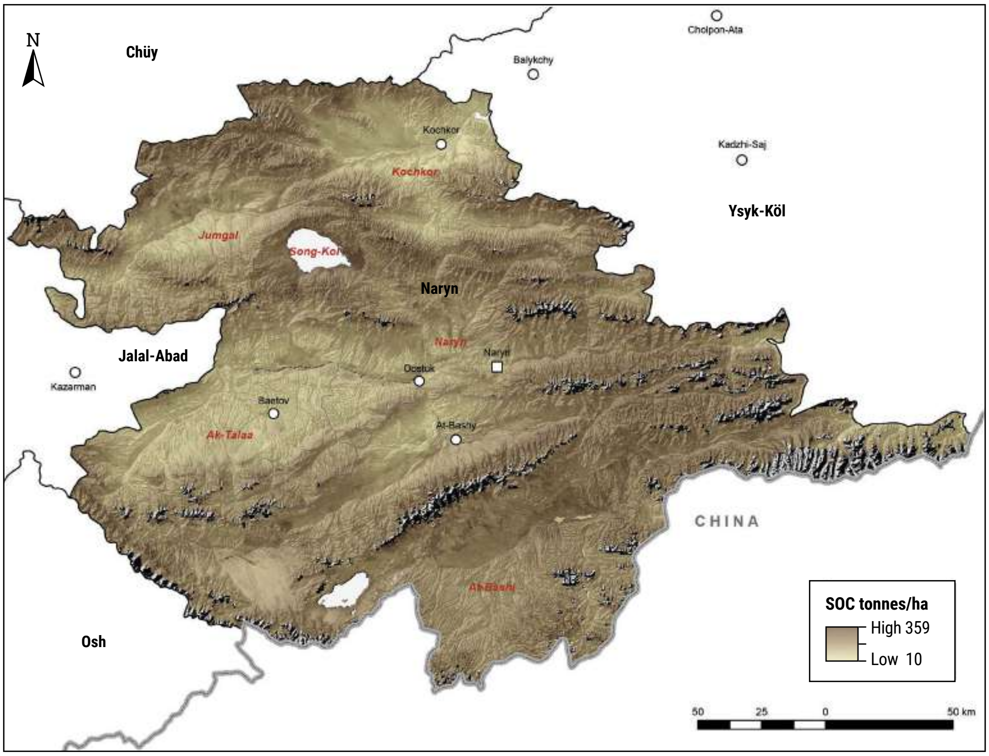
As with vegetation, soils are strongly influenced by altitude and topography. Grey semi-desert soils (sierozems) and grey-brown desert-steppe stony soils are typically found at lower altitudes, brown-chestnut loams in forested areas and skeletal soils of diverse origin, depth and development on the steeper slopes. Alpine meadows and grasslands are characterized by mountain chernozems, while alluvial deposits at higher altitudes are composed mainly of organic, peat-based soils (FAO, 2015).

Figure 43. Glacial deposits showing little vegetative cover or development (2019)

Soils located in winter pasture areas are typically high in pH (7.27 average) and low in organic matter content (12.83 percent), while soils in higher altitude areas are low in pH (6.03 average) and high in organic matter content (21.05 percent) (Hoppe *et al*., 2016). The lower temperatures and higher biomass rates of the summer pastures would allow for more organic carbon to be stored, thus lowering the soil pH. This coincides with the RS data generated for the baseline (see **Figure 44**).

Warmer temperatures are also affecting soil structure in upper catchments and on alpine slopes. Permafrost is melting and leading to mass movement. Some of this movement has been reported to have impacted infrastructure (e.g. irrigation canals, roads and outhouses), although it mostly occurs on upper slopes (**Figure 45**).

Figure 44. Soil organic carbon accumulation in upper soil levels, Naryn Oblast (2019)



Source: Soil Grid. 2019. Soil organic carbon accumulation in upper soil levels, Naryn Oblast. Cited 07 November 2019. https://soilgrids.org/. Modified to comply with UN, 2020

Figure 45. Mass movement erosion of upper slopes, near Son-Kul, June 2019

4.3 Barriers to sustainable rangeland management

Peer-reviewed studies and consultations with regional stakeholders have identified the following obstacles:

- lack of investment in pasture management and maintenance;
- lack of capacity development at land user level and loss of human resources in rural areas due to migratory patterns;
- lack of rural infrastructure (transport, storage, irrigation) development and maintenance, complicated by difficult terrain and a tendency towards extreme climatic events;
- small farm size, making administrative and technical support difficult and costly;
- poor animal health and lack of an effective veterinary service, leading to concerns over food safety issues; and
- lack of investment in innovation and development along the entire agricultural value chain.

5

Using remote sensing to analyse rangeland health against SDG 15.3.1

On completion of the baseline data collection, a series of maps and graphs were developed to better understand the trends and drivers at work within Naryn Oblast. The LD analysis methodology was in line with the good practice guidance of SDG indicator 15.3.1. (Proportion of land that is degraded over total land area, in respect of indicator selection and analysis) (Mattina *et al.*, 2018; UNCCD and CSIRO, 2017). In order to assess the degraded area, SDG indicator 15.3.1 combines information from three sub-indicators: land (vegetation) productivity, land cover and soil organic carbon (SOC) change. The LD analysis was conducted through the use of Geographic Information System (GIS) technology using the required software and tools and the relevant data sets (**Table 8**).

TABLE 8. Main software, tools and data sets used for the LD analysis

MAIN INPUT DATA SETS	OUTPUT MAPS	MAIN SOFTWARE AND TOOLS
1. ESA CCI Global Land Cover, 300-m resolution data set	Land cover type degradation	1. Quantum (Q) GIS 2.18.X spatial software with plugin tool Trends.Earth for LD analysis
2. USGS LAAPDAC MODIS 13 Q1 NDVI, 250-m resolution data set	Land productivity degradation	2. ESRI ArcGIS spatial software for secondary analysis and map publication
3. ISRIC World Soil Information, Soil GRID, 250-m resolution data set	SOC degradation	3. Microsoft Excel for statistical analysis and table and graph publication
4. Combination of data sets 1, 2 and 3	SDG 15.3.1 degradation status	

Notes*:* ESA CCI – European Space Agency Climate Change Initiative; USGS – United States Geological Survey; ISRIC – International Soil Reference and Information Centre; SDG – Sustainable Development Goal; LD – land degradation.

Source: the authors

The monitoring period for the LD assessment was from 2000 to 2015 (15 years) in Naryn Oblast. The steps followed for the sub-indicators and eventual SDG 15.3.1 LD analysis are outlined in the sub-sections below.

5.1 Change in land cover

Land cover degradation analysis was carried out by assessing change in the aggregated ESA CCI LC type data sets, based on the template provided in the good practice guidance on indicator selection and analysis (Mattina *et al*., 2018; UNCCD and CSIRO, 2017) and local expert opinion captured during the December 2019 validation mission in Krygyzstan (see Annex 4) for time step 2000 as the baseline and 2015 as the target year. The transition – or lack of it – from one land cover type to another from the baseline to the target year and its classification as improved, stable or degraded was the basis of the land cover degradation analysis (**Figure 46**).

It is important to note that local expert knowledge/participation was incorporated during the calibration and validation of the land cover type aggregation and transition/ degradation analysis of the sub-indicator land cover degradation as shown in Figure 46 and is provided as Annex 4.

Figure 46. Land cover type transition and degradation matrix table

	Tree-covered	Grassland	Cropland	Urban areas	Bare land	Water body
Tree-covered	0	-	-	-	-	-
Grassland	+	0	+	-	-	-
Cropland	+	-	0	-	-	-
Urban areas	+	0	+	0	-	-
Bare land	+	+	+	+	0	+
Water body	0	-	0	-	-	0

Legend

-	Degradation
0	Stable
+	Improvement

* Grassland class consists of grassland, shrub and sparsely vegetated areas

Source: UNCCD & CSIRO. 2017. *Good Practice Guidance, SDG Indicator 15.3.1: Proportion of land that is degraded over total land area.* Version 1.0 [online]. [Cited 27 April 2021]. https://www.unccd.int/sites/default/files/relevant-links/2017-10/Good%20Practice%20Guidance_SDG%20Indicator%2015.3.1_Version%201.0.pdf

5.2 Change in land productivity

Land productivity is the biological productive capacity of the land measured as NPP. The most commonly used surrogate of NPP is NDVI, which measures vegetation greenness (Tucker, 1979; Campbell *et al*., 1999; Wessels, Prince and Becker-Reshef, 2008). Change in land productivity (land productivity dynamics) was analysed using NDVI bi-weekly products from MODIS data sets and the classified land cover and soil type data sets. Change in land productivity was assessed using three measures of change from NDVI 2000–2015 annual time series data: trajectory, performance and state. Significant change in any of these three NDVI measurements was indicative of: land productivity degradation if reduced; land productivity improvement if increased; or stable if otherwise.

5.3 Change in SOC stock

Change in SOC stock over the reported period was analysed using a combination of SOC stock data set and land cover and bioclimatic data sets that were used as SOC stock proxies. Significant change in SOC stock was indicative of: SOC degradation if reduced, SOC improvement if increased, or stable if otherwise.

5.4 SDG indicator 15.3.1: Land degradation

SDG indicator 15.3.1: Land degradation was derived by aggregating all sub-indicators (change in land cover, change in SOC stock and change in land productivity) and applying the UNCCD rule of "one degraded all-degraded". The degradation state was classified as "degradation", "stable" or "improvement" in a matrix of all the unique combinations of the sub-indicator states (**Figure 47**). Most outcomes under this matrix and the "one degraded all-degraded" rule provide a "degradation" result.

Figure 47. SDG 15.3.1 land degradation state (improvement, stable and degradation)

AGGREGATING SDG 15.3.1 SUB-INDICATORS			
Productivity	**Land cover**	**SOC**	**SDG 15.3.1**
Improvement	Improvement	Improvement	Improvement
Improvement	Improvement	Stable	Improvement
Improvement	Improvement	Degradation	Degradation
Improvement	Stable	Improvement	Improvement
Improvement	Stable	Stable	Improvement
Improvement	Stable	Degradation	Degradation
Improvement	Degradation	Improvement	Degradation
Improvement	Degradation	Stable	Degradation
Improvement	Degradation	Degradation	Degradation
Stable	Improvement	Improvement	Improvement
Stable	Improvement	Stable	Improvement
Stable	Improvement	Degradation	Degradation
Stable	Stable	Improvement	Improvement
Stable	Stable	Stable	Stable
Stable	Stable	Degradation	Degradation
Stable	Degradation	Improvement	Degradation
Stable	Degradation	Stable	Degradation
Stable	Degradation	Degradation	Degradation
Degradation	Improvement	Improvement	Degradation
Degradation	Improvement	Stable	Degradation
Degradation	Improvement	Degradation	Degradation
Degradation	Stable	Improvement	Degradation
Degradation	Stable	Stable	Degradation
Degradation	Stable	Degradation	Degradation
Degradation	Degradation	Improvement	Degradation
Degradation	Degradation	Stable	Degradation
Degradation	Degradation	Degradation	Degradation

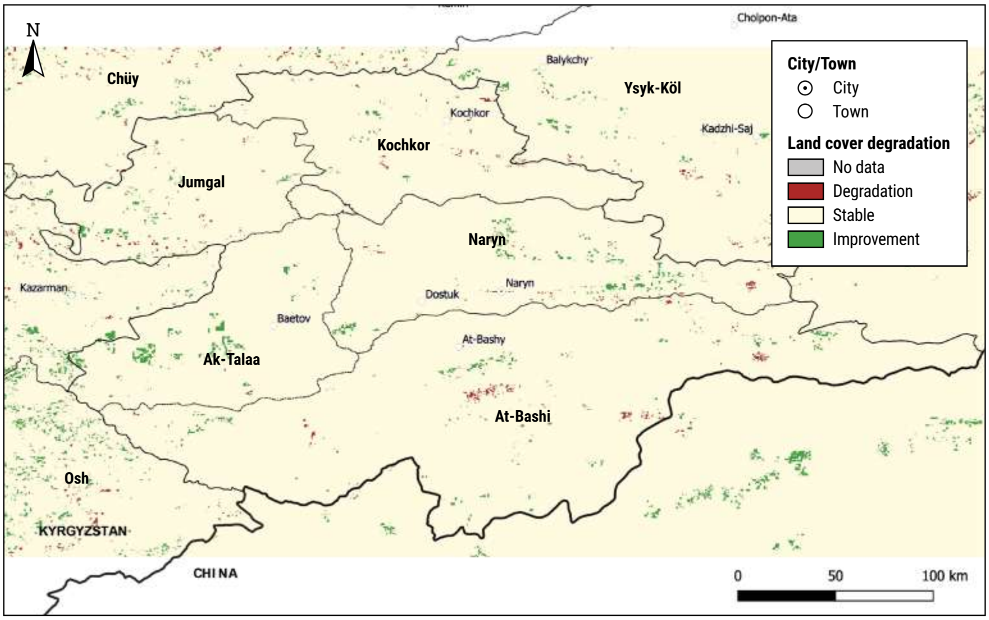
Note: Based on the matrix table of the sub-indicators (land cover degradation, SOC stock and land productivity change).

Source: UNCCD & CSIRO. 2017. *Good Practice Guidance, SDG Indicator 15.3.1: Proportion of land that is degraded over total land area.* Version 1.0 [online]. [Cited 27 April 2021]. https://www.unccd.int/sites/default/files/relevant-links/2017-10/Good%20Practice%20Guidance_SDG%20Indicator%2015.3.1_Version%201.0.pdf

Analysis results for SDG 15.3.1 indicators applied in the Naryn context

Based on the analysis, the output results are illustrated in the form of maps, tables and graphs (Figures 48–55, Tables 9–13), presented in the order of the sub-indicators – land cover degradation, change in SOC stock and change in land productivity – and as the combination of the three sub-indicators to give SDG indicator 15.3.1 Land degradation. For changes in land cover from 2000 to 2015, see **Figure 48** and **Table 9**.

Figure 48. Change in land cover, Naryn Oblast, 2000–2015



Note: The baseline year is 2000 and the target year 2015 – with reference to the transition table (Figure 46) from the summary analysis section for change in land cover. It is important to note that the most recent land cover data set was in 2015, hence the target year being 2015.

Source: Peter Mwangi. 2020. Change in land cover, Naryn Oblast, 2000–2015. Production date: 15 January 2020. Modified to comply with UN, 2020

TABLE 9. Land cover type degradation levels, Naryn Oblast, 2000–2015

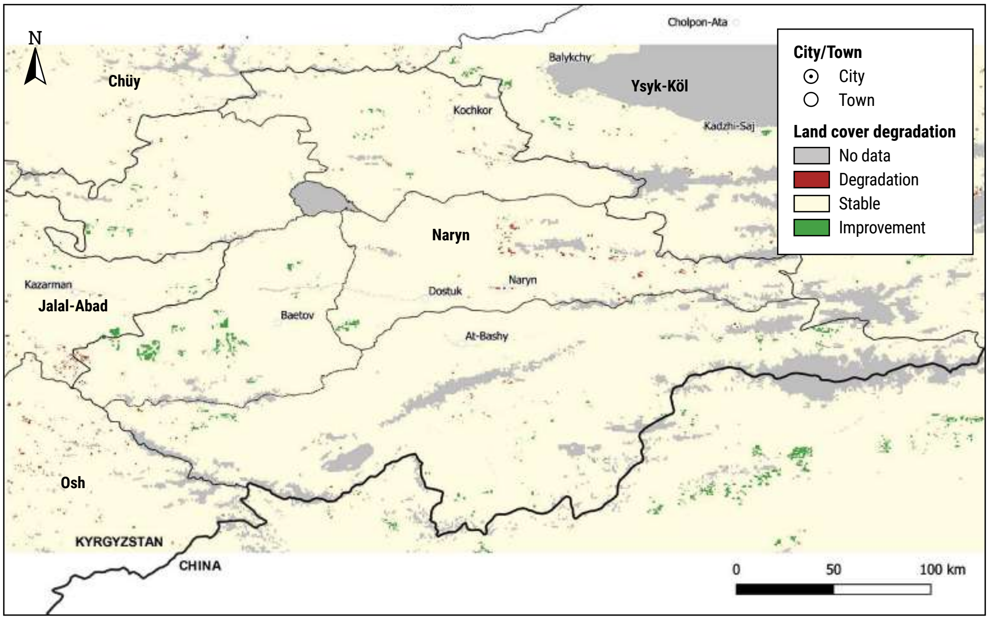
CHANGE IN LAND COVER	AREA (km^2)	PERCENT OF TOTAL LAND AREA
Total land cover	44 897.2	100.00%
Land area with improved land cover	465.3	1.04%
Land area with stable land cover	44 265.9	98.59%
Land area with degraded land cover	165.9	0.37%
Land area with no data for land cover	0.0	0.00%

Source: Peter Mwangi. 2020. Land cover type degradation levels, Naryn Oblast, 2000–2015. Production date: 16 January 2020.

Based on the land cover degradation sub-indicator, less than 1.5 percent falls outside the "stable" category. According to these results, there was little change in the vegetation structure within the time frame chosen (2000–2015). Most land cover degradation (change from grassland to bare land) was in At-Bashy District, while Ak-Talaa and Naryn districts had the majority of the improved land cover (change from grassland to cropland/tree-covered areas).

The same process was used to determine changes in SOC from 2000 to 2015; the results are presented in **Figure 49** and **Table 10**.

Figure 49. Change in SOC stock, Naryn Oblast, 2000–2015



Source: Peter Mwangi. 2020. Change in SOC stock, Naryn Oblast, 2000–2015. Production date: 15 January 2020. Modified to comply with UN, 2020

TABLE 10. Changes in SOC stocks, Naryn Oblast, 2000–2015

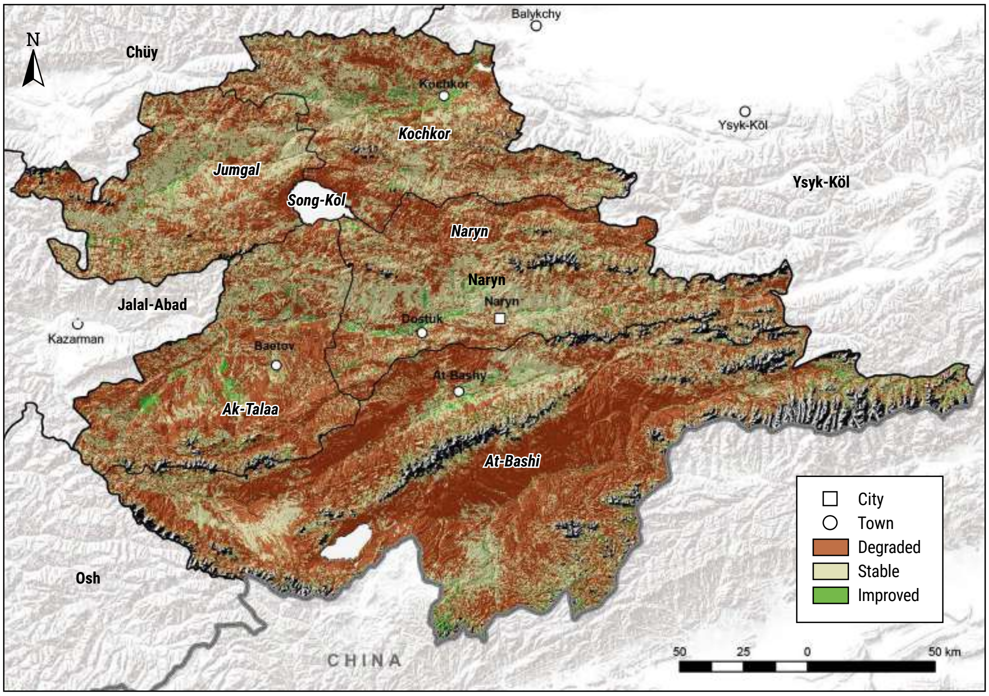
CHANGE IN SOC STOCK	AREA (km^2)	PERCENT OF TOTAL LAND AREA
Total land area	44 897.2	100.00%
Land area with improved SOC	256.5	0.57%
Land area with stable SOC	41 406.9	92.23%
Land area with degraded SOC	99.3	0.22%
Land area with no data for SOC	3 134.6	6.98%

Source: Peter Mwangi. 2020. Change in SOC stock, Naryn Oblast, 2000–2015. Production date: 15 January 2020. Modified to comply with UN, 2020

As with land cover degradation, perceived changes in SOC seem to be negligible, totalling less than 1 percent. This means that according to the change in SOC stock analysis, the structure and fertility of the soil remain fairly intact in Naryn Oblast. Most of the significant SOC stock improvement was in the central and eastern areas of Ak-Talaa District, while the bulk of the significant SOC stock degradation was in the central and mid-eastern parts of Naryn District.

