Working Paper:
Assessment of Pastures Sector and Recommendations for CS-FOR Project

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Final version 5 May 2018

Abbreviations and acronyms

AA	Ayil Aymak [rural municipality area]
AI	Artificial Insemination
AISP	Agricultural Investments and Services Project
AO	Ayil Okmotu [local government of Aiyl Aimak]
APIU	Agricultural Projects Implementation Unit
ARIS	Community Development and Investment Agency [ARIS is acronym of Russian name]
CAMP	Central Asian Mountains Project
CS-FOR	Carbon Sequestration through Climate Investment in Forests and Rangelands
DW	Dry Weight
FAO	Food and Agriculture Organization of the United Nations
GCF	Green Climate Fund
GEF	Global Environment Facility
GHG	Green House Gas
Giprozem	Kyrgyz Land Management Institute
GIS	Geographic Information System
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit [German Agency for International Development]
IFAD	International Fund for Agricultural Development
kg/ha	kilograms per hectare; kg DW/ha = kilograms of dry weight of plants per hectare
KLPRI	Kyrgyz Livestock and Pastures Research Institute
KNAU	Kyrgyz National Agrarian University
KR	Kyrgyz Republic
Leskhoz	= State Forestry Enterprise
LMDP	Livestock and Market Development Project
LPDP	Livestock and Pasture Development Project, phases I and II (in Tajikistan)
LU	Livestock Unit
m, m^2	meters, square meters
M&E	Monitoring and Evaluation
MoA	Ministry of Agriculture, Food Industry and Melioration
NDVI	Normalized Difference Vegetation Index [an index of green biomass recorded by a satellite sensor]
NGO	Non-Government Organization
NSC KR	National Statistics Committee KR
PC	Pasture Committee (Jaiyt committee)
PLMIP	Pasture and Livestock Management Improvement Project (World Bank)
PUU	Pasture Users Union
RS/GIS	Remote Sensing and GIS
SAEPF	State Agency for Environment Protection and Forestry
SDC	Swiss agency for Development and Cooperation
SFF	State Forest Fund (area of land managed by SAEPF)
SLF	State Land Fund (area managed by MoA where majority of pastures are located)
SWOT	Strengths, Weaknesses, Opportunities and Threats
UNDP	United Nations Development Programme
WB	World Bank
WP	Working Paper

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EXECUTIVE SUMMARY

1. Kyrgyz people come from a traditional nomadic background with seasonal movements of livestock. Pasture condition and livestock production were essential to their survival then, and still are today. Livestock and livestock products play a critical role as a source of cash income, commodity exchange in a barter economy, subsistence support to households, and as protection against contingencies like crop failure or financial crises. The livestock sector represents almost 50% of gross agricultural output.

2. Kyrgyzstan's mountain pastures grazed by livestock form the main component of Kyrgyz agriculture supporting up to 90% of the rural population. Spring is the main rainy season and spring growth drives the agricultural production cycle. The short-term impact of global warming is an increase in spring rains, masking the effects of climate change, but after 3-5 years rainfall will decline and storms become more intense accompanied by massive erosion, placing production systems under threat of flooding and landslides. People need to be prepared for a warming trend with unpredictable seasons.

COUNTRY CONTEXT

3. Mountains dominate the Kyrgyz landscape. Land suited to crop cultivation occupies only 11% of total agricultural land, and is the preferred location of towns and villages. Community pastures are divided into winter pastures close to the villages that are grazed year-round, spring-autumn pastures in foothills, and summer pastures in alpine meadows at higher elevation that are often remote from the village. Deterioration of road and bridge infrastructure has impeded access to summer pastures, which tend to be underutilized and prone to weed invasion.

4. Pasture degradation is one of the more important environmental problems throughout Central Asia, affecting a strategic resource for economic development, food security and environmental health. Pastures in Kyrgyzstan are degraded to varying degrees; overall, roughly 50% are classified as degraded. Degradation is responsible for a drop in species diversity and ecological flexibility to respond to climate change; erosion, severe in places; and decline in forage production. Species composition of pastures adjusts to wet years and dry years and along the elevation gradient. High species diversity facilitates adaptation to livestock grazing pressure and ensures ecosystem resilience to climate change.

5. Pasture use is under different institutional frameworks. Three quarters of Kyrgyz pastures fall under Ministry of Agriculture (MoA) jurisdiction. Most of the remaining pastures are declared part of State Forest Fund (SFF) land administered by the State Agency for Environment Protection and Forestry (SAEPF). Under the 2009 law On Pasture, Pasture Users Unions (PUU) and their executive bodies (Pasture Committees, PCs) have legal authority to manage local community pastures of the State Land Fund (SLF). The SFF pastures are not under any regulatory arrangement for local management, especially with respect to use by livestock from nearby villages. The consequence is severe overgrazing and degradation in forest lands.

6. The CS-FOR project will focus on 4 target districts in the regions of Naryn (Ak-Talaa District), Osh (Uzgen District) and Jalalabad (Suzak and Toguz-Toro Districts). These 4 contiguous districts are susceptible to the hazards of erosion and landslides, flooding and summer heat stress. Although principal towns in these districts have populations ranging from 8,354 to 49,410 (2009 census), they include 259 villages with an average population of 1716 people. Small villages are home to 85% of the overall population.

SECTOR PERFORMANCE

7. Average livestock production in Kyrgyzstan is low, with peak milk yield only 5-6 liters per day. Poverty levels are particularly high in small rural villages, where the CS-FOR project can make a big difference. Livestock production is related to the amount and quality of pasture forage and fodder.

Pasture forage is the principal feed resource, but pasture production is poor. Reported Kyrgyz standing forage measured on seasonal pastures is 390 kg/ha in spring, 550 kg/ha in summer, and 170 kg/ha on winter pastures. Forage yield has been steadily declining while livestock numbers steadily rise, a combination leading to disaster without improved grazing management. The data quoted above are taken from grazed pastures, but natural pastures in Kyrgyzstan have enormous potential to recover from degradation caused by heavy grazing. Potential forage production after one year of rest from livestock is up to ten times the forage standing on a grazed pasture. This difference is the basis for optimism through adoption of an intensive pasture rotation grazing system.

8. The livestock/pasture ecosystem is trapped in a vicious cycle of productivity collapse: Overgrazing and degradation cause lower levels of available forage, which reduces animal productivity, motivates households to own more animals to compensate for productivity declines, which in turn increases grazing pressure and leads to more degradation. The pasture degradation process is connected to a net loss of carbon stored in plants and soil. Only a drastic change in grazing management practices can reverse the degradation trend and increase carbon sequestration. PUUs need to develop more sustainable grazing management strategies. SAEPF needs to develop policies, regulations and guidelines that empower local communities to manage the pastures on SFF land for sustainability.

SWOT ANALYSIS

9. **Strengths**: The PUU/PC is a structure for local management of pastures, a framework on which climate-change mitigation efforts can be devised and implemented, and a model for regulation of SFF pastures. Kyrgyzstan has a rich and diverse native flora, including many palatable perennial plant species. Pasture composition can be manipulated through improved grazing management. Breed improvement can potentially increase production per head of livestock if feed supply is elevated, and achieve yields equivalent to current levels but with smaller herd sizes.

10. **Weaknesses**: Traditional pasture management practices are embedded in current herder grazing strategies, causing continuous grazing on entire seasonal pastures and impeding carbon-friendly grazing management. Difficult access to remote summer pastures remains a stumbling block to effective use of these pastures. The SAEPF has neglected proper management of SFF pastures on state forest land. Methane gas (a significant GHG) is released from manure accumulation in poorly ventilated winter housing. There is a shortage of qualified and trained extension personnel to advise PUUs on better pasture and herd management.

11. **Opportunities**: Degraded pastures have potential for rapid rehabilitation under improved grazing management. Seed of local perennial forage species can be broadcast into natural pasture to accelerate recovery from overgrazing. High-yielding and drought-tolerant varieties of fodder crops will increase fodder production per hectare, and avoid conversion of pasture into cultivated land, which releases large amounts of carbon into the atmosphere. When decentralized, local pasture management has been introduced by SAEPF, pastures on both SLF and SFF land used by livestock from the same village can be managed as an integrated ecosystem. Intensive pasture rotation as the standard for improved grazing management will reduce erosion, increase forage and livestock productivity, and increase carbon sequestration. Trees planted in rows and copses on grazing land can provide shade and protection from cold winter winds, enhancing livestock production and carbon sequestration. Use of Remote Sensing/ GIS has the potential to improve pasture monitoring at district and village level. Repair of roads and bridges will improve access to remote summer pastures and allow a better balance of seasonal pasture utilization.