Following the analysis of land cover and SOC in the oblast, land productivity was analysed for the same timeline (see **Figure 50** and **Table 11**).

Figure 50. Change in land productivity, Naryn Oblast, 2000–2015



Source: Peter Mwangi. 2020. Change in land productivity, Naryn Oblast, 2000–2015. Production date: 16 January 2020. Modified to comply with UN, 2020

Table 11. Significant change in land productivity levels, Naryn Oblast, 2000–2015

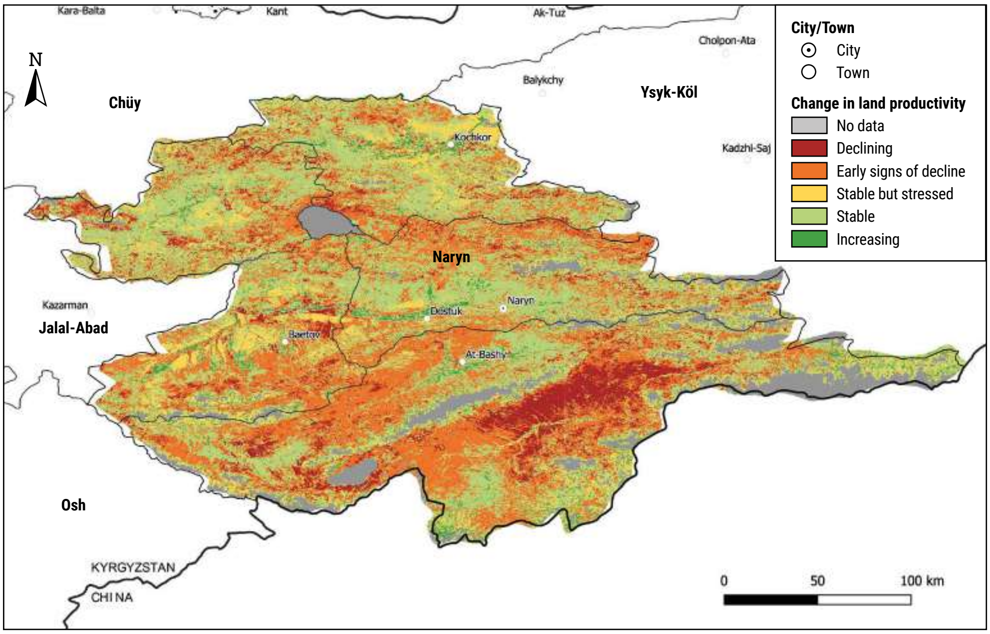
CHANGE IN LAND PRODUCTIVITY	AREA (km^2)	PERCENT OF TOTAL LAND AREA
Total land area	44 897.2	100.00%
Land area with improved productivity	1 583.3	3.53%
Land area with stable productivity	17 910.8	39.89%
Land area with degraded productivity	22 234.7	49.52%
Land area with no data for productivity	3 168.3	7.06%

Source: Peter Mwangi. 2020. Significant change in land productivity levels, Naryn Oblast, 2000–2015. Production date: 16 January 2020.

According to the 15-year trend analysis, the changes in land productivity were more marked than in the other indicator classes. Approximately 40 percent of the Naryn Oblast territory shows signs of stability, being located mainly in the low/flatlands. The improved productivity category has the lowest percentage: just 3.5 percent distributed mainly among the stable land productivity and riparian ecosystems. Areas showing decreased land productivity are the most prevalent, accounting for almost 50 percent of the land area in question.

This approach indicates that degradation is principally located in the highlands, in particular in steep south-facing areas – especially apparent in the central mountain range of At-Bashy District, south of At-Bashy town (**Figure 51**). The map data are presented as percentages in **Figure 52**. According to the local At-Bashy pasture users, this particular area (Ak-Sai) is popular for summer pasture grazing (and is also sometimes used for winter grazing) – hence the potential for overgrazing.[3]

Figure 51. Change in land productivity, Naryn Oblast, 2000–2015

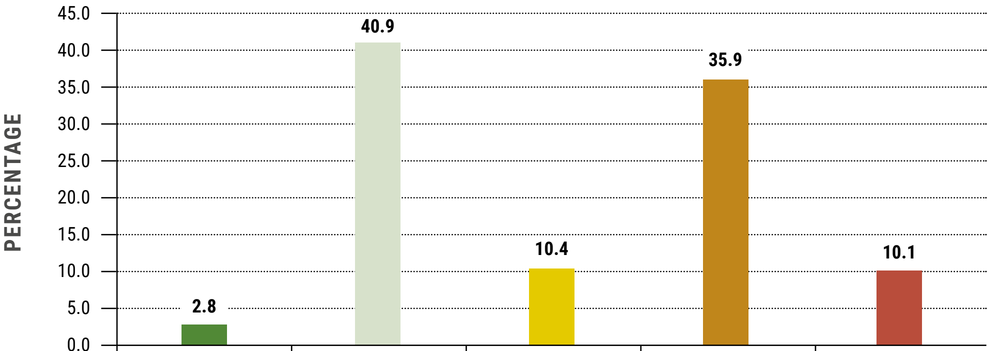


Note: The land productivity change is further divided with five classifications: increasing, stable, stable but stressed, early signs of decline, and declining.

Source: Peter Mwangi. 2020. Change in land productivity, Naryn Oblast, 2000–2015. Production date: 17 January 2020. Modified to comply with UN, 2020.

[3] Information obtained during local validation meeting with pasture users in At-Bashy, 18 December 2019.

Figure 52. Change in land productivity, Naryn Oblast, 2000–2015



With 5 classes	Improved	Stable	Stable but stressed	Moderately degraded	Degraded
With 3 classes	Improved	Stable		Degraded	

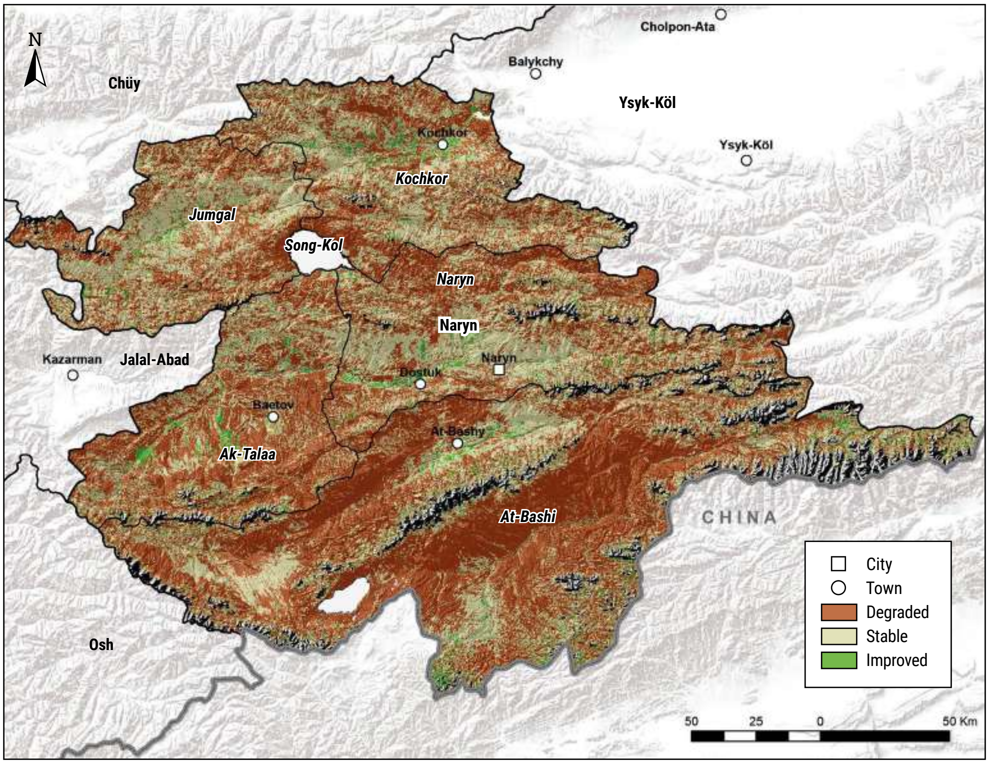
Note: Significant change in any of the three NDVI measurements (i.e. trajectory, performance and state) is indicative of: land productivity degradation if reduced; land productivity improvement if increased; and stable if otherwise.

Source: Peter Mwangi. 2020. Change in land productivity, Naryn Oblast, 2000–2015. Production date: 17 January 2020.

In Naryn Oblast, grassland is the main type of land cover and covers around 71 percent of the total area according to the ESA CCI LC data set. Only 2.8 percent of grassland has improved productivity and about 41 percent was stable between 2000 and 2015, distributed mainly on the low/flatlands and cropping areas. Remote sensing shows that in the periphery of towns/cities and on the north-facing and/or gentler slopes of the highlands, degraded grassland productivity is at a mild (stable but stressed) and intermittent (early signs of decline) stage, while on south-facing and/or steeper slopes, it is at an advanced (declining productivity) stage of degradation (**Figure 52**). The majority of grassland land cover types have degraded productivity (56.4 percent).

The results from the three indicator classes are combined in the map in Figure 53 highlighting degradation in Naryn Oblast (see also **Table 12**).

Figure 53. Land degradation over 15 years, Naryn Oblast, 2000–2015



Note: Derived from the combination of land cover, land productivity and SOC degradation sub-indicators, based on a "one degraded all degraded" rule.

Source: Peter Mwangi. 2020. Land degradation over 15 years, Naryn Oblast, 2000–2015. Date: 19 January 2020. Modified to comply with UN, 2020.

TABLE 12. Land degradation levels, Naryn Oblast, 2000–2015

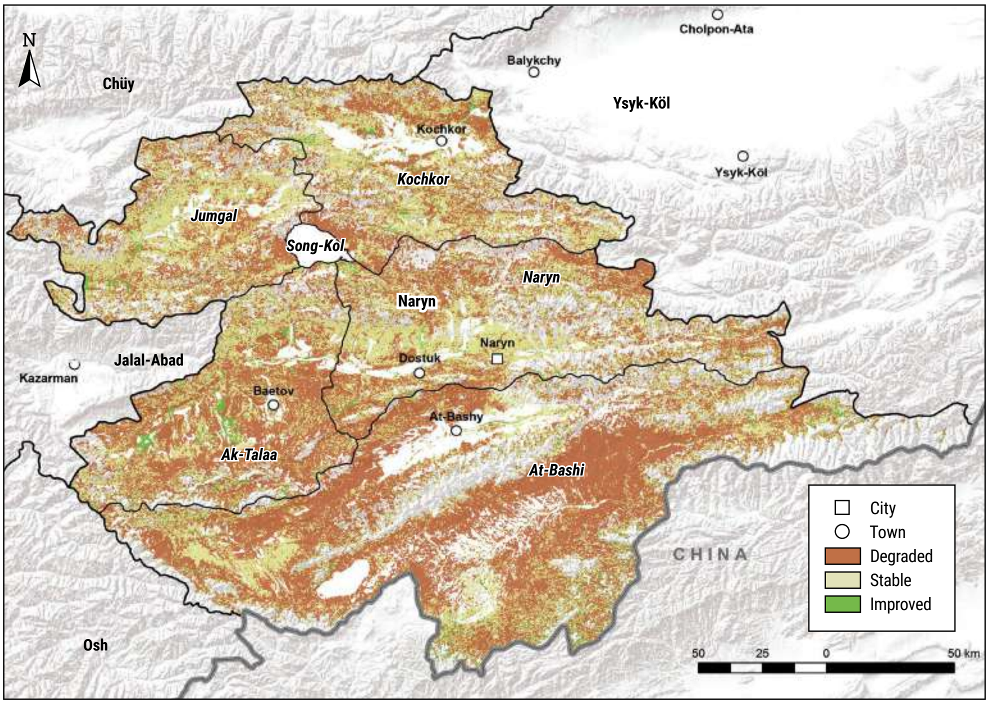
SDG 15.3.1 LAND DEGRADATION	AREA (km²)	PERCENT OF TOTAL LAND AREA
Total land area	44 897.2	100.00%
Land area improved	1 812.1	4.04%
Land area stable	17 525.2	39.03%
Land area degraded	22 294.7	49.66%
Land area with no data	3 265.2	7.27%

Source: Peter Mwangi. 2020. Land cover type degradation levels, Naryn Oblast, 2000–2015. Production date: 17 January 2020.

A substantial amount of LD identified with this system originates from changes in land productivity, while vegetation structure (based on land cover degradation) and soil structure/fertility (based on SOC degradation) have remained intact during the 15-year period and thus contribute little to the “degraded” category.

The pasture or grassland land cover class is presented without the other land cover classes in **Figure 54** and **Table 13**.

Figure 54. Land degradation over 15 years – grassland – Naryn Oblast, 2000–2015



Note: Derived from the combination of land cover, land productivity and SOC degradation.

Source: Peter Mwangi. 2020. Land degradation over 15 years (grassland) Naryn Oblast, 2000–2015. Date: 19 January 2020. Modified to comply with UN, 2020.

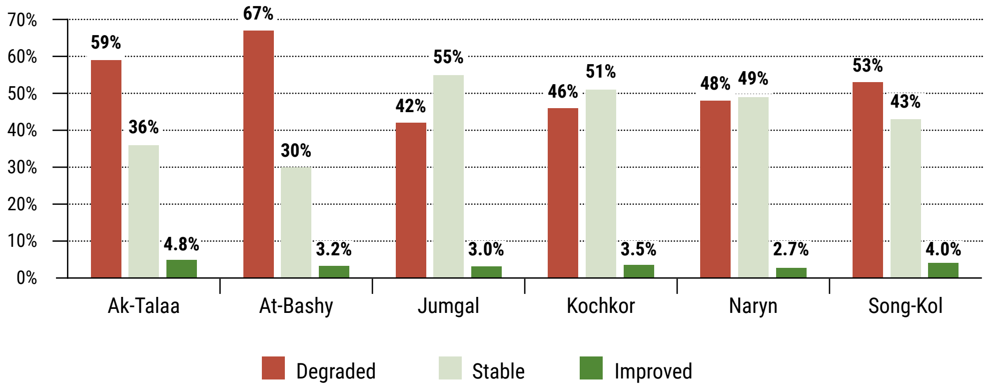
TABLE 13. Land degradation levels – grassland – Naryn Oblast, 2000–2015

SDG 15.3.1 LAND DEGRADATION, GRASSLAND	AREA (km^2)	PERCENT OF TOTAL LAND AREA
Total land area	31 324.3	100.00%
Land area improved	1 060.8	3.39%
Land area stable	12 739.2	40.67%
Land area degraded	17 524.0	55.94%

Source: Peter Mwangi. 2020. Land degradation levels (grassland) Naryn Oblast, 2000–2015. Date: 19 January 2020.

The grassland land cover class stands at 56 percent when viewed individually, 6 percent more more than when all land cover classes are compared under the same system (**Figure 55**).

Figure 55. Grassland degradation levels, Naryn districts



Source: Peter Mwangi. 2020. Grassland degradation levels, Naryn districts. Date: 20 January 2020.

At-Bashy District has the highest proportion of degraded grassland and the lowest proportion of stable grassland, while Jumgal District has the highest proportion of stable grassland and the lowest proportion of degraded grassland. The area under improved grassland is relatively marginal and similar across Naryn's districts (around 3–4 percent) with Ak-Talaa topping at 4.8 percent.

Much of this information and analysis supports local claims of reduced pasture biomass across all pasture types. It also shows land cover and SOC to be relatively stable in the periods studied. In other words, the socio-political system in place is preserving land cover classes and preventing changes from one land cover class to another. It also shows the importance of the "one degraded–all degraded" scenario and how this can lead to large areas being classed as "degraded", even when other indicators are stable.

6 PRAGA field results for Naryn Oblast

This chapter describes the results of applying Steps 5–8 of the PRAGA methodology (**Figure 1** on p. 2) in four oblasts of Kyrgyzstan over the course of 2019 (with most field plots within Naryn boundaries). Chapter 6 contains the following:

- A summary of pilot site selection criteria.
- Participatory selection of indicators to be used for rangeland and pasture assessment.
- Land evaluation by herders who classified PUA seasonal pasture units (summer, transitional, winter) into three categories based on pasture quality, growth rates and resilience to grazing.
- A summary of field results classified by pilot site and seasonal pasture use (unit).