12. Aggressive selection within current herds and inter-breeding with better-performing livestock breeds (such as Ghissar sheep, already widely adopted) can increase production per animal and allow smaller herds to achieve equivalent household livestock production. A higher plane of nutrition on more productive pastures can double current peak milk yields, especially when combined with better breeds. Livestock owners can take advantage of growing market demand for animal products.

13. **Threats**: Inertia in village and PUU leadership creates a reluctance to adopt new management practices. SAEPF fails to develop an integrated Community Management Plan for pastures on SFF land, and resists integrated pasture management for SLF and SFF pastures. Conflicts occur between Leskhozes and PUUs regarding pasture management. Livestock numbers continue to rise without appropriate changes in pasture management, causing lower productivity and overgrazing. Infrastructure for access to summer pastures and for better water-point distribution is neglected. Climate-change mediated impacts of storms, severe winters and droughts, without a mitigation strategy in place, will increase erosion, magnify overgrazing, and result in a decline in livestock production and carbon sequestration. Poor manure management in winter housing is not corrected, with greater release of ammonia and GHG such as methane. Lack of training of extension specialists in grazing ecology and pasture management. Inadequate pasture research solving pasture-management problems.

STATE SUPPORT

14. Under the authority of the 2009 law On Pasture, the Ministry of Agriculture has delegated responsibility for pasture management to Local Self-Governing Bodies (Ayil Okmotus) which in turn delegate pasture management to Pasture Users Unions at the village level. This framework for improved pasture management is lacking for pastures in SFF land under the jurisdiction of SAEPF. A 2013 Agreement to coordinate activities on SLF and SFF pastures has yet to be implemented. Kyrgyz National Agrarian University provides tertiary education on agricultural subjects, but instruction on pasture management is weak. The Kyrgyz Livestock and Pasture Research Institute has few qualified scientists and a limited budget for pasture research.

CURRENT and PAST PROJECTS

15. Livestock and Market Development Project (2012-2018) funded by IFAD is Kyrgyzstan's core pasture development programme covering 5 of Kyrgyzstan's 7 rural regions in two phases. It aims to improve pasture management, livestock productivity, animal health and village prosperity in the context of adaptation to climate-change trends. The Pasture Livestock Management Improvement Project (2014-2019) funded by the World Bank is active in Chui and Talas regions. It aims to improve community-based livestock management and pasture governance, strengthening the technical capacity of pasture management advisors and Pasture Committees. The goal of a GIZ-supported project in three Central Asian countries including Kyrgyzstan (2015-2019) is to introduce Ecosystem-based Adaptation to Climate Change in High Mountain Regions.

16. Current projects within SAEPF that have a pasture component include a GEF/FAO project – Sustainable Management of Mountainous Forest and Land Resources under Climate Change Conditions (2014-2018) – designed to improve sustainable productivity of silvo-agro-pastoral ecosystems in 5 regions that include Ak-Talaa Leskhoz (Naryn region) and Kara-Alma Leskhoz (Jalalabad region). GEF and UNDP are also supporting a project with SAEPF (2014-2018) on Biodiversity Conservation and Poverty Reduction Through Community-Based Management of Walnut Forests and Pastures in Southern Kyrgyzstan.

17. A significant past project is the Agricultural Investments and Services Project (2008-2013) funded by the World Bank, IFAD and the Swiss agency for Cooperation and Development. The purpose of this project was to improve the institutional environment for livestock producers, and animal health. The law On Pasture was approved soon after this project was initiated, and it helped establish PUUs in many villages. In the Suusamyr Valley in Naryn region, GEF and UNDP introduced a project (2007-2012) to combat overgrazing through better pasture management.

LESSONS LEARNED

18. PUUs, PCs and Leskhozes have the tools to transform pasture management at a local level, creating a framework for improving management practices and resilience to climate change. However, oversight of community pastures by PUUs and PCs has not prevented overgrazing and degradation. Better grazing management is required, but In order to change traditional livestock management practices on community pastures and introduce intensive pasture rotation there will need to be capacity

building, technical guidance and an incentive scheme. Benefits of pasture rotation have been demonstrated in 203 PUUs in Tajikistan, resulting in less erosion, more forage, bigger animals, higher milk yield, higher birth rates and improved livelihoods.

19. Long rest periods in pasture rotation allow forage production to approach potential yield, which can be harvested efficiently by livestock in short grazing periods. Pasture Rotation increases carbon sequestration through build-up of above- and belowground biomass. After pastures have been rehabilitated, good grazing management conserves or increases carbon stocks in the ecosystem.

20. Deterioration of road and bridge infrastructure causes access problems for use of summer pasture. There is an imbalance in seasonal grazing pressure with summer pastures underutilized and winter pastures receiving very heavy use. Winter pastures are a high priority for rehabilitation.

21. A strong M&E programme is necessary to assess innovative management practices like intensive pasture rotation and provide feedback to guide adjustments to management. Analysis of remotely sensed images (e.g. satellite imagery) linked to a GIS format is a useful monitoring tool yet to be adopted for Kyrgyz pasture management.

22. Lack of regulations governing livestock use of SFF grazing land leads to overgrazing and damage to tree seedlings and regenerating tree shoots. The SAEPF should re-invest grazing-fee income into infrastructure improvements on SFF grazing lands, including water-point development to spread livestock distribution more evenly.

23. Capacity building is required for all components of social and institutional systems governing pasture management, including MoA, NGOs, KNAU, KLPRI and PUUs/PCs.

24. Grazing management research should be at the scale of community pastures, not small research stations. Grazing trials on small rangeland research stations in America have generated misleading results.

RECOMMENDATIONS

25. **New pasture management strategy**. The current grazing management practice allows livestock to have access to an entire pasture for the whole season. By the end of the season the pasture is evenly overgrazed, and this situation is repeated and reinforced from year to year. Rotational grazing (Pasture Rotation) is designed to maximize pasture growth and available forage on a grazed pasture without reducing the number of grazing livestock. This approach to pasture management places herds on small areas of pasture at high stocking density for short periods of time. The livestock then move to another small area and the previously grazed pasture unit is left ungrazed for the remainder of the season. This grazing strategy promotes increase in plant biomass, encourages root growth, leaf litter accumulation on the soil surface, greater infiltration of rainwater where it falls, less erosion, and improved species composition of the vegetation.

26. Degraded pastures in Kyrgyzstan have a measured standing forage yield between 0.5 and 1 ton DW/ha. Conservatively, the potential yield of biomass on Kyrgyz pastures is at least 3 tons DW/ha. If Kyrgyz pastures can be managed with a pasture rotation so that growth approaches this level while they still provide forage for grazing livestock, the contribution to carbon sequestration is substantial. However, if belowground growth is also taken into account, the carbon sequestration is magnified. The root:shoot ration for perennial grasses can be set conservatively at 2:1. For carbon accounting purposes, the above-ground biomass with a root:shoot ratio of 2:1 can be multiplied by 3 to express the total plant biomass. The calculated increase in total Kyrgyz pasture biomass (shoots and roots) rises from 1.5 to 3 tons DW/ha in a degraded condition to 9 tons DW/ha when plant growth is allowed to approach its potential.

27. Practical application of pasture rotation begins with a grazing plan that divides the seasonal pasture into many small areas called grazing units. In the example in the text, fourteen grazing units are grazed while one unit is rested for an entire year, in rotation. In early spring the grazing period is quite short, 2-3 days, and increases gradually to 6-8 days by the beginning of summer. During the long rest

period either before or after the grazing period, the vegetation grows without livestock presence and comes close to peak biomass. When livestock move from spring pasture to summer pasture, a new rotation is initiated. The calendar time at which a particular unit is grazed varies from year to year.

28. In addition to the ecological benefits listed above, additional benefits can be listed from the experience of 203 PUUs in Tajikistan that have adopted pasture rotation as their standard pasture management practice: bigger and healthier animals; higher milk yield of up to 100% increase in peak production; a higher percentage of cows deliver a calf every year; and higher income for village households from sales of animals and milk products.

29. Following a long rest period, pasture condition can be assessed in terms of biomass yield and species composition. Monitoring of pasture rotation can also be done by tracking animal performance via weight gain and milk yield. Growth of calves and lambs from birth weight to weight at weaning (g weight gain per day) is a sensitive measure of feed quality and quantity.