6.1 Pilot site selection

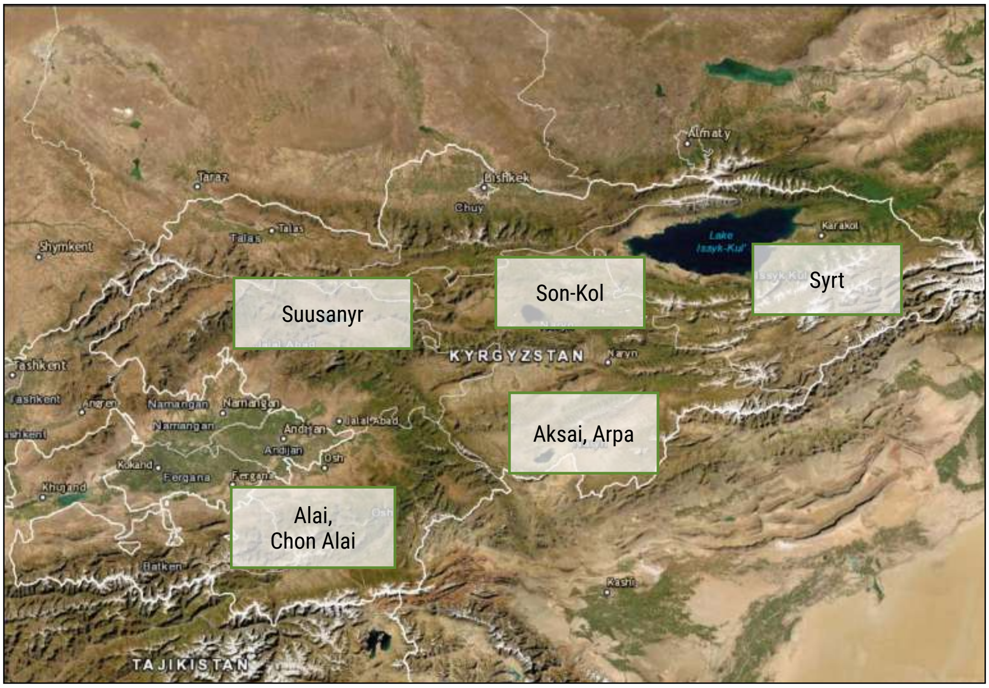
Several areas were discussed during the project inception meeting held in Bishkek on 27 March 2019 and further refined with project stakeholders over the course of April and May 2019 (**Annex 1**). Overall, stakeholders argued for a balanced approach, but stressed the need to emphasize summer pasture areas given their importance to herder livelihoods. **Table 14** shows the areas selected.

TABLE 14. Oblasts and corresponding pilot sites

OBLAST	PILOT SITE
Chuy	Suusamyr
Issyk-Kul	Syrt
Naryn	Son-Kol, Aksai, Arpa
Osh	Alai, Chon Alai

Note: Sites are located on the map in Figure 56.

Figure 56. Selected pilot site areas, Kyrgyzstan (2019)



Source: Camp Alatoo. 2020. Selected pilot site areas, Kyrgyzstan (2019). Production date: 15 September 2019. Modified to comply with UN, 2020

Local inception workshop: participatory field assessment site selection, LD indicators and evaluation of pasture units

In order to select the monitoring points (*ayil almaks* – AA) and determine the main indicators for the assessment of pastures in the AAs to which the above-listed pastures belong, several inception workshops were held and conducted in accordance with the PRAGA methodology, with participants involved in defining LD and selecting indicators and representative areas for field assessment activities. As such, 75 participants (AA and PC representatives as well as herders from each AA) participated in the workshops: 42 from Naryn Oblast, 11 from Chuy Oblast, 12 from Osh Oblast and 10 from Issyk-Kul Oblast.

During the workshops, AA representatives and pasture committees discussed and selected AAs for inclusion in the project (**Table 15**).

TABLE 15. AAs and PCs included in the PRAGA testing from different regions of Kyrgyzstan

NARYN OBLAST	ISSYK-KUL OBLAST	CHUY OBLAST	OSH OBLAST
Ayil aimaks/Pasture committee			
Jerge Tal	Barskoon	Suusamyr	Alai
Terek	Lipenka	Jayil	Gulcho
Kazybek	Orgochor	Sary Bulak	Lenin
Kok Jar	Jargylchak	Kyzyl Dyikan	Uch Dobo
Ak Kuduk	Saruu	Ak Bashat	Jekendi
Kazan Kuigan	Darhan	Kara Suu	Chon Alai
Togolok Moldo			Kashka Suu
Kara Kojun			
Jany Talap			
Kara Suu			
Acha Kayindy			
Bash Kayindy			

The workshop participants also identified the main indicators of pasture status and productivity. For local communities it was easier to define vegetation indicators, while very few soil and water indicators were mentioned (Table 16).

TABLE 16. Community indicators for pasture assessment

SOIL INDICATORS	WATER INDICATORS	VEGETATION INDICATORS
▪ Percentage of bare soil ▪ Soil erosion types ▪ Cattle trails ▪ Soil stones ▪ Presence of marmot burrows	▪ Decrease in river and stream run-off ▪ Water quality, purity ▪ Disappearance of springs	▪ Percentage of land coverage ▪ Main grasses distributed ▪ Increasing number of weeds ▪ Percentage of palatable and unpalatable vegetation ▪ Height of grass cover ▪ Livestock condition ▪ Germination of plants ▪ Increasing number of pests ▪ Tightness of herding yaks (the tighter, the better the pasture)

Source: the authors

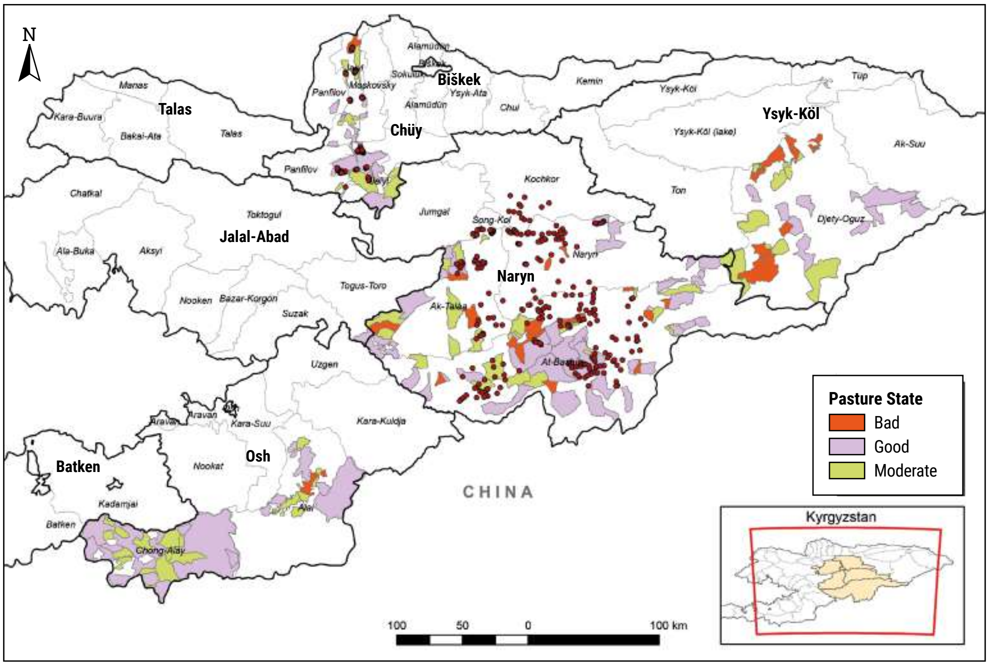
The community mapping participants then divided pasture plots by grazing use according to seasonality. The three categories were: winter pastures, spring–autumn pastures and summer pastures. Each pasture unit was ranked on a scale of “good”, “moderate” and “bad” according to the participants’ knowledge of its productivity, health and resilience. **Figures 57 and 58** show examples of this process during the PRAGA inception workshop in Baetov.

Figure 57. Participatory mapping, Baetov, Kyrgyzstan

Figure 58. Terek, Kok Jar, Togolok Moldo and Jany Talap PCs during community mapping, Baetov, Kyrgyzstan

The results of these mapping and pasture evaluations were later transferred to a digital format and used to create the map in Figure 59.

Figure 59. Pasture evaluation results overlain with PRAGA field plots, Kyrgyzstan (2019)



Source: CAMP Alatoo

6.2 Field data collection

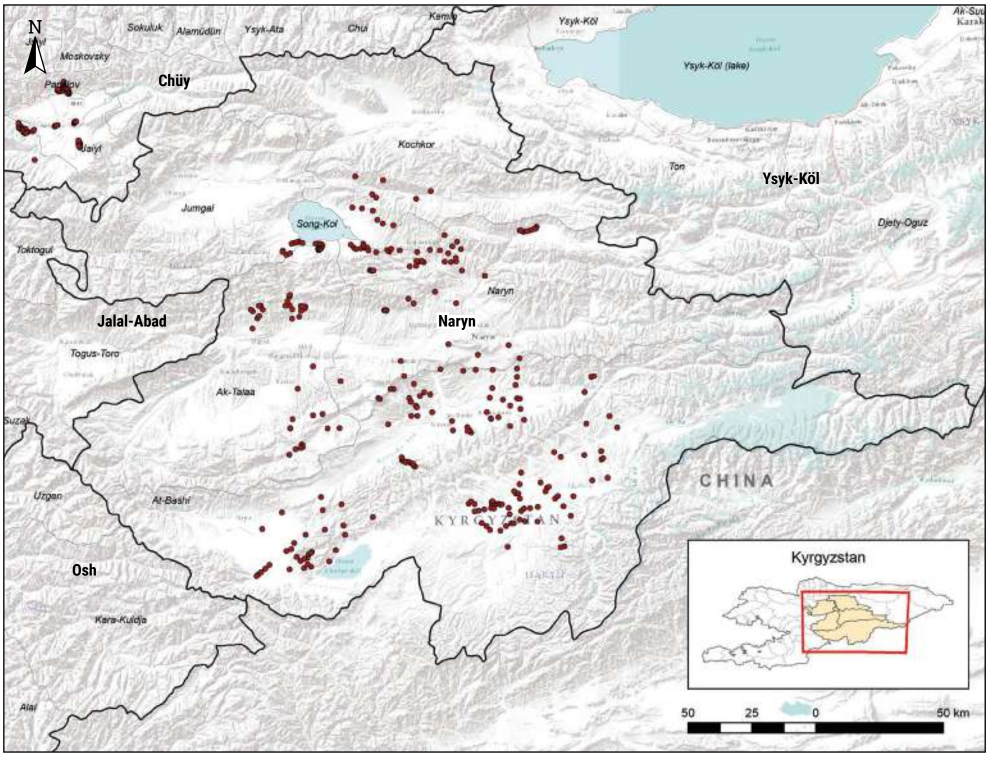
Based on the data obtained during the workshops, CAMP Alatoo experts prepared assessment sheets for each region separately, taking into account the specifics of the region. Representatives from the Pasture Department of the Ministry of Agriculture, the Kyrgyz Institute of Pasture and Livestock and the Kyrgyz Agrarian University, as well as CAMP Alatoo staff members, were included in the assessment team.

Monitoring was carried out at 782 points to assess the status of the programme used to compile online questionnaires (KoBo Toolboxes). All pasture types (autumn, spring, summer, winter) were surveyed to obtain detailed information on grazing. Table 17 and Figure 60 show the results of the recalculation for each area.

TABLE 17. Relation of oblast, pasture area and number of sample plots

OBLAST	PASTURE AREA	NUMBER OF PLOTS
Osh	Alai and Chon-Alay	177
Chuy	Suusamyr	166
Issyk-Kul	Syrt	137
Naryn	Aksai, Arpa and Son-Kul	302

Figure 60. Map of field assessment plots, Naryn Oblast (2019)



Source: CAMP Alatoo

6.3 Results and analysis of the field assessments

In addition to the qualitative indicator sets obtained through participatory processes, some quantitative indicator sets were analysed during the field surveys. This allowed for better baseline development and future monitoring exercises, as well as cross analysis between sites and contexts.

Within these indicator sets, bare soil percentages, the ratio of palatable vs non-palatable species and average grass height were estimated for each plot (see the sample scoring sheet in Annex 3. Grass-seed head formation and germination were also evaluated and tallied for analysis. The results are summarized in **Tables 18 and 19**.

TABLE 18. Combined results from Aksay-Arpa, grouped by seasonal pasture type

AKSAY-ARPA, SUMMER PASTURES	AKSAY-ARPA, SPRING–AUTUMN PASTURES	AKSAY-ARPA, WINTER PASTURES
Pastures in the following municipalities: **At-Bashy District:** Ak-Jar (1), Ak-Moiun (2), Acha-Kaiyndy (3), Bash-Kaiyndy (4), Kazbek (5), Kara-Kojun (6), Taldy-Suu (7) **Ak-Talaa District:** Kok Jar (8)	Pastures in the following municipalities: **At-Bashy District:** Ak-Jar (1), Ak-Muz (2), Acha-Kaiyndy (3), Bash-Kaiyndy (4), Kazbek (5), Kara-Kojun (6), Kara-Suu (7) **Naryn District:** Jan-Bulak (8)	Pastures in the following municipalities: **At-Bashy District:** Ak-Muz (1), Acha-Kaiyndy (2), Bash-Kaiyndy (3), Kazbek (4), Kara-Suu (5) **Naryn District:** Jan-Bulak (6), Uchkun (7)
Assessment team members: **CAMP Alatoo:** Azamat Isakov, Aliya Ibraimova, Azamat Usupbekov **Kyrgyz National Agrarian University:** Ormon Sultangaziev **Kyrgyz Pasture and Livestock Institute:** Abdygul Abdraimov **Pasture committee members:** Ak-Jar: Mokelen uulu Soltonbek Ak-Moiun: Jyldyzbek Alybaev Acha-Kaiyndy: Noruzbaev Mirlan Bash-Kaiyndy: Mursaly uulu Erkinbek Kazbek: Kazybekov Nuradil Kara-Kojun: Abdygaziev Zamir Taldy-Suu: Kurmanbek uulu Abylai Kok Jar: Kalmuratov Ernest	Assessment team members: **CAMP Alatoo:** Azamat Isakov, Aliya Ibraimova, Azamat Usupbekov **Kyrgyz National Agrarian University:** Ormon Sultangaziev **Kyrgyz Pasture and Livestock Institute:** Abdygul Abdraimov **Pasture committee members:** Ak-Jar: Mokelen uulu Soltonbek Ak-Muz: Sultanbek uulu Salamat Acha-Kaiyndy: Noruzbaev Mirlan Bash-Kaiyndy: Mursaly uulu Erkinbek Kazbek: Kazybekov Nuradil Kara-Kojun: Abdygaziev Zamir Kara-Suu: Sharshenaly uulu Altynbek Jan-Bulak: Tashbolotov Altynbek	Assessment team members: **CAMP Alatoo:** Azamat Isakov, Aliya Ibraimova, Azamat Usupbekov **Kyrgyz National Agrarian University:** Ormon Sultangaziev **Kyrgyz Pasture and Livestock Institute:** Abdygul Abdraimov **Pasture committee members:** Ak-Muz: Sultanbek uulu Salamat Acha-Kaiyndy: Noruzbaev Mirlan Bash-Kaiyndy: Mursaly uulu Erkinbek Kazbek: Kazybekov Nuradil Kara-Suu: Sharshenaly uulu Altynbek Jan-Bulak: Tashbolotov Altynbek Uchkun: Mambetov Kerimkul

AKSAY-ARPA, SUMMER PASTURES				**AKSAY-ARPA, SPRING–AUTUMN PASTURES**				**AKSAY-ARPA, WINTER PASTURES**			
Date of assessment:		**26/07/2019 – 07/08/2019**		Date of assessment:		**26/07/2019 – 07/08/2019**		Date of assessment:		**26/07/2019 – 07/08/2019**	
Primary land use:		**Summer pastures**		Primary land use:		**Spring pastures**		Primary land use:		**Winter pastures**	
Relative size:		**245 225 ha**		Relative size:		**104 012 ha**		Relative size:		**84 291 ha**	
Number of plots:		**95**		Number of plots:		**34**		Number of plots:		**26**	
Average ground cover:		**63%**		Average ground cover:		**69%**		Average ground cover:		**62%**	
Ground cover:	0–20%	**1**	**1.1%**	Ground cover:	0–20%	**0**	**0**	Ground cover:	0–20%	**0**	**0%**
	21–40%	**9**	**9.5%**		21–40%	**4**	**11.8%**		21–40%	**5**	**19.2%**
	41–60%	**38**	**40%**		41–60%	**7**	**20.6%**		41–60%	**8**	**30.8%**
	61–80%	**29**	**30.5%**		61–80%	**6**	**17.6%**		61–80%	**8**	**30.8%**
	81–100%	**18**	**18.9%**		81–100%	**17**	**50.0%**		81–100%	**5**	**19.2%**
Average plant height:	0–5 cm:	**37**	**39%**	Average plant height:	0–5 cm:	**17**	**50.0%**	Average plant height:	0–5 cm:	**15**	**57.7%**
	6–10 cm:	**46**	**48.4%**		6–10 cm:	**12**	**35.3%**		6–10 cm:	**11**	**42.3%**
	11–20 cm:	**12**	**12.7%**		11–20 cm:	**4**	**11.8%**		11–20 cm:	**0**	**0%**
	≥ 21 cm and over	**0**	**0%**		≥ 21 cm	**1**	**2.9%**		≥ 21 cm	**0**	**0%**
Palatable species:	0–20%	**0**	**0%**	Palatable species:	0–20%	**0**	**0%**	Palatable species:	0–20%	**0**	**0%**
	21–40%	**0**	**0%**		21–40%	**4**	**11.8%**		21–40%	**0**	**0%**
	41–60%	**2**	**2.1%**		41–60%	**5**	**14.7%**		41–60%	**5**	**19.2**
	61–80%	**4**	**4.4%**		61–80%	**13**	**38.2%**		61–80%	**6**	**23.1%**
	81–100%	**89**	**93.7%**		81–100%	**12**	**35.3**		81–100%	**15**	**57.7%**
Seed formation (amount of grasses with seed heads in assessment time):	None	**25**	**26.3%**	Seed formation (amount of grasses with seed heads in assessment time):	None	**7**	**20.6%**	Seed formation (amount of grasses with seed heads in assessment time):	None	**2**	**7.7%**
	Few	**48**	**50.5%**		Few	**11**	**32.4%**		Few	**10**	**38.5%**
	Moderate	**18**	**18.9%**		Moderate	**9**	**26.5%**		Moderate	**12**	**46.2%**
	Many	**4**	**4.2%**		Many	**7**	**20.6%**		Many	**2**	**7.7%**
Increasing number of weed species:	No	**90**	**94.7%**	Increasing number of weed species:	No	**17**	**50.0%**	Increasing number of weed species:	No	**16**	**61.5%**
	Yes	**5**	**5.3%**		Yes	**17**	**50.0%**		Yes	**10**	**38.5%**

AKSAY-ARPA, SUMMER PASTURES				AKSAY-ARPA, SPRING–AUTUMN PASTURES				AKSAY-ARPA, WINTER PASTURES			
Early drying out of grasses:	No	**55**	**57.9%**	Early drying out of grasses:	No	**7**	**20.6%**	Early drying out of grasses:	No	**6**	**23.1%**
	Yes	**40**	**42.1%**		Yes	**27**	**79.4%**		Yes	**20**	**76.9%**
Evidence of erosion:	No	**43**	**45.3%**	Evidence of erosion:	No	**19**	**55.9%**	Evidence of erosion:	No	**14**	**53.8%**
	Yes	**52**	**54.7%**		Yes	**15**	**44.1%**		Yes	**12**	**46.2%**
Slope:	Flat	**1**	**1.1%**	Slope:	Flat	**0**	**0%**	Slope:	Flat	**0**	**0%**
	Gentle	**72**	**75.8%**		Gentle	**25**	**73.5%**		Gentle	**21**	**80.8%**
	Medium	**11**	**11.6%**		Medium	**0**	**0%**		Medium	**0**	**0%**
	Steep	**11**	**11.6%**		Steep	**9**	**26.5%**		Steep	**5**	**19.2%**
Disappearance of springs:	No	**57**	**60%**	Disappearance of springs:	No	**16**	**47.1%**	Disappearance of springs:	No	**17**	**65.4%**
	Yes	**38**	**40%**		Yes	**18**	**52.9%**		Yes	**9**	**34.6%**
Pasture condition – herders' perception	Bad	**0**	**0%**	Pasture condition – herders' perception	Bad	**1**	**2.9%**	Pasture condition – herders' perception	Bad	**7**	**26.9%**
	Moderate	**32**	**33.7%**		Moderate	**22**	**64.7%**		Moderate	**17**	**65.4%**
	Good	**63**	**66.3%**		Good	**11**	**32.4%**		Good	**2**	**7.7%**
Dominant grassland species recorded				Dominant grassland species recorded				Dominant grassland species recorded			
Festuca				***Artemisia***				***Artemisia terrae-albae***			
Secondary grassland species recorded				Secondary grassland species recorded				Secondary grassland species recorded			
Artemisia absinthium, Kobresia, Festuca valesiaca, Leucopoa Griseb, Prangos, Leontopodium, Carex				*Festuca, Peganum, Eremopýrum, Kobresia, Cirsium, Stipa, Carex, Poa, Elytrigia repens, Phlomoídes, Festúca valesiáca*				*Prangos, Carex, Stipa, Festuca, Phlomoídes, Festuca, Agropyron*			

TABLE 19. Combined results from Son-Kul, grouped by seasonal pasture type

SON-KUL, SUMMER PASTURES		**SON-KUL, SPRING–AUTUMN PASTURES**		**SON-KUL, WINTER PASTURES**	
Pastures in the following municipalities: **Ak-Talaa District:** Ak-Tal (1), Jany Talap (2), Кок-Jar (3), Terek (4), Togolok Moldo (5) **Naryn District:** Ak Kuduk (6), Jerge Tal (7), Kazan-Kuigan (8), On-Archa (9), Uchkun (10), Emgek Talaa (11)		Pastures in the following municipalities: **Ak-Talaa District:** Ak-Tal (1), Кок-Jar (2), Terek (3), Togolok Moldo (4) **Naryn District:** Jerge Tal (5), Kazan-Kuigan (6), On-Archa (7), Emgek Talaa (8)		Pastures in the following municipalities: **Ak-Talaa District:** Ak-Tal (1), Jany Talap (2), Кок-Jar (3), Terek (4) **Naryn District:** Ak Kuduk (5)	
Assessment team members: **CAMP Alatoo:** Azamat Isakov, Aliya Ibraimova, Azamat Usupbekov **Kyrgyz National Agrarian University:** Ormon Sultangaziev **Kyrgyz Pasture and Livestock Institute:** Abdygul Abdraimov **Pasture committee members:** Ak-Tal: Suiunbekov Yryskeldi Jany Talap: Kadyrkulov Ertash Kok Jar: Kalmuratov Ernest Terek: Kojoev Toktomush Togolok Moldo: Sainylov Joodar Ak Kuduk: Saraibek uulu Elmuras Jerge Tal: Asanaliev Ruslan Kazan-Kuigan: Karabagyshev Omurbek On-Archa: Asanbekov Talantbek Uchkun: Mambetov Kerimkul Emgek Talaa:Sydykov Duishonbek		Assessment team members: **CAMP Alatoo:** Azamat Isakov, Aliya Ibraimova, Azamat Usupbekov; **Kyrgyz National Agrarian University:** Ormon Sultangaziev **Kyrgyz Pasture and Livestock Institute:** Abdygul Abdraimov **Pasture committee members:** Ak-Tal: Suiunbekov Yryskeldi Kok Jar: Kalmuratov Ernest Terek: Kojoev Toktomush Togolok Moldo: Sainylov Joodar Jerge Tal: Asanaliev Ruslan Kazan-Kuigan: Karabagyshev Omurbek On-Archa: Asanbekov Talantbek Emgek Talaa:Sydykov Duishonbek		Assessment team members: **CAMP Alatoo:** Azamat Isakov, Aliya Ibraimova, Azamat Usupbekov **Kyrgyz National Agrarian University:** Ormon Sultangaziev **Kyrgyz Pasture and Livestock Institute:** Abdygul Abdraimov **Pasture committee members:** Ak-Tal: Suiunbekov Yryskeldi Jany Talap: Kadyrkulov Ertash Kok Jar: Kalmuratov Ernest Terek: Kojoev Toktomush Ak Kuduk: Saraibek uulu Elmuras	
Date of assessment:	**08/08/2019 – 13/08/2019**	Date of assessment:	**08/08/2019 – 13/08/2019**	Date of assessment:	**08/08/2019 – 13/08/2019**
Primary land use:	**Summer pastures**	Primary land use:	**Spring/Autumn pastures**	Primary land use:	**Winter pastures**
Relative size:	**88 319 ha**	Relative size:	**28 901 ha**	Relative size:	**16 117 ha**
Number of plots:	**82**	Number of plots:	**39**	Number of plots:	**20**
Average ground cover:	**72%**	Average ground cover:	**64%**	Average ground cover:	**71%**

SON-KUL, SUMMER PASTURES				SON-KUL, SPRING–AUTUMN PASTURES				SON-KUL, WINTER PASTURES			
Ground cover:	0–20%	1	1.2%	Ground cover:	0–20%	0	0%	Ground cover:	0–20%	0	0%
	21–40%	1	1.2%		21–40%	4	10.3%		21–40%	1	5%
	41–60%	12	14.6%		41–60%	16	41%		41–60%	4	20%
	61–80%	18	22.0%		61–80%	12	30.8%		61–80%	7	35%
	81–100%	50	61.0%		81–100%	7	17.9%		81–100%	8	40%
Average plant height:	0–5 cm:	27	32.9%	Average plant height:	0–5 cm:	14	35.9%	Average plant height:	0–5 cm:	11	55%
	6–10 cm:	41	50.0%		6–10 cm:	17	43.6%		6–10 cm:	6	30%
	11–20 cm:	12	14.6%		11–20 cm:	7	17.9%		11–20 cm:	2	10%
	≥ 21 cm	2	2.4%		≥ 21 cm	1	2.6%		≥ 21 cm	1	5.0%
Palatable species:	0–20%	0	0%	Palatable species:	0–20%	0	0%	Palatable species:	0–20%	0	0%
	21–40%	4	4.9%		21–40%	6	15.4%		21–40%	0	0%
	41–60%	9	11%		41–60%	7	17.9%		41–60%	4	20%
	61–80%	22	26.8%		61–80%	11	28.2%		61–80%	7	35%
	81–100%	47	57.3%		81–100%	15	38.5%		81–100%	9	45%
Seed formation (amount of grasses with seed heads in assessment time):	None	12	14.6%	Seed formation (amount of grasses with seed heads in assessment time):	None	2	5.1%	Seed formation (amount of grasses with seed heads in assessment time):	None	1	5%
	Few	27	32.9%		Few	16	41.0%		Few	11	55%
	Moderate	34	41.5%		Moderate	15	38.5%		Moderate	6	30%
	Many	9	11.0%		Many	6	15.4%		Many	2	10%
Increasing number of weed species:	No	51	62.2%	Increasing number of weed species:	No	24	61.5%	Increasing number of weed species:	No	19	95%
	Yes	31	37.8%		Yes	15	38.5%		Yes	1	5%
Early drying out of grasses:	No	77	93.9%	Early drying out of grasses:	No	39	100%	Early drying out of grasses:	No	20	100%
	Yes	5	6.1%		Yes	0	0%		Yes	0	0%
Evidence of erosion:	No	64	78%	Evidence of erosion:	No	23	59%	Evidence of erosion:	No	15	75%
	Yes	18	22%		Yes	16	41%		Yes	5	25%
Slope:	Flat	23	28%	Slope:	Flat	13	33.3%	Slope:	Flat	8	40%
	Gentle	38	46.3%		Gentle	16	41%		Gentle	8	40%
	Medium	4	4.9%		Medium	2	5.1%		Medium	1	5%
	Steep	17	20.7%		Steep	8	20.5%		Steep	3	15%

SON-KUL, SUMMER PASTURES				SON-KUL, SPRING–AUTUMN PASTURES				SON-KUL, WINTER PASTURES			
Disappearance of springs:	No	**54**	**65.9%**	Disappearance of springs:	No	**22**	**56.4%**	Disappearance of springs:	No	**13**	**65%**
	Yes	**28**	**34.1%**		Yes	**17**	**43.6%**		Yes	**7**	**35%**
Pasture condition – herders' perception	Bad	**10**	**12.2%**	Pasture condition – herders' perception	Bad	**14**	**35.9%**	Pasture condition – herders' perception	Bad	**5**	**25%**
	Moderate	**52**	**63.4%**		Moderate	**20**	**51.3%**		Moderate	**11**	**55%**
	Good	**20**	**24.4%**		Good	**5**	**12.8%**		Good	**4**	**20%**
Dominant grassland species recorded				Dominant grassland species recorded				Dominant grassland species recorded			
Festuca				***Artemisia* spp.**				***Artemisia* spp.**			
Secondary grassland species recorded				Secondary grassland species recorded				Secondary grassland species recorded			
Artemisia tianschanica, Rúmex confértus, Prangos, Leontopodium, Potentilla anserine, Alhagi, Kobresia stenocarpa, Stipa, Carex, Phlomoídes, Festuca, Caragana, Achillea millefium, Agropyron				*Poa, Festuca, Plantago, Artemisia estragon, Elytrígia répens, Phlomoídes, Caragana, Festuca valesiaca, Agropyron,*				*Hordeum murinum, Achnatherum, Stipa, Carex, Festuca, Caragana, Chenopódium álbum, Ziziphora*			

Following these results, rangeland experts within the project development team reviewed and evaluated the data and compared it with the perceptions of local herders and technicians (**Table 20**).

TABLE 20. Analysis of field results and comparison with local herder perceptions

	Pink indicates a "bad condition" result.
	Yellow indicates a "moderate condition" result.
	Light green indicates a "good condition" result.
	Dark green indicates sites where there is correlation between the results of the field data on pasture conditions and the perception of pasture conditions by herders.
	Red indicates areas where there is no correlation between the results of the field data and the perception of the state of the pastures by herders.

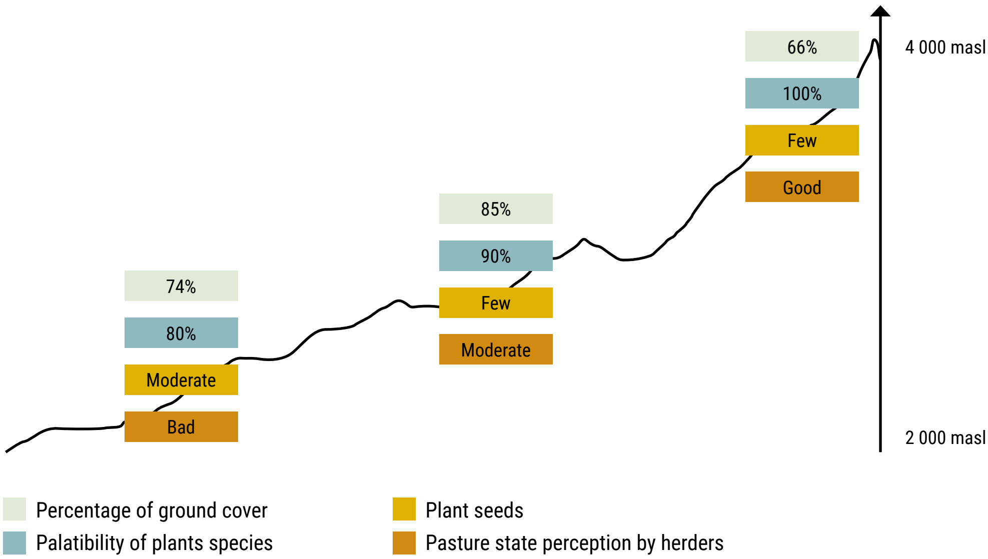
SITE	NO. PLOTS	AVERAGE GROUND COVER	PLANT HEIGHT	WEED SPECIES EXPANSION	PALATABILITY	EROSION	REGENERATION CAPACITY	HERDERS' PERCEPTION OF PASTURE STATE
Aksay-Arpa, summer pastures	95	63% – i.e. not the best indicator for such pastures, but not critical. It is necessary to improve the rotation of pastures.	9 cm – i.e. not a bad indicator, given that the monitoring was carried out during a period of intense grazing and high altitudes of > 3000 m asl.	In about 95% of plots, herders reported no weed expansion.	94% of plants palatable – i.e. high.	55% of plots with signs of soil erosion.	50% of plots have little seed development, 26% none at all. This should not be a major concern, as under these conditions most plants are seeded at the end of the growing season, i.e. mid-September.	66% of pastoralists perceive pastures as in good condition and 34% as in moderate condition. A set of indicators collected from the field study confirms this perception.
Aksay-Arpa, spring–autumn pastures	34	69% – moderate.	9 cm – i.e. moderate, given that grazing should be stopped in these pastures from the end of June. Pasture committees should strictly monitor the seasonal rotation. Apparently, the livestock have moved away from these pastures to summer pastures late, which has not allowed pasture plants to grow.	In 50% of plots, weeds began to grow, most likely provoked by overgrazing.	73% of plants palatable – i.e. a good indicator.	56% of plots with signs of soil erosion – in most cases, the pedestalling of plants.	Gradation between plants with no to many seeds more or less equal. This may indicate that there are plants with different phases of development.	About 65% of plots are marked by herders as in moderate condition. Indicators confirm this perception.

SITE	NO. PLOTS	AVERAGE GROUND COVER	PLANT HEIGHT	WEED SPECIES EXPANSION	PALATABILITY	EROSION	REGENERATION CAPACITY	HERDERS' PERCEPTION OF PASTURE STATE
Aksay-Arpa, winter pastures	26	62% – high.	7 cm – dominated by different species of *Artemisia*, which are mostly not high.	In about 62% of plots, there was no expansion of weed vegetation, also due to the fact that these pastures are of a semi-desert type, where only certain plant species can grow.	81% of plants palatable – i.e. high. Usually, the majority of plants not palatable in other seasons are palatable in winter.	46% of plots with signs of soil erosion. This is mainly trampling by livestock, as winter pastures are located near the village and 6–7 months of the year are under pressure.	In the overwhelming majority of plots (85%), little or moderate seed development.	Herders consider these pastures as in moderate condition. Indicators show that pastures are in a slightly better condition than that perceived by pastoralists.
Son-Kul, summer pastures	82	72% – moderate (for summer pastures at 3 000 masl).	10 cm. Plants usually grow higher, but monitoring coincided with the period of intensive grazing.	In about 62% of cases, there was no expansion of weed vegetation.	81% of plants palatable – i.e. high.	22% of plots with signs of erosion – not severe in most cases and not considered a limiting factor.	Moderate.	Herders' perception is from moderate to good, which is in line with field data.
Son-Kul, spring–autumn pastures	39	64% – moderate.	10.5 cm. Following the time frame of seasonal rotation should help to improve this indicator.	In 62% of plots, there was no increase in weeds species.	72% of plants palatable – i.e. good.	41% of plots with signs of soil erosion – in most cases, pedestalling of plants and stock trails.	In most cases, little to moderate seed development. However, this should be enough, as there are still 2 months until the end of vegetation and the plants still have a chance to get seeds.	Most pastures perceived by pastoralists as in medium condition. Indicators confirm their perception.
Son-Kul, winter pastures	20	71% – good.	9 cm – i.e. moderate, considering that many winter pastures are desert and semi-desert, where vegetation is not high	In only 5% of plots, weed species increase was observed.	71% of plants palatable.	25% of plots with signs of soil erosion – due to trampling by livestock in winter	In most cases, little to moderate seed development.	Herders' perception of pasture conditions is moderate, which is similar to the field data results.

A number of trends emerge:

- Ground cover is the highest in mid-altitude zones (2 500–3 300 masl); in lower and higher areas, this coverage decreases.
- There is correlation between plant palatability and altitude. The lower the altitude, the lower the palatability. Further study is required to understand to what degree this is due to natural secession or to management.
- Evidence of seed formation and grass germination of pasture species showed a negative correlation with altitude. In the lower zones, a moderate number of plants have seeds, and this number decreases from the middle zone. It should be remembered that all plant types were assessed for this characteristic, including non-palatable plants.
- Herders' perceptions of the state of the pastures are correlated with altitude: as the altitude increases, the pasture condition improves. For herders, vegetation palatability is the main indicator; it is therefore possible that the indicator of herders' perception of the state of pasture and the indicator of palatability of pasture plants have a similar trend (see **Figure 61** where the data were obtained by grouping trends by altitude, not seasonality of grazing; hence the small differences).

Figure 61. Field results and participatory indicators and altitude (2019)



Note: Trends are grouped by altitude – not by seasonality of grazing – hence the small differences.

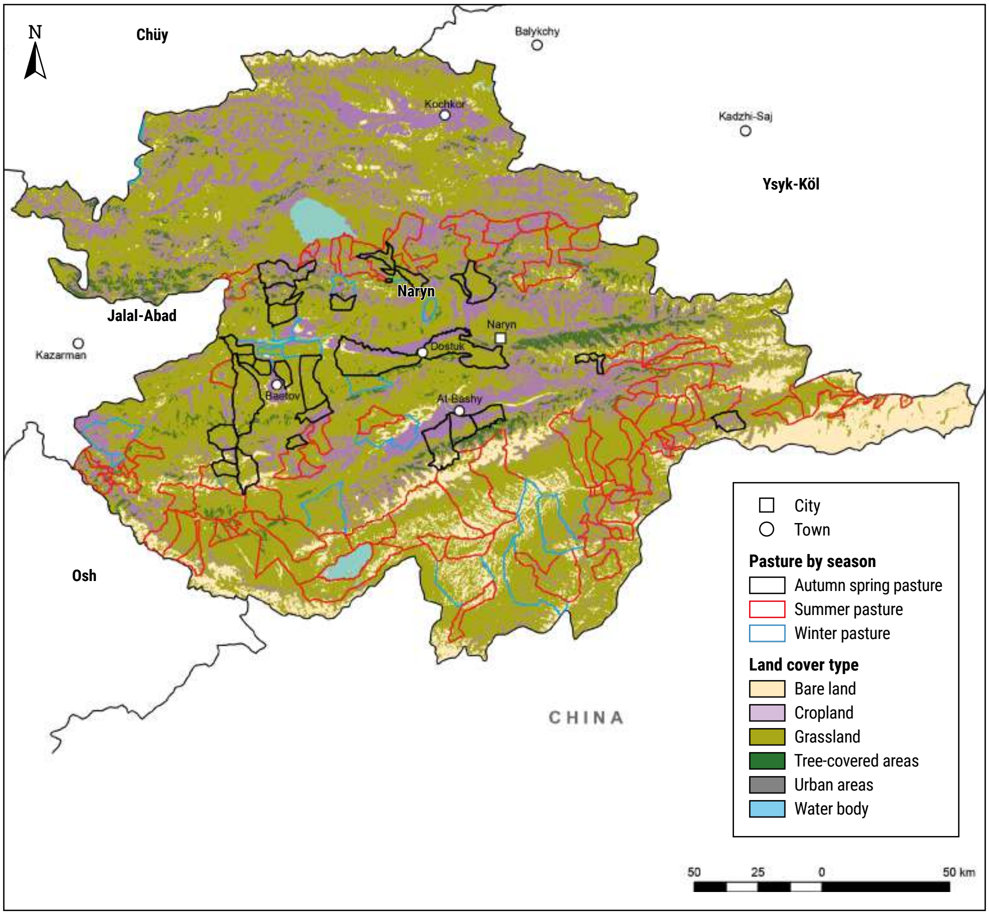
Source: the authors

Linking RS output with pasture condition, based on local land users' perception and results from field monitoring sites

An important step in the PRAGA methodological approach is the linkage and cross analysis of RS data with local perception information and field monitoring and assessment.