30. The extensive area of improved pasture and grazing land (500,000 ha) to be achieved by CS-FOR project implementation is amenable to monitoring and evaluation using the project's preferred method of evidence-based assessment through remote sensing and GIS. Trend in NDVI over time is recorded across landscapes of the target PUUs. Reference areas of ungrazed pasture will permit NDVI trends to be related to on-ground conditions. Several possible reference areas have been identified through second-hand reports, including inaccessible remote summer pastures, but they need to be verified before supporting NDVI calibration.

31. **Establishment of windbreaks and shade-shelter**. In a merging of pasture, livestock and forestry interests, rows or groups of trees in pastures can benefit livestock and increase carbon sequestration. Windbreaks are rows of evergreen trees and shrubs that from a solid wall of foliage perpendicular to the prevailing winds. Windbreaks are best located close to villages where they can significantly reduce cold stress. Shade trees, either solitary or in copses or shelterbelts, should be spread over the pasture, especially on warm south and southwest-facing slopes that receive the greatest sunshine impact. If possible, trees planted for shade or wind protection should have economic value, producing fruits or nuts, for example, or providing habitat for birds and other wildlife. These tree plantings can relieve livestock from the worst cold and heat stress and improve animal health, but there is also potential income from tree products and from attracting tourists to watch birds or enjoy the scenery of a tree-blessed pasture.

32. Trees will need protection for at least the first 5 years after planting. Both careful herding and fences can provide protection from livestock. Successful planting of windbreaks and shade trees will require a substantial long-term commitment from the village population, including fence maintenance and monitoring. Finding a reliable source of tree seedlings is a problem due to a national deficiency of tree nurseries. However, the CS-FOR project could help establish nurseries to serve windbreak and shade tree requirements as well as afforestation/reforestation efforts. Apart from fence maintenance, the main risk to windbreak and shade-shelter investments is that the fence will be taken down too soon, exposing young trees to livestock before they are tall enough to survive livestock impacts. Custodial care of tree plantings will reap rewards in the long run.

33. **Climate-change friendly improvements to livestock production**. Livestock are responsible for methane (CH_4) emissions that have 34 times the GHG potency of CO_2 (IPCC 2014). Several strategies can reduce methane emissions from village herds. (1) Methane is emitted whether or not an animal is productive. Unproductive livestock such as surplus males should be culled, fattened and sold, along with cows that fail to produce a healthy calf every year. A smaller herd produces less methane. (2) Poor-producing animals should be replaced with more productive breeds in aggressive selection of current herds or a crossbreeding programme, using AI if necessary, to achieve better weight gain and higher milk yields per head. If individuals produce more livestock products, herd numbers can be safely reduced without lowering household income. Higher productivity demands a higher plane of nutrition, which is the general result of the pasture rotation form of grazing management. Fewer livestock will ease the grazing pressure on pastures. (3) Manure accumulation on the floor of winter housing is a prime source of

methane gas through anaerobic decomposition. Better manure management involves improved ventilation of the barn and removing manure to spread on vegetable and fodder-crop fields. The urea in urine produces ammonia gas that makes a barn environment unhealthy to livestock. Here again, better ventilation is the answer. (4) Reduce dependency on conventional livestock by diversification into alternative enterprises, such as yak farming, milking-goat production, poultry and turkey farming, and bee keeping for honey. In addition, CS-FOR should consider introducing appropriate technology for biogas capture and management at the farm scale, or constructing large-scale biogas plants that utilize manure from a sector of the community to make methane fuel that is burnt for heating or cooking or to drive machinery. The products of methane combustion are carbon dioxide and water.

34. **Broadcasting seeds of forage species to improve pasture.** The Kyrgyz Livestock and Pastures Research Institute has an on-going programme of pasture improvement on lands that can be lightly cultivated with harrows, i.e., relatively flat or gently sloping land. On land too steep for cultivation, seed can be broadcast into natural undisturbed pasture vegetation. Seed broadcast is carried out in late October/November with additional harrowing to "sow" seed, and on natural pasture to allow winter rains and snow to settle the seed down to the soil surface where germination occurs. Seed of palatable native perennial grasses can be collected by hand from protected sites, as practiced by KLPRI, or from rested units in a pasture rotation.

35. Kyrgyzstan has many forage grass species suited to broadcast seeding, including smooth brome (*Bromus inermis*), cocksfoot (*Dactylis glomerata*), bulbous barley (*Hordeum bulbosum*) and volga fescue (*Festuca valesiaca*). The naturalized forage legumes sainfoin (*Onobrychis viciifolia*) and lucerne (*Medicago sativa*) are also candidates for broadcast seeding. Among forage shrubs, the native *Artemisia terrae-albae*, *Krascheninnikovia ceratoides* and *Bassia prostrata* have been broadcast successfully in other Central Asian countries. The success rate of broadcast seeding into existing vegetation can be quite low, but if only 1 or 2 plants are established per m^2 that may be a sufficient starting point to ensure that the species survives and spreads in the plant community. Under intensive rotational grazing, palatable perennial grasses have a competitive advantage in re-growth capacity after defoliation over less palatable and weedy species.

INTRODUCTION

36. The historic background of the Kyrgyz people is a nomadic and semi-nomadic pastoral existence, with regular movements of cattle and small ruminant flocks according to season and pasture conditions. The annual cycle of migrations was governed by the decisions of elders who inspected grazing areas ahead of herd movements and managed livestock to prevent either too-early or too-intensive grazing. The traditional management sought to preserve the integrity of plant resources used for pasture and medicinal purposes, as well as maintaining supplies of food supplements and forest products.

37. Traditional seasonal migrations were not random; they were strictly organized along vertical gradients. Portions of pastureland (and subsequently plots on arable land) were assigned to ayil family groups. The annual cycle of migration followed a seasonal progression: winter pastures (kishtoo), spring (jazdoo), summer (jailoo), and autumn (kuzdoo) pastures. At the lowest elevation the vegetation consisted of drought-resistant grasses and shrubs that could tolerate the long hot summers. At higher elevations were mountain meadows, and above this level were alpine and subalpine meadows and forests. Kyrgyzstan's vast plant species diversity of 3,500 species allowed shifts in species composition according to the prevailing climate conditions (wetter or drier) and adaptations to grazing intensity. In these dynamic ecosystem responses, sharp fluctuations in climate from year to year did not change the overall pasture productivity.

38. During the Soviet era, livestock were owned and managed by the state. Many animals were kept in feedlots and fattened for local markets and export to the Soviet Union. The remainder grazed natural pastures under a strict system. Pastures were divided into 4 segments, one of which was rested from livestock for an entire year, and the rest phase was rotated around the other 3 pasture segments. Older

Kyrgyz people have expressed nostalgia for the Soviet system because it maintained pastures in good condition and prevented overgrazing. However, in recent decades since independence from the Soviet bloc, livestock farms were privatized and livestock numbers increased. Grazing management failed to adjust to the new circumstances and large areas became overgrazed and degraded. Irrational and off-season use of pastures, combined with massive cutting of trees and shrubs, led to the local degradation of pastures particularly around the villages, while the distant pastures were underused and overgrown with unpalatable weeds that are unsuitable for livestock feed. Along with degeneration of strict pasture management, the transition from Soviet control to Kyrgyz independence saw a crumbling of infrastructure and decay in social services, especially for rural populations, aggravating food insecurity and rural poverty.

39. Essential features of land degradation are: 1) the composition and structure of vegetation are depleted; 2) plant community diversity is diminished; 3) erosion increases and soil quality and depth are reduced. These changes are associated with decline in plant production and forage availability, all of which threaten the ability of ecosystems to function properly and limit the ability of natural vegetation to adjust to climate change. Risks to environmental integrity and household viability escalate. Livestock play a critical role in protecting communities against the negative effects of contingencies such as crop failure and unforeseen financial crises. The problem of pasture degradation is one of the more important environmental problems throughout Central Asia and the Caucasus, and is closely linked to the social and economic well-being of the population. Pastures serve as a strategic resource for economic development in pastoral areas and the basis for food and environmental security in rural villages.

40. Increasing pasture productivity through improved pasture management, along the lines recommended in this Working Paper, will allow farmers and livestock producers to increase the profitability and sustainability of their enterprises and thereby combat poverty and social hardship. That in turn will contribute to the general welfare of the people of Kyrgyzstan, ensure a sufficient level of food security for the state and preserve the ecological integrity of pasture ecosystems.

41. The main thesis of the CS-FOR project is that sustainable development of the local community through the introduction of new approaches to land and livestock management will mitigate the risks arising from climate change. The project will expand our knowledge of the causes of overgrazing and pasture degradation, identify appropriate indicators for evaluating the state of vegetation and soil cover, and demonstrate the possibility of mitigating degradation. A possible barrier to project implementation may be a lack of understanding of grazing management by local authorities and community members. The project will need to raise awareness of the risks associated with climate change, and of the project's strategies to overcome those risks.

COUNTRY CONTEXT

42. Kyrgyzstan is a mountainous country where the main component of agriculture is livestock husbandry based on feed from natural pastures. Pastures and the livestock that depend on them are the principal resource providing livelihoods for at least 60% of the Kyrgyz population and up to 90% of people living in rural villages. Traditions of the Kyrgyz people favour a livestock-centered lifestyle. The importance of pastures and grazing livestock to Kyrgyzstan is dictated by the geography of the country. High mountains dominate the landscape and arable land comprises only about 11% of agricultural land. The majority of rural villages are located in valleys and on flat and undulating land suitable for farming.

43. Kyrgyzstan has a continental Mediterranean climate with drier summers and wet winters and springs. Most of the rain falls from March to June, making the spring growing season relatively reliable for both pastures and crops. Recent years have exhibited higher than average annual rainfall, which is consistent with climate change predictions for Central Asia. By 2023 if not before, however, average annual rainfall will start to drop and precipitation become more erratic and occasionally severe, with storms driving potentially intense erosion events. The number of floods, mudflows and landslides has significantly increased over the past decade. A warming trend that has already started will continue and glacier melting is predicted to accelerate, feeding streams and rivers with higher water loads. Water

quality deteriorates due to increased sedimentation in water-courses. For rural villages, monitoring glaciers in Kyrgyzstan's mountains is a better guide to climate change than tracking rainfall, at least over the next 5-7 years. After that, conditions are likely to shift towards a lower precipitation regime, making crop harvests uncertain and livestock production from pastures more risky.

44. Pastures of Kyrgyzstan lie between 600 and 4000 m above sea level over a distance of several tens of km. Regular changes in vegetation reflect elevation zones. In the lowest vegetation belt are relatively drought-resistant grass and shrub communities: deserts, semi-deserts and steppes. In the mid-elevation belt, with a more favorable precipitation regime, the vegetation consists mainly of mountain meadows, steppes and sparse savannas. At the highest elevations (2600-4000 m above sea level) are alpine and subalpine meadows occupying almost 4.1 million hectares, of which 1.9 million hectares lie above 3000 m. Forests occur at the higher elevations. The vegetation ecosystems have a complex compositional structure containing groups of species with different ecological requirements. In cold and wet years moisture-loving species predominate and in dry and warm years the vegetation is dominated by species tolerant of dry conditions. Thus, sharp climatic fluctuations do not cause major shifts in overall pasture productivity. But this equilibrium in forage production is possible only if the pastures retain their natural species diversity and structure. If they are degraded as a result of overgrazing they cannot react to different climate scenarios of wet and dry years.

45. The State Register Committee and Kyrgyz Giprozem report that 70% of all pastures near villages are degraded, with figures of 50% and 30% for middle and remote pastures, respectively. Degradation causes not only a steady decline in productivity but in species diversity as well, often with increase in invasive weeds, and therefore a decline if ecosystem resilience to climate change. Riverine plains and riparian zones have suffered from excessive agricultural activity. Riparian zones are ecological disaster areas that require collaborative community interventions to achieve rehabilitation. They should receive special attention in the ecosystem-based approach planned for CS-FOR.

46. Herders still follow a pattern of migration to seasonal pastures, but the benefits of this seasonal rotation have been steadily declining. Deterioration of road and bridge infrastructure limits access to distant summer pastures that tend to be underutilized. On the other hand, grazing pressure on pastures close to villages has increased.

47. Pasture use is under different regulatory frameworks and institutional responsibilities. The majority of 9.03 million ha of pasturelands (76%) lie in the State Land Fund (SLF) under the jurisdiction of the Ministry of Agriculture, Food Industry and Melioration. An additional 14% of pasturelands are in the State Forest Fund (SFF) administered by the State Agency for Environment and Forests (SAEPF). Grazing lands in forestland are 34% of total SFF area, and have higher economic importance. [Forestry contributes only 0.05% to GDP.] They are under local control of Forestry Enterprises (Leskhozes) but utilized by people living in villages outside the SFF lands who receive a ticket for grazing rights. No mechanisms have been developed for pasture management within Leskhozes, nor for integration of management of PUU pastures and Leskhoz grazing lands.

48. Lack of a management plan with pasture monitoring and carrying capacity assessment means that SFF grazing areas tend to be overstocked and overgrazed. Overgrazing causes degradation in composition of the pasture with unpalatable species increasing, soil erosion and destruction of tree seedlings, in both natural regeneration areas and tree plantations. Neglect of grazing management counteracts efforts by the SAEPF to establish, expand and preserve healthy forests. As livestock numbers in villages near SFF lands increase, the problem of overgrazing and damage to forest resources also increases. In addition to livestock grazing, these villages harvest SFF forests for fuelwood, construction timber and medicinal plants, often through illegal activities on SFF lands.

Target Districts

49. Outside the two main cities of Bishkek and Osh, Kyrgyzstan is divided into 7 regions, of which 3 contain Districts that have been singled out for the CS-FOR project. Four Districts selected for the target

area are Ak-Talaa in Naryn region, Uzgen in Osh region, and Suzak and Toguz-Toro both in Jalalabad region. They are adjacent to one another, located in an area of Kyrgyzstan that exhibits a confluence of hazardous zones comprising mudslides in heavy spring rains, spring flooding along river-plains and flash floods from spring-summer run-off, and summer heat stress. Osh & Jalalabad regions are particularly prone to natural environmental disasters.

50. The target areas lie in the Naryn River watershed, so climate change melioration activities in this target area will have extended impacts downstream covering a much larger area and population.

51. An analysis of each of the four Districts in terms of area, principal town, number of villages, and urban and rural populations, is presented in Table 1. The population data have been drawn from the 2009 population census. [The CS-FOR Concept Note uses a different characterization of rural communities that includes Leskhozes in forestlands along with individual villages.] Populations have undoubtedly grown since 2009, but the relative proportions are probably similar.

52. Uzgen District in Osh region and Suzak District in Jalalabad are the largest in terms of total population with Uzgen town being the largest District capital at nearly 50,000 people. The populations of capital towns in the other three target Districts are around 10,000. Villages in all four Districts are fairly small with average populations ranging from around 1,000 to 1,800 people. Altogether the rural population is 85% of the four-District total population. The large population of Uzgen, the sixth largest city in the country, inflates the relative size of the urban population in the target Districts, which is 10% of the total for the country as a whole.

53. The four Districts are of substantially different sizes, ranging from 3069 km^2 for Suzak to twice that area for Ak-Talaa (7266 km^2). Pasture area follows a similar pattern with the smallest area of pasture in Suzak District (1290 km^2) and almost three times that area of pasture in Ak-Talaa (3508 km^2).

Table 1: Characterization of the four target Districts, with population data based on the 2009 census.

REGION	District	Area km^2	Total pasture area (km^2)	District population	Main Town	Main town population (2009)	Number of villages	Rural population (2009)	Population per village
Naryn	Ak-Talaa	7266	3508	30,643	Baetov	8,354	19	22,289	1173
Osh	Uzgen	3308	1533	228,114	Uzgen	49,410	99	178,704	1805
Jalalabad	Suzak	3069	1290	241,198	Kok-Zhangak	10,451	129	230,747	1789
Jalalabad	Toguz-Toro	3816	1945	22,136	Kazar-man	9,486	12	12,650	1054

54. Urban centres embrace a variety of enterprises and government business, but in small rural villages household incomes derive mainly from livestock and livestock products; 90% of rural households keep animals. Livestock are not only a source of income but also serve an important subsistence role supporting household viability.

55. The CS-FOR project will focus on natural resources and livestock management of small villages. Most villages have formed Pasture Users' Unions (PUUs) for collective management of community pastures. Unfortunately there is no comparable community organization for local management of grazing resources in SFF land.