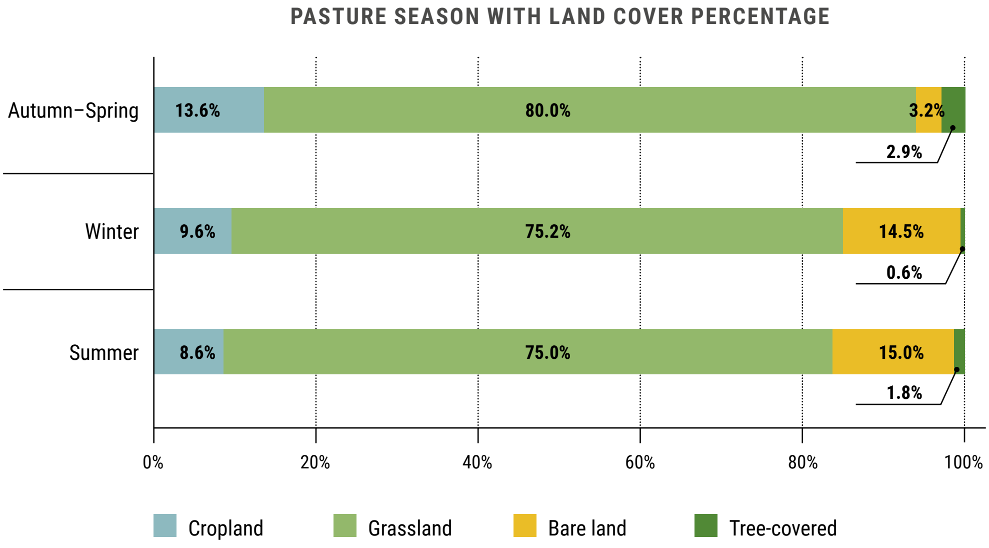
First, the PRAGA development team outlined correlations between seasonal pasture use and land cover (**Figures 62 and 63**).

Figure 62. Distribution of locally delineated pastureland according to season set against the 2015 land cover types, Naryn Oblast (2019)



Source: Camp Alatoo and European Space Agency, Climate Change Initiative (ESA, CCI). 2015. Distribution of locally delineated pastureland according to season set against the 2015 land cover types, Naryn Oblast. Cited 05 February 2020. https://www.esa-landcover-cci.org/. Modified to comply with UN, 2020

Figure 63. Land cover type and pasture use (2019)



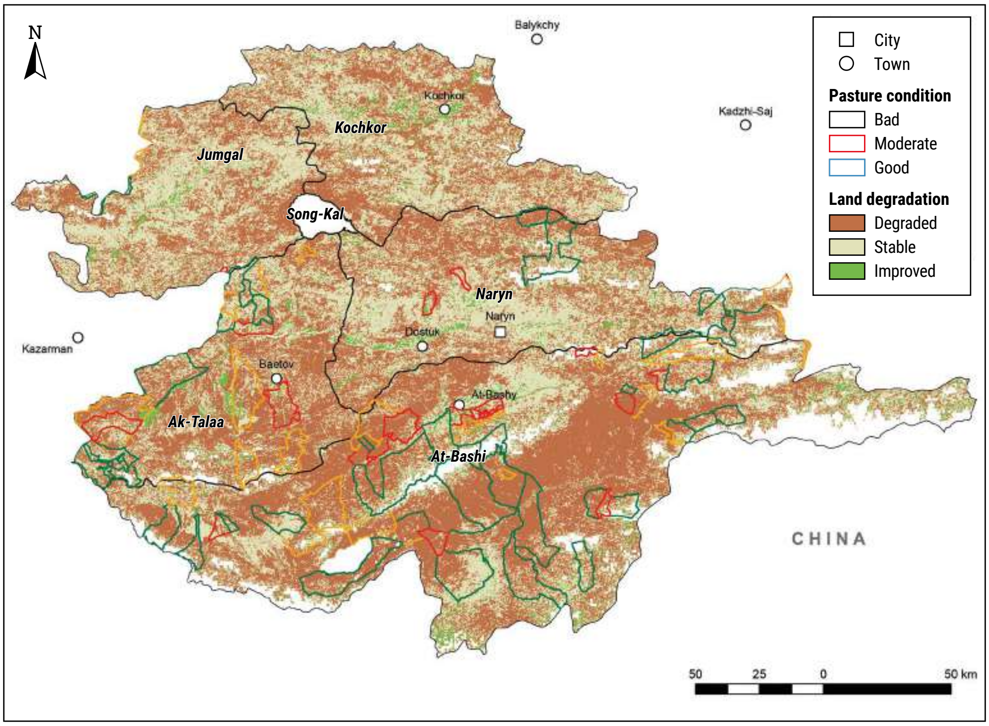
Source: Peter Mwangi. 2020. Land cover type and pasture. Date: 05 February 2020.

The locally delineated pastureland falls well within its essential vegetation type – grassland – covering 75–80 percent across the different seasons. In comparison, Naryn Oblast is 70 percent grassland. It is important to note that autumn–spring pastureland includes over 13 percent of cropland; in contrast, winter and summer pastureland cover less than 10 percent of cropland and a large proportion of bare land (approximately 15 percent).

Remote sensing LD in relation to participatory land user evaluations

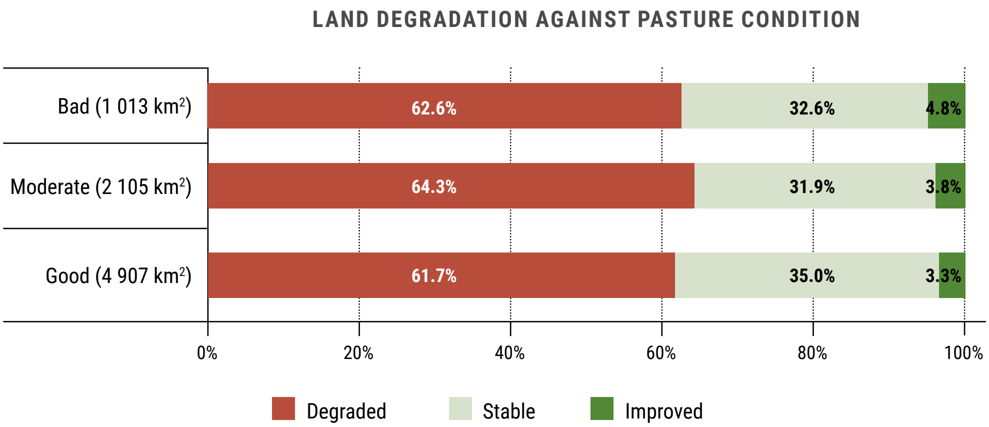
Next, a map was prepared showing LD as viewed through RS and local pasture users' evaluation of the resource (**Figures 64 and 65**). Although there is some correlation, there are also areas where the two systems of evaluation clearly differ, that is, the southern areas of the Oblast.

Figure 64. Distribution of pastureland condition according to local users across LD status, Naryn Oblast, 2015 (2019)



Source: Camp Alatoo and Peter Mwangi. 2020. Distribution of pstureland condition according to local users across the LD status, Naryn Oblast, 2015. Cited 07 February 2020. Modified to comply with UN, 2020

Figure 65. Percentage of improved, stable and degraded land among bad, moderate and good pastureland depicted by local users, 2015



Source: Camp Alatoo and Peter Mwangi. 2020. Percentage of improved, stable and degraded land among bad, moderate and good pstureland depicted by local users, 2015. Cited 08 February 2020.

Figures 64 and 65 show that RS does not establish a clear link between stakeholder evaluations and field results, which were for the most part largely in agreement with one another regarding the state of the land and its resources. In fact, the percentages of degraded land identified through RS and presented in Figure 64 are similar throughout the three participatory stakeholder categories of good, moderate and bad, within a range of 61.7–63.4 percent.

Once again, most of the disparities are located in the southern part of the oblast. Here there are many pastures rated "good" by pasture users, yet suffering from "degradation" according to the RS methodology. However, of the three LDN indicators, only productivity showed temporal and spatial differences, and the definition and scale of degradation is therefore largely limited to one indicator type: productivity. Furthermore, the temporal aspect was not applied in the field pasture condition assessment – that is, the pastureland condition in the past (15–20 years ago) compared to its present condition – while it was factored in during the RS LD analysis.

Remote sensing LD in relation to the field monitoring points

The LD according to RS was also compared with monitoring points from the field (**Figure 66**). The plot analysis and classification was based on the collected field data focusing on five indicator sets: 1) presence of soil erosion; 2) percentage of grass (plant) cover; 3) percentage of edible (palatable) plants; 4) grass height; and 5) signs or degree of plant seed head formation and evidence of germination. The plots that showed negative trends in two or more indicator sets were classed as "degraded"; those that had none or only one "degraded" indicator of the five considered were classed as "not degraded".

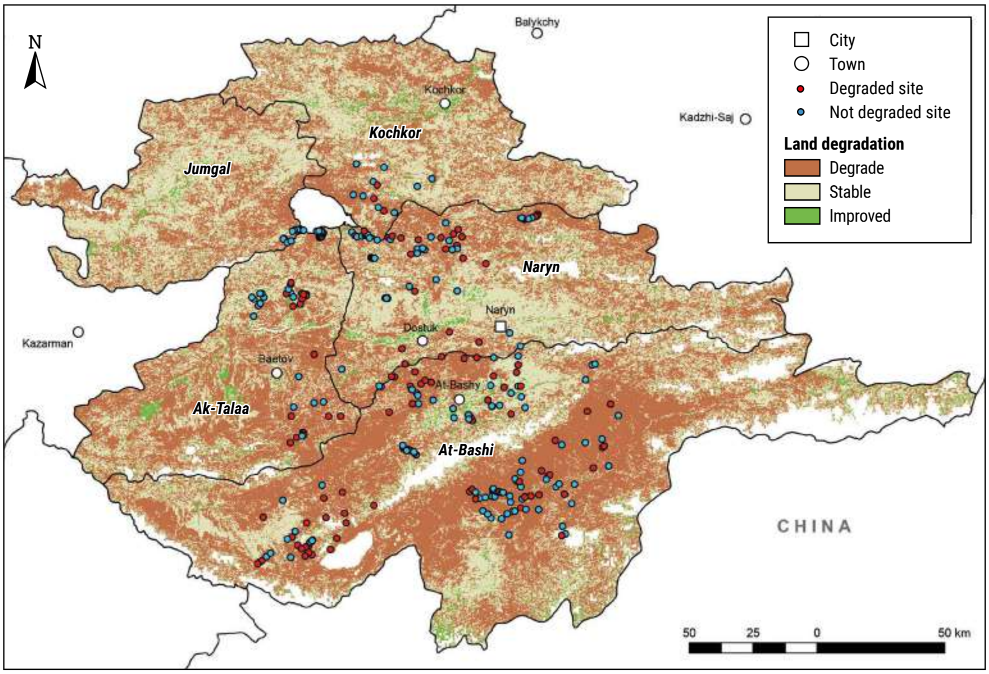
Figure 66. Land degradation state of the field monitoring points

<table>
<tr><th></th><th>DEGRADATION INDICATORS IN THE FIELD</th><th>ALL 5 DEGRADED</th><th>ANY 4 OF 5 DEGRADED</th><th>ANY 3 OF 5 DEGRADED</th><th>ANY 2 OF 5 DEGRADED</th><th>ANY 1 OF 5 DEGRADED</th><th>NONE DEGRADED</th></tr>
<tr><td>1</td><td>Presence of soil erosion</td><td rowspan="5">Yes 5/5</td><td>No 1/5</td><td rowspan="2">No 2/5</td><td rowspan="3">No 3/5</td><td rowspan="4">No 4/5</td><td rowspan="5">No 5/5</td></tr>
<tr><td>2</td><td>Less than 50% of grass (plant) cover</td><td rowspan="4">Yes 4/5</td></tr>
<tr><td>3</td><td>Less than 50% of edible (palatable) plants</td><td rowspan="3">Yes 3/5</td></tr>
<tr><td>4</td><td>Grass height at 0–5 cm</td><td rowspan="2">Yes 2/5</td></tr>
<tr><td>5</td><td>No signs of plant seedhead formation/germination</td><td>Yes 1/5</td></tr>
<tr><td></td><td></td><td colspan="4">Degraded field</td><td colspan="2">Not degraded field</td></tr>
</table>

Note: Based on the matrix (Tables 18 and 19) from five field degradation indicators.

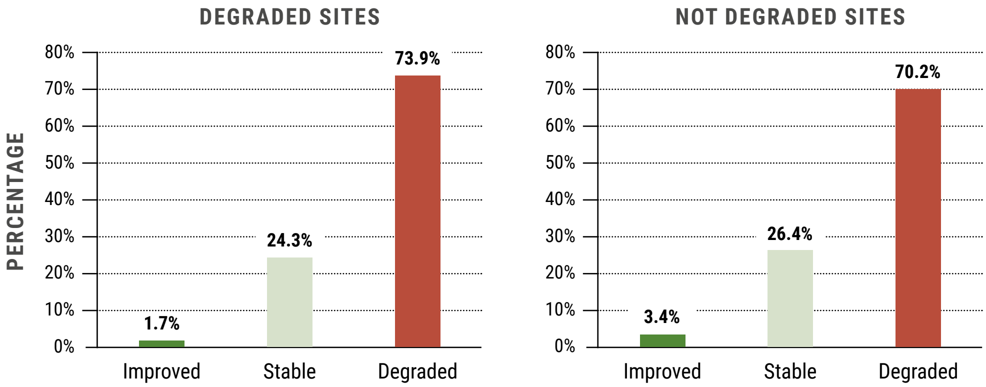
The results can be seen in **Figures 67 and 68**.

Figure 67. Distribution of the 2019 field plots, classified as "degraded" or "not degraded" against the results of the LD mapping results using RS (2019)



Source: Camp Alatoo and Peter Mwangi. 2020. Distribution of the 2019 field plots, classified as "degraded" or "not degraded" against the results using remote sensing. Cited 10 February 2020. Modified to comply with UN, 2020.

Figure 68. Percentage of improved, stable and degraded land in 2015 set against the "degraded/not degraded" data from the field plots



Source: Camp Alatoo and Peter Mwangi. 2020. Percentage of improved, stable and degraded land in 2015 set against the "degraded/not degraded" data from the field plots. Cited 10 February 2020.

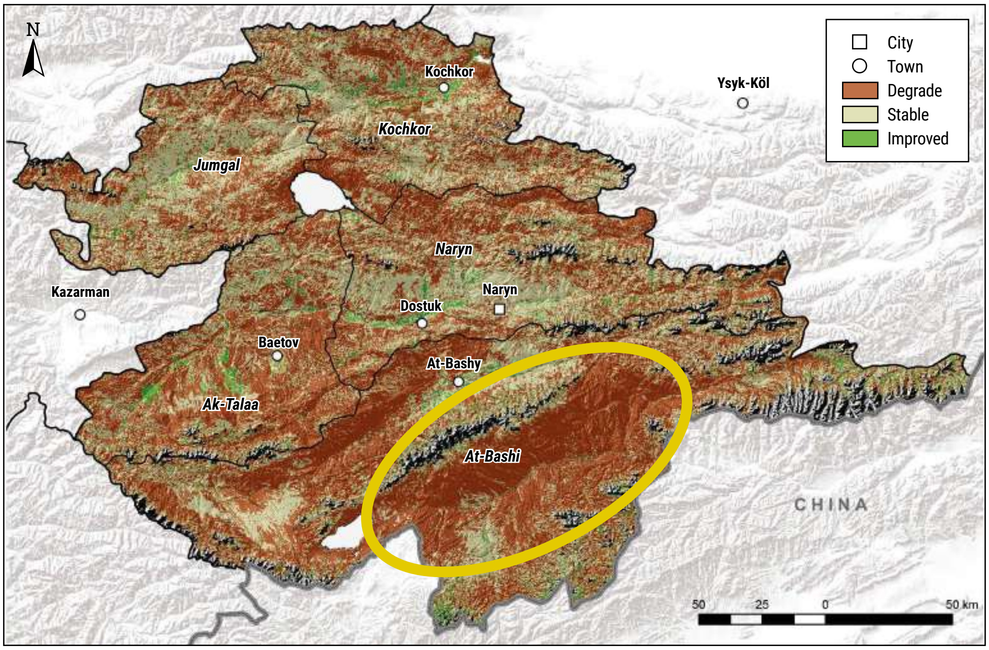
According to Figure 68, there was slight correlation with the degraded sites holding more degraded land (74 percent) and less improved and stable land (1.7 percent and 24 percent, respectively). However, the correlation is largely insignificant and calls into question the validity of the use of RS without participatory stakeholder inputs and up-to-date field data (see the At-Bashy case study).

6.4 Case study: At-Bashy

Field indicators and participatory evaluations of pasture quality were largely in agreement (see Table 20 on p99); on the other hand, in some areas, the RS component was in contrast with these information sources. The pastures to the south of the town of At-Bashy are a good example of this and show how relying heavily on remotely sensed data without ground-truthing and stakeholder inputs can lead to false positives and in some cases poor investment of time and resources.

Figure 69 shows how the areas identified by RS as having active areas of degradation lie in the district of At-Bashy, in particular south-facing slopes and the northern and southern banks of the Chatyr Kol River (circled in yellow).