56. Details of pastures in the three regions are given in Table 2. The area of pastures in Naryn, Osh and Jalalabad regions (5,716,000 ha) amounts to 62% of the total for Kyrgyzstan. Of this total, half the pasture area occurs in remote summer pastures. Winter pastures close to villages are only 20% of the total, but they receive the heaviest use. Winter pastures in Osh region comprise only 81,000 ha but, like

other winter pastures, they have relatively low productivity. Overall production in each region may be calculated in proportion to the seasonal grazing areas, as follows: Naryn, 283.5 kg DW/ha; Jalalabad, 668 kg Dw/ha; and Osh, 534 kg DW/ha. For the three regions, average production is 495 kg DW/ha.

Table 2: Pasture areas and productivities (kg DW/ha) in 3 project regions relative to country data.

Target regions	Area of total pasture (thousand ha)	Area of seasonal pastures (thousand ha)			Productivity (kg/ha)		
		spring-autumn	summer	winter	spring-autumn	summer	winter
Naryn	2795	900	1130	765	280	350	190
Jalalabad	1638	494	852	292	640	790	360
Osh	1283	403	799	81	540	560	250
Total for 3 regions	5716	1797	2781	1138			
Average for 3 regions					487	567	267
Total in the country	**9147***	**2955**	**4129**	**2063**	**390**	**550**	**170**

* Total pasture area of 9147 is 0.45% less than other official figures of 9188 thousand ha (Giprozem).

SECTOR PERFORMANCE

57. Livestock and livestock products are the main source of livelihood for people living in rural village communities. In 2012, the livestock sector represented nearly 50% of gross agricultural output; livestock on natural pastures comprise the bulk of Kyrgyz livestock production. As presented in the Working Paper on Livestock, productivity of livestock is fairly low. Milk yield is a good index of overall productivity, and at 5-6 litres per day it stands at half or less than potential yield from local cows. Many households report that cows often fail to deliver a calf every year, which impacts household milk supplies and family nutrition as well as numbers of young animals available for sale or for replacement females.

58. Poverty levels in rural villages are high, reflecting the poor performance of livestock on which the households depend, and inadequate income for household needs. Ultimately, however, livestock production is directly related to the amounts of available forage and fodder. If livestock productivity is disappointing it is because the performance of the pasture/forage component is poor.

59. Growth in livestock numbers and irrational use of natural grazing resources has led to significant productivity decline. Data collected by the Kyrgyz Livestock and Pasture Research Institute suggest that over the past 10-15 years, the average pasture yield has decreased 2-2.5 times. Relatively low forage yields are shown in Table 2 above. The poorest forage productivity is on winter pastures – 170 kg/ha nationally versus 267 kg/ha for the three target regions. Summer pastures, on the other hand, while occupying the largest pasture area both nationally and in the 3 regions of CS-FOR, have the best productivity levels at both scales.

60. The higher forage productivity of summer pastures is likely a reflection of lower stocking rates due to difficulty of access under poor infrastructure, and the inability of poor households to pay transport and herding costs for remote pastures. Also, access difficulties may cause delay in seasonal summer grazing that allows initial growth to occur without livestock grazing pressure. There is clearly an imbalance in use of seasonal pastures. If more livestock could graze summer pastures it would take some pressure off the spring-autumn pastures.

61. Almost all livestock are kept close to villages on foothill areas, on winter and spring-autumn pastures that experience a stocking rate higher than the pasture can sustain. Lower forage production translates into lower animal production, which provokes a rise in herd numbers to compensate, which in

turn increases pasture degradation in a vicious cycle of declining productivity. As long as individual animal productivity is low, the only production incentive for livestock owners is to increase the number of animals they own.

62. Another factor exacerbating the rise in animal numbers is the poor quality of livestock breeds found in rural villages. They are well adapted to survive under harsh conditions and able to walk long distances, but their productivity is genetically limited. Spring pastures are critical to the overall herd productivity. It is on spring pastures that calves, foals, lambs and kids spend their early months of life, taking milk from their mothers and starting to graze. Spring is also the season when horses conceive.

63. It is necessary to consider that reports of forage yield such as those in Table 2 are based on clipped quadrats in grazed sites. The potential forage yields are much higher. Two examples from southern Kyrgyzstan are illustrated in the photos below.

Photos. The photo on the left shows the fence-line contrast of a half-hectare fenced exclosure in Bazar Korgon (Jalalabad region). The yield of biomass inside the exclosure after one year was reported to be 900 g DW/m^2, or 9 tons DW/ha. The photo on the right is of the small fenced Kara-Tash exclosure in Nookat District of Osh region after one year of protection from livestock. The yield inside the Kara-Tash exclosure is estimated at 3,000 kg DW/ha versus 350 kg DW/ha outside.

64. The natural pastures of Kyrgyzstan have enormous potential to recover from heavy grazing in a short time, even from an overgrazed condition. The Kara-Tash exclosure (right-hand photo above) is within 20m of a drinking water-point for cattle. Incipient erosion channels made by cattle walking to and from water have been eliminated by vegetation growth inside the exclosure, showing that one-year's protection from grazing can control erosion. This is perhaps the greatest natural asset of Kyrgyz pasture ecology, apart from the high native species diversity. Most pastures, however, are in a degraded state to varying degrees. National data indicate that nearly 50% of Kyrgyz pastures can be classified as degraded.

65. After the adoption of the law "On pastures" in 2009, 454 Pasture Users Unions and their executive Pasture Committees were approved for local management of pasture resources. This mechanism creates an advantage over SFF grazing lands that do not yet have a local representative body to manage grazing, timber harvest and forest regeneration. There needs to be policy and regulatory developments in the SAEPF administration to empower local managers and provide SFF management guidelines. Climate change will exacerbate degradation of pastures if the communities fail to become more adaptive in their management strategy. This issue is important for both PUU pastures and SFF grazing lands, but in the case of SFF land the introduction of locally oriented management protocols can incorporate melioration measures as well as methods for improving resilience to climate-change impacts.

SWOT ANALYSIS OF THE SECTOR

<table>
<tr><th>STRENGTHS</th><th>WEAKNESSES</th></tr>
<tr><td>
The 2009 law On Pasture decentralizes pasture management responsibility to Pasture Users' Unions and Pasture Committees at the village level. The PUUs have the authority to develop annual and long-term pasture management plans, issue grazing tickets and collect fees, make improvements to infrastructure, purchase equipment and invest in community welfare.
The national and local governments are motivated to resolve the differences in pasture management for pastures of the State Land Fund and State Forest Fund. Pastures on SFF land lack a regulatory framework for developing pasture management plans, so SFF grazing lands tend to be severely overgrazed.
Pastures occupy around 87% of the entire country, and livestock grazing on natural pastures is the principal source of sustenance and livelihood for the majority of the rural population. This situation creates pressure on the Kyrgyz government to ensure that pastures are managed for sustainable forage production, including protocols to mitigate the adverse effects of climate change.
Kyrgyzstan has a rich and diverse flora, including many native pasture species of high quality. Plant communities in pastures can shift species composition in response to changing climate without losing productivity, provided that species diversity is maintained.
Kyrgyzstan has developed protocols for monitoring pasture condition to assist PUUs in estimating carrying capacity and specifying stocking rates in pasture management plans.
Methods for intensive pasture rotation have been developed and tested in Tajikistan, in environments similar to Kyrgyzstan's. Adopting intensive pasture rotation can increase pasture growth, forage and livestock production, reduce erosion and increase carbon sequestration.
Breed-improvement potential for cattle and small ruminants can increase productivity per head of livestock and allow reductions in stocking rate to achieve the same level of household income.
Livestock and Market Development Project (LMDP) is active in 5 regions of Kyrgyzstan, including the 3 regions targeted by the CS-FOR project. LMDP assists PUUs in business management, pasture management plans and training.
</td><td>
Rural communities underestimate the threats to pastures and livestock caused by climate change. Short-term (3-5 years) predictions indicate that climate change in Kyrgyzstan could drive an increase in precipitation.
Management plans for SFF grazing lands have been neglected. The goal of integrated pasture management for both SLF pasture and SFF adjacent grazing land has not yet been realized.
Social pressures favour the status quo, with community resistance to change in pasture and livestock management, and to development of community participation for regulation of pasture use.
Traditional pasture management practices remain embedded in herder grazing strategies, reinforcing continuous use of entire seasonal pastures and preventing carbon-friendly grazing management.
The trend towards degradation of pastures continues without appropriate management interventions driving rehabilitation.
Access to remote summer pastures is still impeded by poor and damaged infrastructure, leaving distant pastures underutilized and pastures close to villages overgrazed.
Animals remain in enclosed barns during winter without adequate ventilation, where build-up of manure increases levels of unhealthy ammonia and raises anaerobic methane gas production.
A natural reluctance to change livestock breeds and improve pasture management practices means that animal productivity per head remains low, with many mature cows failing to deliver a calf every year. All livestock contribute to Green-House Gas (GHG) emissions, whether they are productive or not.
Poor animal health services. [See Working Paper on livestock.]
Shortage of qualified extension personnel to advise rural communities (PUUs and Leskhozes) on better pasture management and procedures to minimize the impacts of climate change.
Inadequate instruction on pasture management and grazing strategies at Kyrgyz National Agrarian University.
Insufficient staff and poor resources for pasture and grazing research at Kyrgyz Livestock and Pasture Research Institute.
</td></tr>
<tr><th>OPPORTUNITIES</th><th>THREATS</th></tr>
<tr><td>
Due to the inherent ecological properties and floristic resources of Kyrgyz pastures, there is potential for rapid rehabilitation of degraded areas under improved grazing management.
</td><td>
Inertia in Ayil Okmotu and PUU leadership towards adoption of change to management practices.
Failure of the State Agency for Environment
</td></tr>
</table>