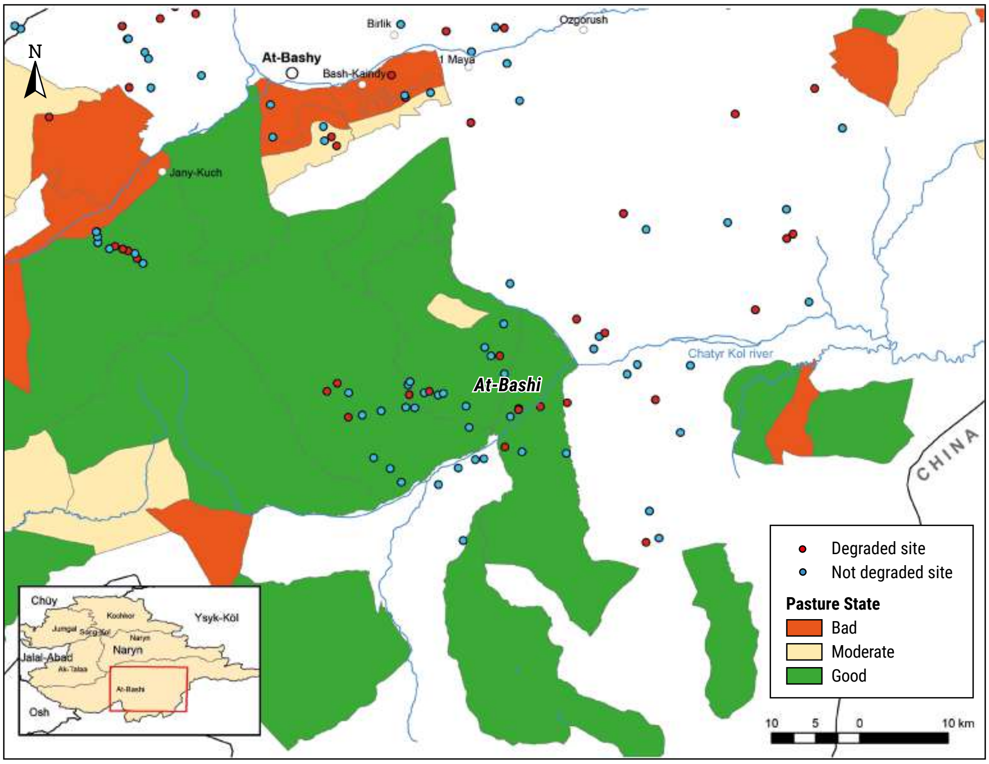
Figure 69. Estimated area affected by land degradation, highlighting areas in the south of At-Bashy District



Source: Camp Alatoo and Peter Mwangi. 2020. Estimated area affected by land degradation, highlighting areas in the south of At-Bashy District. Cited 15 February 2020. Modified to comply with UN, 2020.

However, during consultations at the validation workshop in At-Bashy in December 2019, local participants argued the contrary, claiming that the area had reliable, quality pastures that had changed little over the years (**Figure 70**).

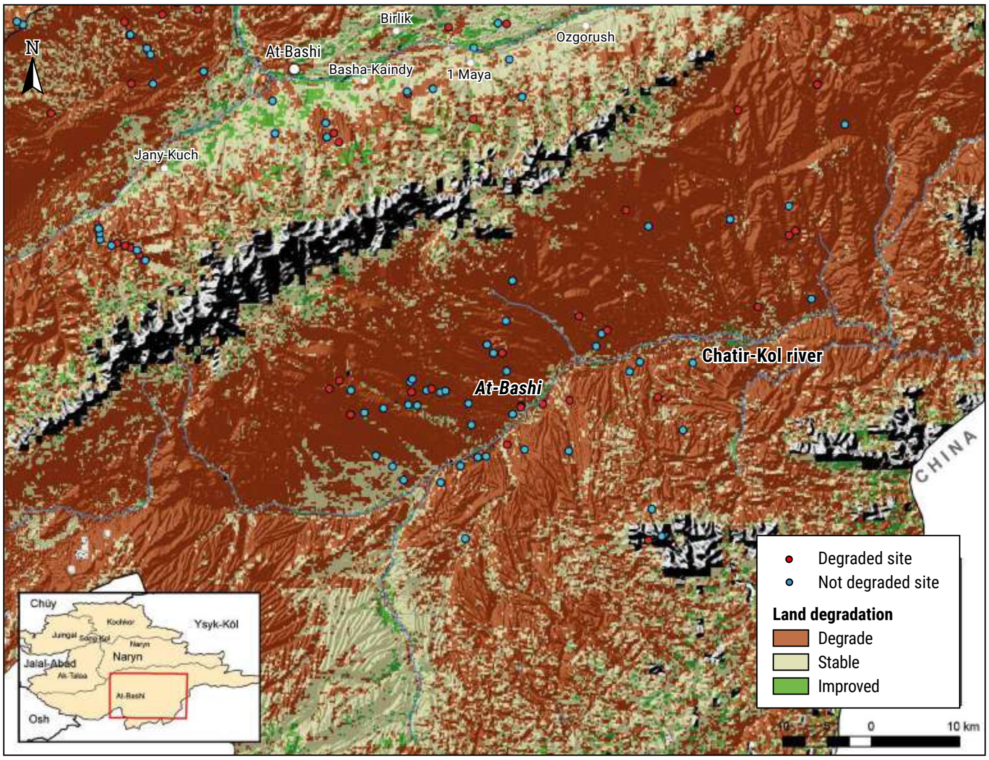
Figure 70. Participatory pasture state evaluation as perceived by local PUA and PC members in At-Bashy District



Source: CAMP Alatoo.

The field surveys also showed the area to be in moderate condition, with a significant percentage of sites classified as "degraded" but a slight majority classified as "not degraded". **Figure 71** overlays data from the field plot and the "degradation" state according to RS.

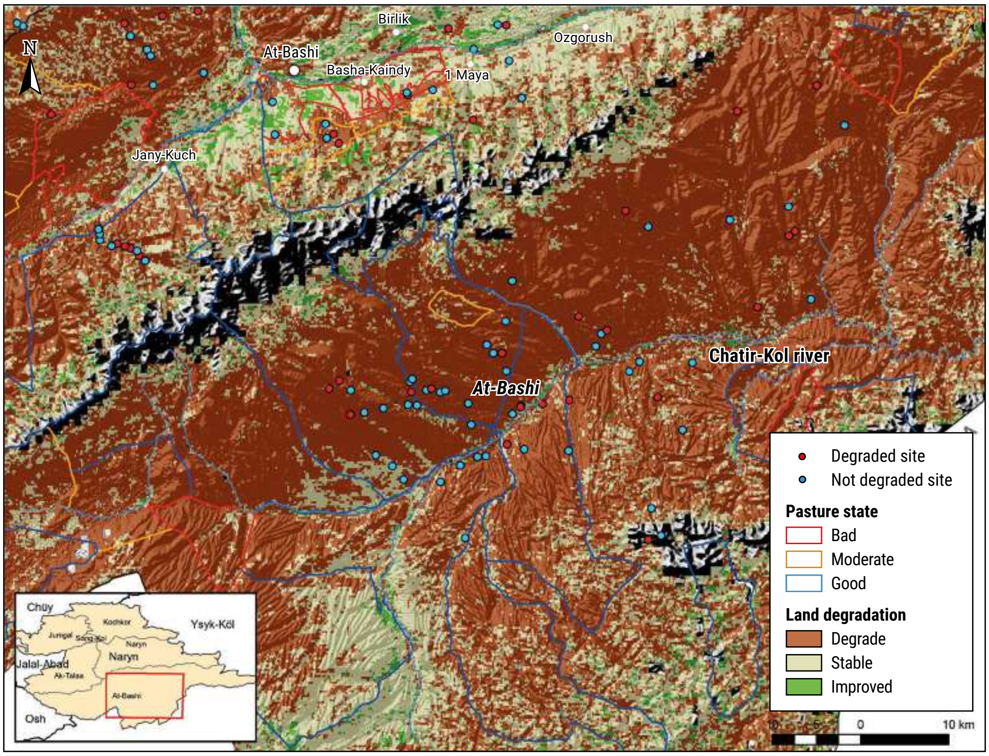
Figure 71. Field plot data showing those areas classified as "degraded" and those areas "not degraded" set against the estimated area affected by degradation



Source: Camp Alatoo and Peter Mwangi. 2020. Field plot data showing those areas classified as "degraded" and those areas "not degraded" set against the estimated area affected by degradation. Cited 15 February 2020. Modified to comply with UN, 2020.

When the three primary information sources are overlaid, the contrast becomes apparent (**Figure 72**). Also of interest are the results from the area surrounding the township of At-Bashy: RS revealed improvement, while village land users placed the area in the "bad" category. Figure 72 also highlights not degraded field plots, once again reinforcing the need for combined approaches to data collection.

Figure 72. Field plot data showing those areas classified as "degraded" and those areas "not degraded" set against the estimated area affected by degradation



Source: Camp Alatoo and Peter Mwangi. 2020. Field plot data showing those areas classified as "degraded" and those areas "not degraded" set against the estimated area affected by degradation with the local pasture state. Cited 15 February 2020. Modified to comply with UN, 2020.

Had RS been the primary tool for locating areas of concern and intervention, the pastures in the southern part of At-Bashy would have most likely been selected for investment for restoration (in line with the scenario presented in Figure 69). However, the reality as viewed through the participatory evaluations and field surveys is more complex (Figure 72).

This inherent complexity is an important point to consider not only when applying RS as a tool for locating areas for investment, but when building enabling environments for project activities and outcomes. Had At-Bashy been selected, other districts in the region could argue that they should receive the same treatment since LD affects their lands and pastures (indeed, they scored low in the participatory evaluations and field scores). They would question an approach that placed the focus on At-Bashy District – and rightly so, if the data presented here are correct.

If the field results are taken as the most reliable source of information – and there are strong arguments both in favour of and against this supposition – then in the majority of cases they validate the inputs and perspectives of the local land users (Table 20, p99). Consultations and participatory processes with local land users in this case proved to be an accurate, low-cost option for assessment and had the added advantage of placing decision-making capacity and ownership in the hands of land users from an early stage of activities while creating a clear evidence-based decision-making opportunity for policymakers. As the process develops, land users are in the best position to say how pastures listed as "bad" can be managed to transition to "moderate" and possibly "good". In addition, land users and the PCs also have participatory indicators and simplified field data collection methods (five visual indicators) on which to base decision-making. The time and travel required to conduct monitoring exercises can then be reduced by randomly selecting sites previously surveyed and revisiting them to see if the chosen management options are producing the desired results. This can be followed after some years by a repeat of the entire assessment protocol for the area to establish new trends.

In the At-Bashy case study, the participatory element of the PRAGA approach clearly provided the means for identifying the complexity at work in the area and laid the groundwork for the introduction of improved practices, due to its participatory nature and respect for traditional information and knowledge. Its use as an assessment tool and baseline for improved planning and stakeholder engagement was validated in the case of Naryn Oblast.

7 Results from the validation of remote sensing, field assessment with local herder perceptions

Validation meetings (**Figure 73**) were held with pasture committees from Naryn Oblast for all three approaches:

1. perceptions of PC members about the state of pasture areas;
2. results of field research on community indicators; and
3. remote sensing results (NDVI).

This was followed by discussions on all the indicators from the three approaches and the results are presented in Table 21. This exercise helps align assessment data to the management objectives of the land users, showing what they define as a desirable (healthy) and not desirable (unhealthy) state of the rangelands. The ultimate aim is for these results to inform management decision-making regarding, for example, grazing plans and investments on rangeland restoration.

Table 21. Validation results for pasture assessment

	Spring and autumn pastures
	Winter pastures
	Summer pastures
	Assessment results do not have same result
	Assessment results have same result

DISTRICT	MUNICIPALITY	TYPE OF PASTURE	P[1]	F[2]	NDVI	DISCUSSION
Naryn	Kazan-Kuigan	Spring–autumn	Moderate	Bad	Increases	RS shows the growth of the GI but it comes entirely from arable land.
Naryn	Jerge-Tal	Spring–autumn	Moderate	Moderate	Increases	The GI considers as pasture arable land used for grazing once forage crops are harvested. Otherwise, the state of pastures is stable.
At-Bashy	Ak-Zhar	Spring–autumn	Moderate	Moderate	Increases	The GI considers as pasture arable land used for grazing once forage crops are harvested. Otherwise, the state of pastures is stable.
At-Bashy	Kazbek	Spring–autumn	Good	Moderate	Increases	PC members agree with the RS data and believe that the condition of these pastures is good. The field data that affected the final estimate of “moderate” is the plant height of 7 cm. The PC feels that this is not a bad score for these types of pastures.
At-Bashy	Bash-Kajyndy	Spring–autumn	Moderate	Moderate	Increases	The GI increases, but the PC cannot accept it. The map also shows that the area of degraded areas is not small.
At-Bashy	Kara-Suu	Spring–autumn	Moderate	Bad	Increases	The GI grows due to the factoring in of arable land.
At-Bashy	Acha-Kajyndy	Spring–autumn	Moderate	Moderate	Increases	The GI grows due to the factoring in of arable land. Otherwise, the state of pastures is stable.
Ak-Talaa	Togolok Moldo	Spring–autumn	Bad	Bad	No data	

DISTRICT	MUNICIPALITY	TYPE OF PASTURE	P[1]	F[2]	NDVI	DISCUSSION
Ak-Talaa	Terek	Spring–autumn	Bad	Moderate	Stable	After discussions, PC agreed that they assumed that there were a lot of weeds. The field study did not reveal an abundance of weeds. They concluded that the conditions of these pastures are moderate.
Ak-Talaa	Kok-Zhar	Spring–autumn	Good	Good	Increases	In these pastures, the results of the three approaches coincided.
Naryn	Ak Kuduk	Winter	Moderate	Moderate	Increases	The GI grows due to the factoring in of arable land. Otherwise, the state of pastures is stable.
At-Bashy	Ak-Zhar	Winter	Bad	Bad	Decreases	In these pastures, the results of the three approaches coincided.
At-Bashy	Kazbek	Winter	Moderate	Moderate	Increases	The GI shows growth, although the overall picture shows an equal number of both improved and degraded areas. With this in mind, the state of the pastures can be considered stable.
At-Bashy	Bash-Kajyndy	Winter	Bad	Bad	Increases	33% improved exclusively due to arable land. If arable land is excluded, the condition is consistently bad.
At-Bashy	Kara-Suu	Winter	Moderate	Moderate	Stable	In these pastures, the results of the three approaches coincided.
At-Bashy	Acha-Kajyndy	Winter	Bad	Bad	Increases	43% improved exclusively due to arable land.
Ak-Talaa	Kok-Zhar	Winter	Good	Good	Increases	In these pastures, the results of the three approaches coincided.
Naryn	Kazan-Kuigan	Summer	Good	Good	Decreases	PC members dispute the results of RS. In these types of pastures, the presence of open ground is natural and rarely vegetation cover exceeds 70–80%.
Naryn	Ak Kuduk	Summer	Moderate	Moderate	Stable	In these pastures, the results of the three approaches coincided.

DISTRICT	MUNICIPALITY	TYPE OF PASTURE	P[1]	F[2]	NDVI	DISCUSSION
Naryn	Jerge Tal	Summer	Bad	Bad	Decreases	In these pastures, the results of the three approaches coincided.
At-Bashy	Ak-Zhar	Summer	Good	Good	Increases	In these pastures, the results of the three approaches coincided.
At-Bashy	Kazbek	Summer	Moderate	Moderate	Increases	The NDVI shows the growth of the GI, but the maps show that the state is stable.
At-Bashy	Bash-Kajyndy	Summer	Good	Good	Increases	In these pastures, the results of the three approaches coincided.
At-Bashy	Kara-Suu	Summer	Moderate	Good	Increases	In this municipality, the PC chairman is new and believes that the condition of the summer pastures is good.
At-Bashy	Acha-Kajyndy	Summer	Good	Good	Increases	In these pastures, the results of the three approaches coincided.
Ak-Talaa	Kok-Zhar	Summer	Good	Good	Increases	In these pastures, the results of the three approaches coincided.
At-Bashy	Kara-Koiun	Summer	Moderate	Moderate	Increases	The GI increases, but the PC cannot accept it. The map also shows that the area of degraded areas is not small.
At-Bashy	Taldy-Suu	Summer	Good	Moderate	Decreases	PC members dispute the results of RS. In these types of pastures, the presence of open ground is natural and rarely vegetation cover exceeds 70–80%.
Ak-Talaa	Togolok Moldo	Summer	Moderate	Moderate	No data	
Ak-Talaa	Terek	Summer	Moderate	Moderate	Stable	In these pastures, the results of the three approaches coincided.

Notes:
1 Pasture users' and PCs' perceptions of pasture states.
2 Field assessment.
RS – remote sensing; GI – green index; PC – pastoral committee; NDVI – normalized difference vegetation index.

Figure 73. Validation of RS results with PCs

Comparison across the three approaches showed controversial results as only about 39 percent of cases had the same results. However, the results differ according to pasture type. For spring–autumn pastures, all three approaches showed the same result in only 11 percent of cases, compared with 41.7 percent in summer pastures and 43 percent in winter pastures. Sections 7.1–7.3 present the reasons behind these differences as discussed with herders.

7.1 Winter pastures

In almost all cases, winter pastures are located at low altitudes and RS results showed an increase in the GI of up to 43 percent. Pasture users did not agree with this, as according to them, GI growth was only relative to arable land. Remote sensing takes into account arable land that is also used as winter pasture once the winter feeding crops such as alfalfa, sainfoin and barley are harvested. However, arable lands do not form part of the "rangelands" under assessment (i.e. rangeland areas used for extensive livestock production). Furthermore, the green spots on non-arable pastureland were in fact cultivated rainfed areas where farmers grow forage for livestock. These green spots were eliminated following verification by pasture users (**Figure 74**).

Figure 74. PC chairman pointing out the green plots on pasture area used for growing crops

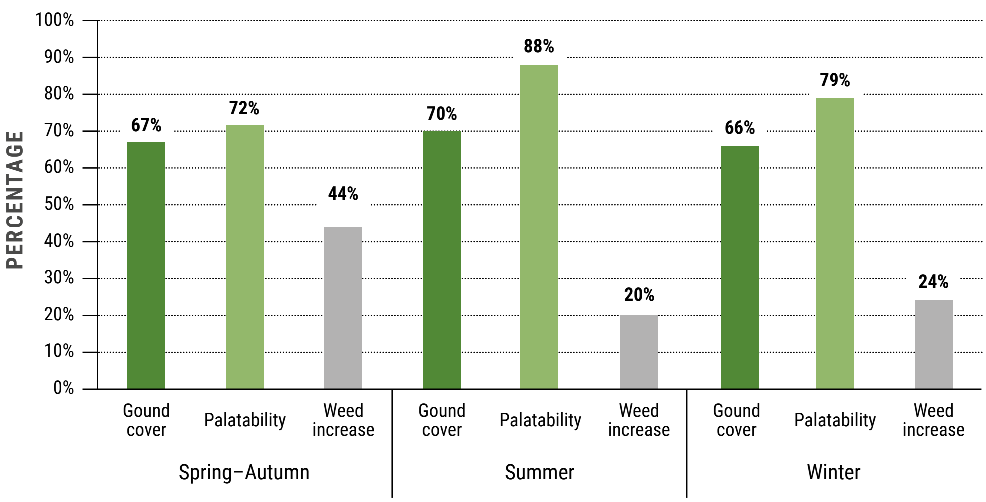
7.2 Summer pastures

In summer pastures, in those areas where RS showed an increase in pasture degradation, pasture users expressed objections, arguing that in these types of pastures, the presence of open ground is natural and expected with vegetation cover rarely exceeding 70–80 percent.