• Selected pasture areas can be improved by broadcasting seed of nutritious and palatable native species of grasses and legumes. This practice has been piloted already by the Livestock and Pasture Research Institute and within the framework of the GEF-FAO project "Sustainable Management of Mountainous Forest and Land Resources Under Climate Change Conditions". • Selective breeding can produce grazing-tolerant varieties of native forage species for pasture improvement projects. In this regard, the creation of a national seed fund for high-quality grasses for grazing should play a key role. • Specialized seed multiplication farms and dedicated 1-ha seed-increase plots in PUUs would increase availability of seed from locally adapted pasture species. A high volume of seed is necessary to make extensive seed broadcasting by hand or mechanical means a viable economic option. • Pastures on SLF and SFF lands used by livestock from the same village can be managed as an integrated ecosystem when the State Agency for Environment Protection and Forestry has developed appropriate protocols. • Access to remote summer pastures is improved through repair and maintenance of infrastructure like roads and bridges. • Trees planted in rows and copses on grazing land can provide shade and protection from cold winter winds, enhancing livestock production and carbon sequestration. • Transport, storage and marketing of livestock products, including wool, can be improved through targeted investment. This could increase household incomes in rural villages. • Intensive pasture rotation adopted as the standard grazing management model on communal pastures will reduce erosion and mudslides as well as increase productivity and carbon sequestration. • Higher forage production under intensive pasture rotation on communal pastures will reduce the need for livestock grazing on SFF grazing lands. • Rest periods in a pasture rotation sequence create more natural hay resources that can be harvested for winterfeed. Hay-based fodder from natural pastures has a smaller carbon footprint than concentrate feeds. If nutritionally necessary, grass hay can be mixed with grains and concentrates. • Raising productivity per ha of fodder crops, using high-yielding varieties, will avoid expansion of cropland at the expense of pastureland whose cultivation would release large amounts of carbon into the atmosphere. • Better performing livestock breeds such as Ghissar sheep are available to increase productivity per head to offset a reduction in herd size. Bigger animals produce less methane	Protection and Forestry to develop an integrated Community Management Plan for pastures in both SFF and SLF lands. An integrated ecosystem approach is necessary to prevent overgrazing and degradation of SFF grazing lands. • With or without an integrated pasture management plan, conflict occurs between PUUs and Leskhozes regarding pasture management. • Livestock numbers continue to rise without adequate adjustment to provide sufficient forage and fodder supplies, leading to low productivity and overgrazing. • Lack of water-point development in remote pastures frustrates implementation of improved grazing management. Long distances to walk to water increase GHG emissions per kg of livestock product. • Greater climate variation in the form of longer and/or more severe winters, droughts, and more severe summer storms: 1) reduces livestock production and increases disease and mortality; 2) magnifies overgrazing; and 3) increases erosion and mudslides. • Pasture areas are converted to cultivated land, causing a significant loss of stored carbon. • Pastures are fertilized with Nitrogenous chemicals that increase release of nitrous oxide into the atmosphere. Nitrous oxide (N_2O) is a GHG 300 times more potent in causing global warming than CO_2. • Failure to improve winter housing of livestock to increase ventilation, and failure to remove excess manure, causing a sustained release of methane and ammonia. • Lack of commitment to training in pasture management and developing a cadre of Kyrgyz technical experts and extension specialists in grazing ecology and grazing management. • Inadequate resources for community-scale research in pasture ecology and grazing management, with an emphasis on problem solving.

per kg of product. • With better nutrition, especially when combined with breed improvement, peak milk yields of cows can rise from 5-6 liters/day to 12-15 liters/day. • Kyrgyzstan is typical of most developing countries that are experiencing an increasing domestic demand for animal products. • The number of livestock in village herds can be reduced without lowering herd productivity by culling unproductive animals, using animal health measures, and managing for a calf every year. • Artificial Insemination (AI) centres can be established, equipped and staffed with trained personnel to facilitate genetic improvement for higher animal productivity. • Analysis of remotely sensed images and use of Geographic Information Systems (GIS) can improve monitoring of pastures at both village and District levels. National and International sources and expertise can be drawn upon. • The introduction of an ecosystem-based integrated forest management planning approach will reconcile forestry management with livestock grazing.	

STATE SUPPORT FOR THE PASTURE SECTOR

66. The Law “On Pasture” dated 26 January 2009 established the legal authority for livestock-owning households in a village to create a cooperative Pasture Users Union (PUU) representing all village households. The PUU manages communal pastures in terms of stocking rates and periods of use, and issues seasonal pasture “tickets” to livestock-owning households. The PUU can collect grazing fees, operate bank accounts, receive benefits from donor-supported projects and acquire assets such as agricultural machinery and veterinary clinics. A PUU has the right to lease equipment and clinic facilities to members and put together a budget for PUU expenditures that must be approved by the membership, for items that will benefit the community as a whole.

67. An earlier law on “Flora Protection and Use” (2001) requires people who use pastures and hayfields to protect the flora from degradation. Despite its admirable intent, Kyrgyzstan has limited resources to enforce the provisions of this law.

68. All pastureland belongs to the State of the Republic of Kyrgyzstan in the State Land Fund (SLF). The Ministry of Agriculture, Food Industry and Melioration (Ministry of Agriculture, MoA) has over-riding responsibility for the production of pasture forage and livestock. Through its departments and agencies it sets policy, regulations and guidelines for pastureland use. Pasture management *per se* is transferred to Local Self-Governing Bodies (Ayil Okmotus) that in turn delegate management responsibility to local PUUs and their Pasture Committees. In practice, the Pasture Committee and Aiyl Okmotu work closely together.

69. On-ground activities to implement MoA guidelines are in the hands of the parastatal group ARIS, which delivers agricultural extension through Regional and District officers and technical specialists spread throughout the country. Through ARIS, Pasture Users Unions and their executive bodies (Pasture Committees) receive advice on organization, administration and business management of their affairs. In

general, however, there is a shortage of qualified technical staff to carry out the important functions of supervision and monitoring of pasture management to prevent land degradation and promote sustainable exploitation of pasture and livestock resources. Educational entities need to be boosted to satisfy this need for technical expertise.

70. Agricultural training is provided in agricultural lyceums, technical schools and universities. The key institution is Kyrgyz National Agrarian University (KNAU), which also exercises oversight of the Kyrgyz Livestock and Pasture Research Institute (KLPRI). The University offers training in agronomy, forestry, animal husbandry, veterinary medicine, water conservation, agricultural economics and accounting. Pasture management is a minor component of the KNAU curriculum and receives somewhat superficial treatment. The KLPRI has a relatively small research budget and limited resources for extension of research results into the rural production environment. It is complemented by CAMP Alatoo, an NGO that carries out pasture research and socio-economic surveys and receives support from donor organizations as well as the Kyrgyz government. Training exercises for pasture users on sustainable pasture management in the field are also carried out by particular FAO projects.