7.3 Spring–autumn pastures

In 89 percent of all cases of spring–autumn pastures, the GI increased, according to RS data. Pasture users' perceptions and field survey data contradict this, pointing to more moderate conditions – although pasture users were not able to clearly explain this result. The situation became clearer after analysing some indicators of the field survey. Spring–autumn pastures are in the middle belt of mountain ranges, where conditions are more favourable for vegetation growth and development: precipitation is greater than in the lower zones, and temperatures are higher than in the upper zones, resulting in high diversity of pasture vegetation. However, vegetation diversity is not always a positive indicator for herders in terms of grazing, as diverse vegetation includes non-palatable plant species. Pasture users perceive non-palatable plants as "weeds". On approximately the same ground cover in all types of pastures, spring–autumn pastures have a smaller percentage of palatable plants and twice as many weeds (**Figure 75**). At the same time, RS can show the growth of the GI, which may be due to the increase in weeds. This may indirectly explain the increase in GI in 89 percent of spring–autumn pastures despite less optimistic field study figures.

Figure 75. Indicator values on different types of pastures



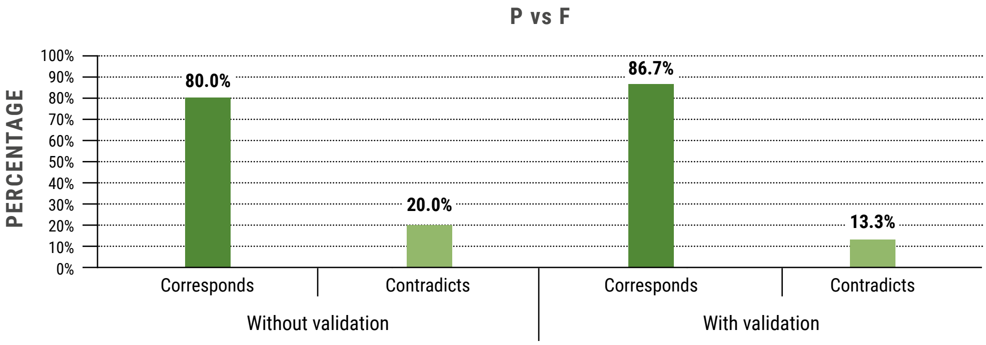
Source: the authors

7.4 Adjustments of discrepancies

Following the identification of discrepancies within the three approaches in pasture assessment and with the justified reasons, errors were excluded, based on more information received by local communities.

The pasture users' perceptions and field assessments showed similar results, but in the validation exercise, the level of similarity increased by 6.7 percent (from 80 percent to 86.7 percent) (**Figure 76**).

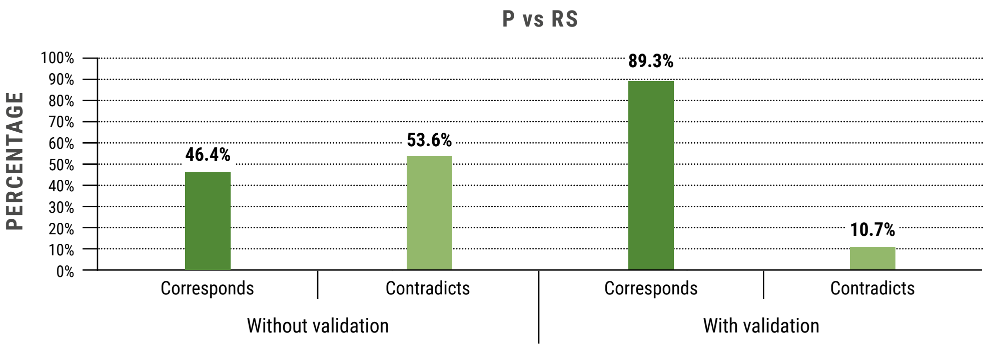
Figure 76. Comparison of pasture user perception (P) with field data (F) "without validation" of received data and "with validation of data"



Source: the authors

For pasture user perceptions of RS, the initial discrepancy was 53.6 percent; however, following validation, the compliance level increased by 43 percent to 89.3 percent overall (**Figure 77**).

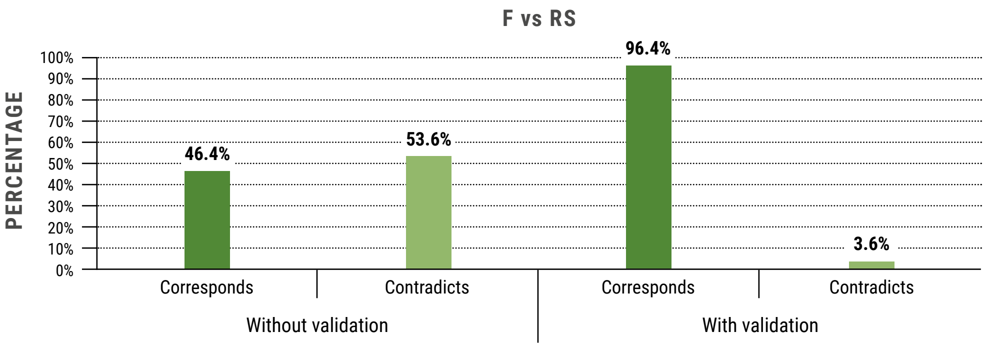
Figure 77. Comparison of perception of pasture users (P) with RS "without validation" of received data and "with validation of data"



Source: the authors

Between field assessment and RS, the compliance between the two approaches was only 46.4 percent before data validation, but rose to 96.4 percent after validation (**Figure 78**).

Figure 78. Comparison of field data (P) with RS "without validation" of received data and "with validation of data", %



Source: the authors

Based on the results, there can be major discrepancies between RS approaches and other field-based qualitative approaches, such as field assessments and local perceptions. It is also evident that pasture users are well aware of their pasture conditions: approximately 80 percent of their perception was close to or confirmed by field data. This further reinforces the need to integrate local knowledge in assessments and to ground-truth satellite-generated data.

7.5 Cost-effectiveness in assessments

The differing level of accuracy in the different pastures can help in designing cost-effective monitoring protocols for pastures in mountainous regions, as it is possible to prioritize which low-cost assessment can still deliver robust results and which ones require a combination of approaches.

- **Winter pastures.** All three approaches work well and are applicable, as the compliance rate is 100 percent. There are several reasons for this. First, most winter pastures are degraded because of the high loads (since they are usually located near settlements); it is, therefore, easier for pasture committees to determine their condition, which is often unhealthy pasture conditions. Second, the diversity of vegetation in these pastures is low due to their state and climatic conditions (in contrast, where there is high diversity, mistakes are more likely because of the difficulty in distinguishing between palatable and non-palatable species). Lastly, due to their location in close proximity to settlements, they are easy to monitor as pasture users can observe the daily changes in these pastures.

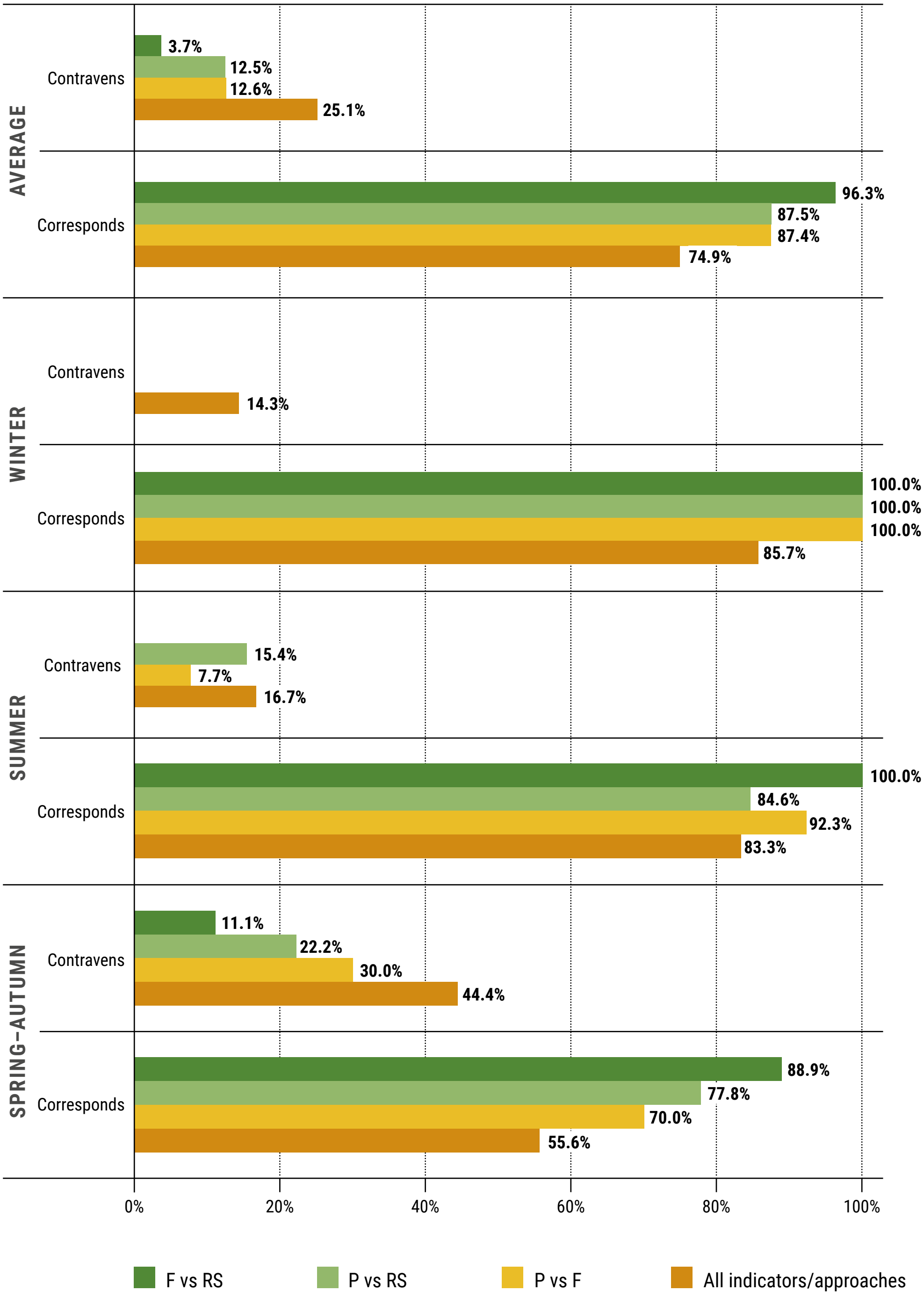
- **Summer pastures.** It is best to use field survey and/or RS approaches where the assessment results show 100 percent consistency. It is very important to validate the RS data using field assessment. In high-altitude conditions, the climatic factors mean that natural vegetation coverage rarely exceeds 70–80 percent. After validation, the compliance results are high.
- **Spring–autumn pastures.** Due to their specificity, there are wide variations between the three approaches. As a result, it is recommended to validate field assessments and RS with local/traditional knowledge of the herders.

Figure 79 summarizes the correspondence between the results of different approaches.

7.6. Summary of the validation exercise

1. A key stage of PRAGA implementation is data validation, which should (preferably) be done with those pasture users who were involved in the earlier stages of the methodology, for example, creating mental maps and defining indicators, and who participated in field assessment of pastures. Remote sensing without data validation has a low compliance rate with the results obtained by other methods such as mental mapping and field studies.
2. Pasture users are aware of the state of their pastures. In 80 percent of cases, their perception of the state of their pastures was close to or confirmed by field data.
3. In Kyrgyzstan – a mountainous region – altitude and seasonality of pasture influence the PRAGA approach and its results. The correct interpretation of the results depends on the precise conditions and the PRAGA implementation team should therefore have specialists who know the specifics of a particular region.
4. All three approaches are applicable to winter pastures. In these pastures, the conformity of assessment results is very high (close to 100 percent).
5. For summer pastures, field surveys and/or RS approaches are the most appropriate.
6. On spring–autumn pastures, not one combination of the three approaches gave 100 percent consistency of results; this shows the importance of incorporating local knowledge.

Figure 79. Summary of the correspondence between the results of different approaches (%)



Source: the authors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8 Conclusions and recommendations

Various authors (Livine *et al*., 2017; Jamsranjav *et al*., 2018; Liechti, 2012) have called into question the extent and intensity of LD as reported – whether under Soviet management or on the regional (oblast) and national scales. Methodology, as well as definitions of what constitutes LD and how to categorize it, can significantly alter results. The disparities that emerge due to different perspectives between local and official data sources on a range of issues make understanding on-the-ground realities and decision-making more complex. The definitions of LD and indicators of LD in Naryn Oblast are presented in Annex 1.

The baseline and field data can serve as a basis on which to conduct large-scale assessments; however, the validation of the results should be done with local communities in order to arrive at the right interpretation based on their land management objectives. This is important, because scientific approaches may not be sufficient to interpret correctly local definitions of degradation and local land management objectives. The section below presents some of these local definitions.

Local herders acknowledge the threats that LD and climate change pose for their ways of life and accept the role local management decisions have played. Their main concern regards weed and non-palatable plant encroachment on the lower-altitude winter pasture areas, although they admit that biomass levels have significantly decreased across all pasture types over time. They also agree that improved management and restoration of traditional stock movements based on season and pasture availability can be used to restore pasture productivity.

From the various conversations during the process, it emerged that proposals for a reduction in stocking rate are not considered a viable solution, given the potential socio-economic ramifications of this proposal. In fact, most PC members state that stocking rates are within the land's carrying capacity and that management solutions, including annual herd movement across the different altitude levels, should be encouraged in order to halt further LD. The options proposed were part of a holistic management approach.

To improve the capacity to address LD and its drivers, stakeholders propose the following:

- **Improved capacity to enforce PUA rules and regulations.** There needs to be more collaboration from local authorities, regarding in particular fee collection as well as enforcement of other rules and regulations.
- **More financial autonomy for PUAs.** At present, the associations have no say regarding financial resources and decision-making.
- **More financial income for PUAs.** Most PCs feel that the possible disassociation between PUA members (direct land users) and the PC is the result of their restrictive budget. More funds are needed to deal with priority issues such as road infrastructure and access (bridges, sanitary facilities, shepherds' huts) for remote pastures in order to demonstrate to PUA members that PCs are effective and working in their interests.
- **Increased communication and understanding between legislators and PUAs.** Overall, there is satisfaction regarding the various laws in support of sustainable rangelands and livestock production. However, there are areas for improvement in policy, because certain articles imply contradiction and limit the impacts and benefits of other articles and laws (i.e. pastoralists work under the Pasture Law 2009, the Land Code, Budget Code, Local Self-Government Code, Hunting Code and in some cases the Mining Code).
- **Enhanced collaboration between herders and coordination of PUA herds (Kezuu and Bada).** A more landscape-focused management approach could include grouping of animals by species and collaborative efforts to reach and make accessible isolated pasture areas.
- **Development or improvement of early warning systems.** Such systems could involve contact or communications to alert herders, especially those in isolated areas, of extreme weather conditions, or they could focus on longer-term climate threats such as prolonged drought or low temperatures.

8.1 Recommendations

Policy aspects

- **Improved support for the Pasture Law.** Despite potential setbacks and faults in the Kyrgyz Pasture Law, it continues to represent one of the most powerful pieces of legislation existing today at the global level. It should be valued for the rights and opportunities it provides. Nevertheless, improvement is necessary to allow it to develop and lead to improved pasture management at the national level.
- **Improved or more flexible land classification protocols.** PUA members would like to see areas classified under a specific land cover or land use category made available for secondary, seasonal uses (e.g. pastureland could be used for cropping at certain times of the year), or subjected to land use change in certain cases. They feel that many classifications are antiquated and do not reflect the state of the land as it is today. They also argue that this will allow for more innovation, income streams and improved land management in peri-urban areas.
- **Professional capacity building.** Individuals or cooperatives offering “herding services” for livestock owners can benefit from capacity building. By working with herders directly and helping to develop and professionalize the service, vulnerable populations are taught applicable skills and land management and planning is improved, potentially leading to LD avoidance and restoration of degraded areas. PC members lack the resources to provide capacity building to the PUA herders, and this policy recommendation would thus transfer the requirement to other agencies.
- **Official recognition of the profession of “herder” by state agencies.** Herders have for the most part remained a marginal professional activity, increasingly so in the post-Soviet era. This group’s demands include greater recognition by the state in terms of social security and pension funds.
- **Early alert and agricultural insurance systems.** As climate change is an increasingly pressing issue, there should be provision in the law to allow funding mechanisms to both warn local producers during adverse weather conditions and compensate in times of prolonged drought or low temperatures.
- **Increased transparency and use of governmental pasture monitoring data.** Although pasture monitoring and assessment has played a significant historical role within the country, it is unclear how exactly this information is used and how it informs decision-making. Both GIPROZEM and Pasture Department data could be more accessible and better serve decision-making processes.

- **Improved livestock monitoring and identification services.** The disparities that often occur between official livestock census numbers and the numbers that exist in reality may be the result of loopholes in animal census protocols and tagging. Incentives and funding to improve census and tagging mechanisms are therefore recommended, especially as food security and product tracking are two vital requirements for trade, and the costs would most likely be offset by increased trade options in the medium to long term. For instance, free or low-cost vaccinations could be offered in exchange for the registering and tagging of animals.

Technical aspects including on pasture monitoring

- **Herder participation in assessment.** It is apparent that herders indeed know the status of their pastures and have developed assessment habits that scientific monitoring can utilize. For example, RS without data validation has a low compliance rate with the results obtained by other methods such as mental mapping and field studies. The main areas for herder participation regard definition of indicators, selection of sites and validation of results. Data validation should preferably be with those pasture users already involved in the early stages of the methodology such as creation of mental maps, definition of indicators and participation in field assessment of pastures. These data should then be utilized in decision-making frameworks for economic considerations such as investments and for the ecological management of pastures.
- **Cost-effectiveness.** It is possible to identify the pastures to prioritize for qualitative assessment by integrating scientific approaches with traditional knowledge. While spring–autumn pastures located in the middle belt of mountain ranges are species-rich, it is nevertheless difficult to separate palatable and non-palatable species including weeds for further management. In such areas, monitoring frameworks can benefit from traditional knowledge in order to discern truly palatable species and therefore gauge the health of rangelands.
- **Adaptation of management.** It is necessary to adapt management practices in order to stop the loss of perennial grass species. This is especially the case in mid- and high-altitude pastures that appear to be undergoing a transition, as perennial grasses and legumes (e.g. *Poa, Festuca* and *Medicago* spp.) are being substituted by hardier, less palatable species, in particular *Artemisia* spp. and

Carex spp. Vital grass species should be used as indicators on which to base grazing times and intensities, and management should focus on improving their health and increasing the percentage of ground cover. If other palatable grasses are found to provide adequate levels of production while maintaining ecosystem services, grazing regimes could be adapted to focus on them as grazing indicators.

- **Strengthening of communal herding and grazing plans.** Grouping herds – rather than managing separate small herds – is often an easy, effective way to maintain grass recovery periods for individual pasture areas. This practice is useful for informing grazing plans that respect grass recovery times, which should be neither too short nor too long. When grazed, grasses mobilize root reserves to replace lost growth. However, when overgrazed, they can fail to produce seeds and eventually perish. On the other hand, long periods of rest or lack of grazing animals on pastures to complete biological and mineral cycles can lead to declines in productivity and loss of biodiversity. Monitoring systems are therefore used to adapt grazing to these processes, leading to improved growth rates, biodiversity and ecosystem productivity.
- **Improved management of hay fields and lowland pastures including through irrigation.** Although considered a low priority by stakeholders, the current practice of purchasing fodder for cattle in the winter months suggests that restoration of Soviet era gravity-fed irrigation canals and distribution networks to hay fields and lowland pastures would be a cost-effective way of increasing biomass production. Further savings are possible if the hay/grass sward is left standing for late-season grazing and livestock are kept overnight on the fields to fertilize the area ahead of spring growth.
- **Maintenance of landscape approach to grazing planning and management.** Throughout Central Asia, pasture use is linked to seasonal growth patterns, vegetation type and altitude. This interpretation of the landscape from a grazing point of view is a key component of SLM in the region. The Pasture Law has protected and institutionalized mobility, although changes in lifestyle might alter how mobility is practised.