71. In addition to SLF pasturelands, there are more than 1 million hectares of grazing lands occurring within designated forest boundaries and that lie under the jurisdiction of the State Agency for Environment Protection and Forestry (SAEPF), which is outside the MoA. These grazing lands assigned to the forestry sector (State Forest Fund or SFF land) are used for livestock grazing by households in nearby villages through “tickets” issued by SAEPF specifying livestock numbers or grazing area, grazing period and location. Unlike the communal pastures managed by PUUs, however, they do not fall under the law “On Pastures”. They are governed by terms of reference for the SAEPF, not the MoA.

72. Fees generated from the tickets provide revenue direct to the SAEPF in Bishkek. In contrast, tickets issued to graze pastures managed by the PUU generate direct revenue for the PUU that can be expended on community development projects. In its current form, the SAEPF contains no provision for sustainable management of grazing resources on SFF land, nor provides grazing management guidelines or infrastructure investments to ease to access to SFF lands and develop water-points.

73. In an effort to coordinate activities on SLF and SFF pastures, the MoA and the SAEPF signed an Agreement on 11 April 2013 to promote rational use of pasturelands from both jurisdictions that effectively comprise one livestock production ecosystem. This Agreement has not yet been effectively implemented.

PAST AND CURRENT PASTURE DEVELOPMENT PROJECTS AND PROGRAMMES

74. The core development programme focusing exclusively on pasture and livestock management on SLF pastures is the Livestock and Market Development Programme (LMDP) funded by the International Fund for Agricultural Development (IFAD). This programme has been implemented in two phases: LMDP I in Issyk-Kul and Naryn regions, 2012-2017, and LMDP II in Batken, Jalalabad and Osh regions in 2013-2019. The project aims to improve pasture management, livestock productivity and village prosperity in the context of resilience to adverse climate effects and adaptation to climate change trends. Improvement in animal health services and enterprise diversification are additional components of the programme. LMDP utilizes the framework of PUUs and their authority under the law “On Pasture” to achieve community-based pasture management through participatory community planning.

75. A closely related project addresses principally the needs of Chui and Talas regions, with ramifications for other parts of Kyrgyzstan. The Pasture and Livestock Management Improvement Project (PLMIP), 2014-2019, funded by the World Bank, aims to improve community-based livestock management and pasture governance, with an emphasis on strengthening the technical capacity of pasture management advisors and Pasture Committees. PLMIP supports the Agricultural Projects Implementation Unit (APIU) within the MoA.

76. Prior to these two projects, the World Bank, IFAD and the Swiss agency for Development and Cooperation (SDC) supported the Agricultural Investments and Services Project (AISP), 2008-2013, within the MoA. A primary aim was to improve the institutional environment for livestock producers, plus a programme of livestock disease melioration for both animal and human health. The law “On Pasture” was enacted as this project was beginning, so under AISP 475 PUUs were created in rural communities across the country.

77. At around the same time (2007-2012), the Global Environment Facility (GEF) and UNDP launched the Sustainable Mountain Pastures Management Project for the MoA in Suusamyr Valley, Naryn region. The general objective was to combat overgrazing through cost-effective pasture management practices.

78. Two current SAEPF projects that have a pasture-management component are specifically concerned with Districts embraced by the proposed GCF project.

- The Sustainable Management of Mountainous Forest and Land Resources Under Climate Change Conditions, with GEF and FAO support, 2014-2018, aims to improve sustainable management and productivity of silvo-agro-pastoral ecosystems in 5 Kyrgyz regions. Among the areas of focus are Ak-Talaa Leskhoz in Naryn region and Kara-Alma Leskhoz in Jalalabad region.
- In Toktogul and Toguz-Toro Districts, GEF and UNDP have a joint project with SAEPF (2017-2021) on landscape conservation and management, with an emphasis on conservation of biodiversity and sustainable use of forest and pasture resources. The project has the long title: Conservation of Globally Important Biodiversity and Associated Land and Forest Resources of Western Tian Shan Forest Mountain Ecosystems to Support Sustainable Livelihoods.

79. In the Jalalabad region, the SAEPF is implementing a project funded by GIZ (German Ministry for Economic Cooperation and Development), 2014-2018, on Biodiversity Conservation and Poverty Reduction Through Community-Based Management of Walnut Forests and Pastures in Southern Kyrgyzstan. The strategy to achieve sustainable forest and pasture management is to work with PUUs, forest enterprises, Local Self-Governing Bodies, Leskhozes and state agencies, for mutual goals and better livelihoods for the local populations. Climate change will be addressed by planting trees resistant to anticipated adverse impacts of climate change, such as walnut and certain fruit trees.

80. Finally, a GIZ project covering Kyrgyzstan, Kazakhstan and Tajikistan (2015-2019) plans to introduce Ecosystem-Based Adaptation to Climate Change in High Mountainous Regions of Central Asia. The concept is that people will continue to use natural resources, including pastures, to improve their livelihoods without harming the environment within a climate-change scenario.

LESSONS LEARNED AND GOOD PRACTICES

81. Traditional livestock management that has its roots in centuries of Kyrgyz herders moving their animals on established seasonal routes still governs the approach to livestock management today. At the local pasture level, cattle and small ruminants usually spend seasonal grazing time in the same area every year. To change these traditions and introduce an intensive pasture rotation within seasonal pastures will require an incentive scheme, training and capacity building at the PUU and PC level.

82. In its thrust to enhance carbon sequestration potential through direct investment in afforestation, reforestation and pasture rehabilitation, the CS-FOR project is equipped to drive changes in management of community and forestland pastures through a programme of technical assistance and strategic incentives. An illustrative incentive is for the project to pay the grazing fees on behalf of PUUs who agree to change their grazing management practices under project guidance. In Tajikistan, PUUs were financed by the IFAD-funded project (LMDP) for their top funding priority and then were required to adopt and implement pasture rotation before receiving additional tranches of investment.

83. In the past 8 years since passage of the law On Pasture, Kyrgyzstan has decentralized pasture management to Local Self-Governing Bodies that have in turn delegated pasture management to Pasture Users Unions and their Executives, the Pasture Committees. This process has transformed pasture management from a state of relative chaos following national independence into an organized system. The Pasture Committees can make annual and long-term grazing plans, issue grazing tickets, collect fees, operate bank accounts, receive support from the Kyrgyz government and national NGOs and international donors, purchase equipment, repair infrastructure, and do all this with transparency and accountability to the community. The PUU/PC system is the framework for improving management practices according to principles of adaptation to climate change.

84. Management of grazing lands in the State Forest Fund (SFF) is handicapped by a lack of regulations governing livestock use and grazing management. The current level of oversight on SFF grazing lands by the responsible agency, State Agency for Environment Protection and Forests (SAEPF), is limited to collecting grazing fees. The result of managerial neglect is overgrazing of SFF land and livestock predation on seedlings of tree plantations and on shoots and young plants in areas of forest regeneration. SAEPF has not invested in infrastructure like roads and bridges to facilitate access to SFF grazing lands, nor in water-point development to improve animal distribution.

85. Whereas most of the income from grazing tickets issued by the PUU is spent locally to help the community, income from SFF grazing tickets goes to the SAEPF office in Bishkek, from where some is redistributed to Leskhozes. The CS-FOR project has an opportunity to encourage and guide good pasture management practices on SFF land. The operation of PUUs and PCs for managing SLF pastures is a good model to establish local control over SFF grazing lands, perhaps by giving authority to a joint Leskhoz/PUU oversight committee.

86. Poor infrastructure occurs on community pastures as well, though not as bad as on SFF land. Infrastructure has deteriorated since independence. Many PUUs are working to fix roads and bridges to improve access to remote summer pastures. At present, however, there is an imbalance in seasonal grazing pressure. Due to access problems, summer pastures tend to be underutilized which forces heavier grazing pressure onto spring-autumn pastures at lower elevation, and particularly heavy use of winter pastures close to the village. Overgrazed and degraded winter pastures are the highest priority for rehabilitation.

87. The situation has been exacerbated since independence in 1991. In the Soviet era, livestock numbers were regulated, many livestock were kept in collective farms under feedlot conditions, and the livestock that grazed pastures moved in a fixed pattern that included prescribed summer grazing and a year of rest in one quarter of the pastureland, rotated annually. Animal numbers are no longer restricted, the collective farms have been abandoned, and the pastures are no longer under mandatory regulation. The PUUs and PCs exercise oversight under the law On Pasture, but this has not prevented overgrazing and degradation.