Socio-economic aspects

- **PUA incentive programmes.** Incentives for early or on-time payments of pasture fees or improved livestock management could encourage PUA members to meet their obligations. For example, those who pay on time could have first access to pastures; likewise, those practising proper grazing management or disease prevention could have reductions in fees or other benefits.
- **Cooperatives for products and producers.** The consolidation of products and producers in cooperatives or under the umbrella of a common brand is a potentially interesting option in terms of value addition, marketing and sales and transport of items. Even if PUA producers are sceptical about an institutionalized cooperative scheme, they could at least follow specific production models to create a shared brand under which PUA members could sell their goods.
- **Women's empowerment including in decision-making.** Gender equality and equal opportunity are cross-cutting issues; gains in these areas lead to increased economic growth at the household, regional and national levels. As women's roles in rural areas often involve agricultural chores and responsibilities, their input and participation in decision-making is crucial to improve on-farm efficiency and quality of output.
- **Infrastructure development and maintenance.** It is essential to enable easy access to and mobility in remote pastures to help reduce pressure on low- to mid-range pastures.

8.2 Lessons learned

There follows a summary of the lessons learned during the application of PRAGA in Kyrgyzstan. For a more detailed list, please see **Annex 5**.

- The PRAGA methodology met expectations regarding its ability to assess very large areas of rangeland. The area covered was approximately 2 million ha, or 20 000 km^2.
- Pastoral perspectives and views on the status of the pasture resources were largely in agreement with the field results obtained (Table 20). This reaffirms the importance and validity of participatory inputs in rangeland/pastureland assessments and points to the possibility of using them as part of a low-cost assessment approach in landscapes that need more attention (e.g. those with high diversity). Remote sensing proved fairly effective in assessing high-altitude

pastures that are difficult to access due to their remoteness; however, for mid- and low-altitude pastures, RS needs to be integrated with field assessment and local/traditional knowledge held by herders.

- Discrepancies emerged between RS and field assessment of LD with spatial and temporal scaling. The RS data sets/assessment had a resolution (minimum unit) of 300 m (i.e. 90 000 m^2) and a temporal range of 15 years (i.e. 2000–2015); on the other hand, field assessment was carried out as a plot, with data collected in summer 2019 without temporal range assessment/reference.
- Ensuring the participation of local pasture users who directly use the pasture areas surveyed was very important in the initial stages of indicator selection, mental mapping of the pasture state and validation of results.
- In the field, some areas with complicated access such as swamps or high vegetation plots are less likely to be assessed. If issues regarding number and selection of sample points (random/representative) are clarified in advance, the distortion could to some extent be avoided.
- LDN indicators of land cover and SOC showed marginal change (Figures 48 and 49), leaving productivity (Figure 50) as the sole indicator effectively showing degrees of variability. Productivity is more subject to seasonal and climatic influences (e.g. seasonal weather conditions, grazing patterns and intensities) as well as other land use impacts (e.g. fire).
- The PRAGA methodology steps should – where possible – be followed systematically, but with intermediary reviews and feedback mechanisms. However, flexibility can also be applied when appropriate. For example: once Step 2 (identifying the landscape for assessment) is finalized, Step 3 (baseline review) and Step 4 (large-scale assessment and RS) should be finalized in conjunction with or immediately before Step 5 (participatory mapping of target landscape). Thereafter, outputs from Steps 4 and 5 have to be reviewed in order to decide whether to revisit and/or change the spatial extent and location of the landscape to be assessed (Step 2) in the spirit of capturing heterogeneity and divergence of rangeland health and LD. This also gives the participants an insight into the indicator selection parameters/limits (Step 6) that will be investigated during the field assessment (Step 8).

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Stakeholder analysis and voluntary roles in project implementation[1]

ANNEX 1

ORGANIZATION	PROPOSED ROLE IN PROJECT
FAO Kyrgyzstan	Technical, financial, logistical and organizational support. Liaison between stakeholders, both national and international.
Ministry of Agriculture	Information and feedback on baseline and monitoring methodology. public relations and interagency communication.
CAMP Alatoo	Facilitation of local inception and validation workshops. Organization and execution of field assessments for the two chosen pilot site areas. Field data management and feedback on tested monitoring system.
Ministry of Agriculture (Department of Pastures)	Participation in workshops, field assessment and events with department experts. Potential source of baseline information. Evaluation of monitoring system results and policy improvement proposals.
IUCN	Lead technical support in participatory monitoring methodology development.
SAEPF	Information on pilot sites and districts, feedback on methodology and results when monitoring systems are applied to State Forest Fund lands and grazing policy. Potential source of baseline information.

[1] Original results from the Stakeholder Analysis and agreed roles in Project activities, Project Inception Meeting, Bishkek, 11–12 March 2019.

ORGANIZATION	PROPOSED ROLE IN PROJECT
GIPROZEM	Information on pilot sites and districts. Potential source of baseline information, feedback on methodology and results.
PCs/land user groups/National PUA/forestry management units	Provision of time, information, knowledge and feedback. Evaluation of proposed monitoring system and how it answers ground level needs and proposals.
Scientific Research Institute of Livestock	Participation in field assessments. Potential source of baseline information. Data analysis and evaluation of monitoring methodology results.
GIS Department of Ministry of Agriculture (Department of Pastures)	Aid in interpretation and evaluation of baseline information and mapping of monitoring results.
Community Investment and Development Agency	Gender issues, feedback, expert opinions. Potential source of baseline information.

Notes: FAO – Food and Agriculture Organization of the United Nations; GIPROZEM – National Soil Institute; GIS – Geographic Information System; IUCN – International Union for Conservation of Nature; PC – pastoral committee; SAEPF – State Agency for Environmental Protection and Forestry.

ANNEX 2

Data sources for map creation[2]

MAP NAME	DATA SET	CONTEXT/INDICATOR	SOURCE
Type: Socio-economic			
Infrastructure	Roads	Context	HDX
	Settlements/Urban centres	Context	HDX
	Distance to roads/settlement	Pressure	
Protected areas	Wildlife parks and reserves and heritage sites	Context	WDPA
Human population density	Persons per km^2 at certain year/s	Context	GPW
Change in human population density	Change in human population density from initial to current/ reporting year	Driving force/Pressure	
Poverty mapping	Proportion of people below poverty line	Driving force/Pressure	
Drinking water access	Proportion of household with access to safe drinking water sources	Impact	
Water point distribution	Water points/Infrastructure	Context	
Distance to water source	Water points	Pressure/Impact	
Human development index	Human development index at year...	Context	
Livestock distribution	Livestock (TLU) density per km^2 point or surface	Pressure	

[2] Context data sets and maps and their relevance as DPSIR (driving force-pressure-state-impact-response) baseline indicators.

MAP NAME	DATA SET	CONTEXT/INDICATOR	SOURCE
Type: Biophysical			
Bio/agroclimatic distribution	Bio/Agroclimatic data	Ecoclimatic state	
Wildlife distribution	Key species or species richness distribution	Biota state	IUCN Red List
NPP distribution	Mean annual NDVI of 2000 and 2015/8 and graphical trends	Biota state	MODIS 13q
Land cover/use distribution	Land cover types/use 2000–2015	Biota state	ESA CCI
SOC stock distribution	SOC stock data set	Soil state	ISRIC GPW
Terrain and hillside	Elevation above sea level	Landform state	ASTER/SRTM
	Slope	Landform state	
Hydrology distribution	Wetlands, lakes and river distribution	Water state	FEWSNET or WRI
Type: Climatic			
Evapotranspiration distribution	Potential/actual evapotranspiration	Climate state or driver in case of climate change	CGIAR CSI Global-PET
Precipitation distribution	Rainfall distribution of 2000 and 2015–2018 and graphical trends	Climate state or driver in case of climate change	CHIRPS
Temperature distribution	Temperature distribution of 2000 and 2015–2018 and graphical trends	Climate state or driver in case of climate change	CHIRPS

Notes: ASTER – Advanced Spaceborne Thermal Emission and Reflection Radiometer; CGIAR CSI – CGIAR Consortium for Spatial Information; CHIRPS – Climate Hazards Group InfraRed Precipitation with Station; ESA CCI – European Space Agency Climate Change Initiative; FEWSNET – Famine Early Warning Systems Network; Global-PET – Global Potential Evapotranspiration; GPWE – Gridded Population Of The World; HDX – Humanitarian Data Exchange; ISRIC – International Soil Reference and Information Centre; IUCN – International Union for Conservation of Nature; MODIS – Moderate-Resolution Imaging Spectroradiometer; NDVI – Normalized Difference Vegetation Index; NPP – Net Primary Productivity; SRTM – Shuttle Radar Topography Mission; TLU – Tropical Livestock Unit; WDPA – World Database on Protected Areas; WRI – World Resources Institute.

PRAGA field survey sheet

ANNEX 3

Sampling sheet used for PRAGA field surveys

Name of assessor/team:	Date of assessment:
Site identity	
Site name:	Plot ID: (name or reference)
Site geo-reference: (GPS reference)	
Site description	
Slope: (flat, gentle, medium, steep, sharp)	Shape: (convex, concave, straight)
Aspect: (N, S, E, W)	
Predominant land use: (grazing, browsing, cropping, forestry, protected area)	
Precipitation quantity for year of analysis: Drought Below average Average rainfall Higher than average	
Soil indicators	
Surface crusting evident: Yes / No	Can it be broken with the finger: Yes / No
Percentage of bare soil: ___________%	
Erosion: No evidence Localized Widespread Inconsequential Significant Severe	

Vegetation/biodiversity				
Ground cover % (including plants, leaf litter): 0 10 20 30 40 50 60 70 80 90 100%				
Palatable plants:	None	Few	Moderate	Many
Average height of grasses/forbs:	0–5 cm	6–10 cm	11–20 cm	≥ 21cm
Evidence of seed formation:	None	Few	Moderate	Many
Dominant plant species:				
Participatory indicator sets and values				

ANNEX 4

Land cover aggregation process

VALUE	ESA CCI LAND COVER	UNCCD	LOCAL EXPERT
200	Bare areas	Bare land	Bare land
202	Unconsolidated bare areas	Bare land	Bare land
220	Permanent snow and ice	Bare land	Bare land
10	Cropland, rainfed	Cropland	Cropland
20	Cropland, irrigated or post-flooding	Cropland	Cropland
30	Mosaic cropland (> 50%)/ natural vegetation (tree, shrub, herbaceous cover) (< 50%)	Cropland	Cropland
11	Herbaceous cover	Cropland	Grassland
40	Mosaic natural vegetation (tree, shrub, herbaceous cover) (> 50%)/ cropland (< 50%)	Cropland	Grassland
110	Mosaic herbaceous cover (> 50%)/ tree and shrub (< 50%)	Grassland	Grassland
120	Shrubland	Grassland	Grassland
130	Grassland	Grassland	Grassland
150	Sparse vegetation (tree, shrub, herbaceous cover) (< 15%)	Grassland	Grassland
60	Tree cover, broadleaved, deciduous, closed to open (> 15%)	Tree-covered areas	Tree-covered areas

VALUE	ESA CCI LAND COVER	UNCCD	LOCAL EXPERT
70	Tree cover, needle-leaved, evergreen, closed to open (> 15%)	Tree-covered areas	Tree-covered areas
71	Tree cover, needle-leaved, evergreen, closed (> 40%)	Tree-covered areas	Tree-covered areas
80	Tree cover, needle-leaved, deciduous, closed to open (> 15%)	Tree-covered areas	Tree-covered areas
81	Tree cover, needle-leaved, deciduous, closed (> 40%)	Tree-covered areas	Tree-covered areas
90	Tree cover, mixed leaf type (broadleaved and needle-leaved)	Tree-covered areas	Tree-covered areas
100	Mosai tree and shrub (> 50%) herbaceous cover (< 50%)	Tree-covered areas	Tree-covered areas
190	Urban areas	Urban areas	Urban areas
210	Water bodies	Water body	Water body

Notes: ESA CCI LC – European Space Agency Climate Change Initiative Land Cover; UNCCD – United Nations Convention to Combat Desertification.

ANNEX 5

PRAGA lessons learned

Definition of land degradation and its indicators for Naryn Oblast

As a participatory methodology aimed at involving land users in the identification, definition and solution of LD issues, local feedback was important to understand what LD meant for decision makers.

The definition of LD and its drivers was a common component of the various workshops and was defined by project stakeholders from Naryn Oblast as follows:

- overall poor condition or state of pastures (land not meeting its potential);
- “only the grass that is not edible remains” (transition to other less productive ecological states);
- increase in the number of weeds/non-palatable plants;
- decrease in ground cover;
- soil moisture and dew rates decreasing (changes in local water cycles);
- early drying of rivers and springs;
- animals less grouped, more prone to wander (changes in animal grazing patterns and behaviour);
- less milk;
- unjustified increase in the number of livestock (number of stock do not relate to actual carrying capacity); and
- incorrect use of pastures and overgrazing, which leads to situations in which the cattle do not stand in one place (erratic, uncontrolled grazing of stock).

Lessons learned:

- There existed areas of agreement and discrepancies between stakeholder/field results and RS. This was explored in the At-Bashy case study. Although there were discrepancies, the mixture of the different data types and sources allowed for a deeper level of understanding and complexity of analysis.
- The field data collection system (Annex 3) proved to be relatively simple and quick. In just 5 days, the assessment team was able to assess 13 pastures in different locations with more than 150 sample points in total. This is similar to the results obtained in other countries and contexts in which this field data collection system has been conducted. Considering travel to different sites, around 20–40 plots are feasible per day for a two-person team.
- Even after exchanges with local herders and pasture committees and use of maps, it took some time to find the selected pastures. The pasture borders were often not clearly recognizable. If possible, it would be good to load shapefiles of pastures on a phone/tablet to avoid wasting time searching for sites and pasture borders.
- The use of KoBo Toolbox on a smartphone/tablet was very helpful and made data collection quick. Moreover, use of this tool means that data do not have to be digitalized and can be easily edited directly in the field.
- The methodology does not state how the monitoring points should be selected and evaluators therefore adopt different selection processes: some choose the points randomly, while others select representative sample points. Both approaches have advantages, but the lack of consistency leads to a mixture, which can distort the assessment results.
- The area covered in each monitoring point was not clearly demarcated (e.g. a circle with a defined diameter), leading to uncertainty about which phenomena and which plant species were part of a monitoring point and which were only in the vicinity. A more precise definition of the monitoring point (specific area) could help to prevent this uncertainty and make assessments more consistent.
- The field guide does not specify which assessment indicators should be chosen nor how specific indicators should be measured. This means, on the one hand, that indicators can be adapted to local needs, but on the other, that completely

different indicators may be chosen in the diverse study areas or that there is strong variation in the measurement of the indicators. A global comparison of the field data thus becomes very challenging.

- The method is very flexible. To maintain this high level of flexibility, it is proposed to i) provide a catalogue of indicators for selection; and ii) make some basic indicators mandatory and the additional indicators optional. See Annex 3 for the five mandatory indicator sets used in the field assessments in the sample sheets provided.
- As all measurements of field indicators are done visually, the methodology can be considered approximate, with a certain degree of subjectivity, which increases as more field teams are involved. The result is a quick, cheap assessment that requires no technical equipment or scientific background. On the other hand, the data can only be considered as estimates, not as true scientific measurements on which to base future monitoring.
- To guarantee consistency – at least on a regional level – it could be helpful to provide all assessment teams with pasture assessment "training", where economically and logistically rational. This would enable the calibration of expectations and results.
- In the PRAGA methodology, indicators concerning soil are proposed, but special equipment is usually needed to achieve a degree of accuracy. To keep the methodology cost-efficient, simple indicators like "signs of soil erosion" and "stone cover" should be selected. However, this means that no information about actual soil state is collected (chemical/composition) and comparisons with this baseline information would be difficult for future assessment teams.

Biophysical, climatic and socio-economic trends identified for Naryn Oblast

The trends identified by Kyrgyz Government representatives and the PRAGA development team through the application of the methodology are presented in **Table A5.1** and grouped into three categories: Biophysical, Climatic and Socio-Economic.

TABLE A5.1. Biophysical, climatic and socio-economic trends and drivers identified in literature

CATEGORY	TREND/DRIVER
Biophysical	• Increase in grazing pressure due to growing animal herds, despite uncertainty regarding exact numbers and evolution over time. • Overall reduction in pasture biomass loads across all pasture types in PUA-managed areas. • Most consistent grazing pressure currently exerted on winter and peri-urban pasture areas, which are thus commonly cited as the most degraded of the various classes of grazed lands. The reported increase in non-palatable species in these areas and the field data recorded support this hypothesis. • Rare grazing on isolated pastures, with unknown impacts on biodiversity or pasture growth. • Low number of palatable, perennial grass species (*Poa*, *Festuca*, *Stipa*) in low- and mid-level pasture areas according to field data and literature. To what extent this is a natural occurrence or due to management is worth further study, as it will have important ramifications for pasture management. • Reduction in biomass leading to reduction in soil cover and soil moisture retention capacity. • Reports of springs and streams carrying less water and drying earlier in the season. • Reports of drier soil profiles and reduced grass-seed germination. • Mass movement of soils in upper slopes due to temperature changes. • Reports of increasing soil salinity, especially in spring and autumn transitional pastures.
Climatic	• Confirmed increase in temperatures (according to locals, 2.4 °C). • Reports of reduced total precipitation. • If not changes in total precipitation, then apparent changes in intensity, distribution and seasonal patterns of precipitation. • Reduction in precipitation as snowfall. • Reduction in permanent snowfield and glacier surface area.

CATEGORY	TREND/DRIVER
Socio-economic	• Sustained population growth, especially in areas to the north of Naryn Oblast and in the oblast capital itself. • Migration of youth to larger urban areas or abroad leading to changes in rural demographics, influencing local culture, capacity and production. • Influence of international remittances within rural communities. • Consolidation of smallholdings (peasant and household plots), as the most common and important production model in terms of regional agricultural output. • Increased use of peri-urban and winter pasture areas in line with increasingly sedimentary lifestyle patterns. • Danger and risk of accessing isolated pastures due to increasing weather unpredictability. • Use of livestock, especially cattle and horses, as a savings strategy and investment opportunity. • Reduction in milk output per head/increase in total milk production due to increased herd numbers. • New opportunities resulting from increase in community-based tourism industry, although impacts are still quite limited. • Increase in hunting-related activities and incomes, with uncertain linkages, rights and obligations under the Pasture Law. • Consolidated gender roles in rural areas resistant to change.

Notes: PUA – pasture users association.

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