88. Grazing management that employs a pasture rotation protocol allows spring growth to approach potential productivity, which in turn increases biomass accumulation above- and belowground and raises carbon sequestration. Contrary to intuition and common opinion, carbon stores are preserved or increase under sound grazing management, according to numerous research studies. After the ecological integrity of a pasture ecosystem has been restored, the carbon dynamics reach equilibrium between carbon export via livestock grazing and carbon sequestration via plant growth. Insofar as leaf removal stimulates buds and shoots in some grasses, grazing enhances carbon capture.

89. In areas of Tajikistan analogous to the target Districts of CS-FOR, rotational grazing has been introduced to 203 PUUs for the past 3 years with promising results. Intensive pasture rotation (described in the Recommendations section below) has been associated with more forage available, bigger animals, higher birth rates, better milk yields, improved livelihoods, and reduced erosion. Efforts are underway to trial intensive pasture rotation in Kyrgyzstan, for example in Toguz-Bulak and Baskoon PUUs in Issyk-Kul region and in 1500 ha of Maady PUU in Kara-Suu Rayon, but there is inertia in the traditional Kyrgyz system of pasture use. The CS-FOR project will attempt to find incentives to challenge current

management practices because we know that pasture rotation can increase carbon sequestration and mitigate the adverse effects of climate change.

90. As PUUs adopt intensive pasture rotation, there needs to be a strong M&E programme to assess innovative management and provide feedback to PUU and project leadership so that appropriate adjustments can be made. In spite of the assurance of profitable outcomes from pasture rotation, initial implementation is likely to be a trial and error process; excessive grazing pressure in early spring is a particular risk. It will require coordination and commitment on the part of everyone involved: the PUU and Pasture Committee, the herders, the small-holder households contributing livestock to grazing herds, and the representatives of donor organizations and NGOs. It is also necessary to provide relevant training for PUU and PC members so that they understand the reasons for adopting new methods of pasture management and are not just following a prescription.

91. Monitoring of pasture condition using remotely sensed satellite images and Geographic Information Systems has not yet been adopted in Kyrgyzstan, despite exploratory efforts. Research and trials are needed to arrive at a practical and cost-effective method of RS/GIS monitoring that is useful at different scales: regional, district and village pastures.

92. One of the limitations that changes in grazing management will face is a lack of technical capacity in the village and a shortage of specialist advice and extension service. Capacity building is required not only for MoA and NGO staff, but also in educational and research institutions. Dissemination of technical advice and research results to government agencies and PUUs/PCs needs to be improved. Extension services need to be strengthened with trained personnel, helpful bulletins in print and online materials.

93. Mutual exchanges of knowledge and experiences between PUUs should be supported. A maxim of innovation efforts worldwide is that adopters need to be part of a supportive peer community with which they can share experiences, receive advice and participate in a mutually sustaining dialogue. In Kyrgyzstan, one simple step in this direction is to arrange for exchange visits among different PUUs to build confidence and learn from one another.

94. Research on grazing management needs to be at the scale of community pastures. An important lesson from rangeland grazing research in the United States is that the results from grazing trials conducted in small paddocks on research stations are misleading. They fail to accommodate the effects of livestock distribution at a landscape scale, where animal movement is a critical component. For example, commercial producers consistently report that rotational grazing increases forage production and carrying capacity, but the majority of US research trials have found no benefit to pasture rotation.[i]

95. Private-public partnerships in agricultural enterprises can expand the scope of donor-funded or government-supported programmes and increase the likelihood of sustainability of development activities. The CS-FOR project could organize public-private partnerships in the four target Districts with an emphasis on activities that address the issues of climate change adaptation and mitigation.

RECOMMENDATIONS

96. In spite of efforts to expand income diversity, rural communities in Kyrgyzstan do not have any other significant sources of livelihood other than livestock, for income and subsistence. It is necessary, therefore, to find methods of sustainable rural development in the face of climate change that will make the traditional way of existence of the rural population more risky due to shortage of feed. The increasing risks are ecological, social and economic.

97. Issues to be addressed when planning for climate change:

- Rising summer temperatures and greater variation in winter temperatures.
- Greater variation in seasonal precipitation with sharp decreases and increases.
- More intense and infrequent rainstorms.

- Reduced snow cover.
- Danger of breakthrough of glacial lakes.
- Irregular and unpredictable levels of soil moisture.
- Increase in erosion and landslides.
- Changes in composition of native vegetation, especially in mountain regions.

98. An adaptive approach to the use of pasture forage resources will be the introduction of a new pasture management strategy and the replacement of low-productive cattle, sheep and goats with higher-yielding animals that adapt to climate change conditions. Planting trees for windbreaks and shade-shelter combines a pro-forestry approach to better environmental conditions for livestock. Introducing locally adapted forage-grass seeds by broadcasting into existing pastures will accelerate improvement in pasture species composition.

a) New pasture management strategy

99. The new grazing management strategy is designed to raise pasture productivity, preserve a desirable composition of the pasture vegetation, and provide animals with more forage to achieve a higher yield of livestock products. By promoting plant growth, better control over grazing management can substantially increase carbon sequestration. Rotational grazing is the main recommendation for an intervention that will have the most beneficial result in terms of climate change, environment and communities, and cover the target pasture domain of 500,000 ha.

Rationale

100. Current pasture use allows livestock to stay in one area for an entire season; different herds occupy different parts of the pasture so that the entire pasture is grazed all the time. The result is that by the end of a grazing season the pasture is evenly overgrazed. Increases in livestock numbers aggravate the negative impacts of this approach to pasture use, and yet as the human population rises villages need more animals to maintain household livelihoods. And as productivity of the pasture resource declines through overgrazing, productivity per head of livestock also declines, driving up the demand for bigger herds. It is a vicious cycle.

101. Even without the effects of climate change on pasture condition and productivity, this method of pasture utilization is unsustainable, promoting weed invasion and erosion. When coupled with climate change, overgrazing can lead to ecological and economic disaster. We need a fundamentally different approach to the way in which pasture resources are currently utilized, one which preserves the ecological longevity of pasturelands and increases their yields while capturing and storing more carbon.

102. A rotation of grazing among small areas of a seasonal pasture can let the pasture grow undisturbed by livestock for most of the season. Only small areas are stocked, and grazed for short periods. Basically, the same total area of the pasture is feeding the same total number of livestock, but the distribution and timing of the livestock-pasture interaction is controlled with careful management. A short grazing period combined with a long period of rest from livestock produces more plant growth and more forage, which has five important consequences.

- Root growth and depth of root penetration into the soil increases, because root growth depends on the amount of green leaves and pasture rotation increases leaf growth. If pastures are kept short under continuous grazing, the stunted leaf biomass cannot supply surplus energy to the root system, and the root biomass shrinks. A bigger root system, on the other hand, explores a larger volume of soil, and access to more soil water storage creates resilience to summer drought and periods of low precipitation brought on by climate change. Ultimately, the size and distribution of the root system drives plant productivity.
- By maximizing the growth of forage during periods of rest from grazing, the amount of leaf litter lying on the soil surface increases, namely, the loose dead leaves and other plant parts. The

exposure of bare ground is reduced, and the litter protects the soil surface from raindrop impact and reduces loss of water through evaporation, and keeps the top layer of soil cooler.

- The increases in both aboveground and belowground plant biomass, as well as litter deposits, enlarge sinks of carbon accumulation, enhancing carbon sequestration.
- Higher vegetative cover exhibited under rotational grazing management, combined with more litter on the ground, create barriers to movement of rain-water and snow-melt across the ground surface. With less dispersion of surface water, more of the rainfall stays where it falls and infiltrates into the soil profile, and there is less erosion from surface water flow. Greater capture of incident rainwater may be the principal benefit of pasture rotation. Enhancing soil water content directly increases plant growth, like an irrigation effect. Soil erosion is a major problem in Kyrgyz pastures, with its worst expression on hill slopes in the form of land slumps and mudslides. As soon as a small channel is initiated on a hillside, water running down the small channel excavates a bigger channel. If ameliorative measures are not introduced immediately, such as protection of the gully head and re-vegetating the catchment area through complete rest from grazing or adopting an intense pasture rotation, the channel grows into an even bigger fissure on the landscape and eventually the hillside collapses. A full year of rest from grazing on an eroding hillside will encourage vegetation growth and allow erosion gullies to start healing.
- Botanical composition of the pasture vegetation improves with more species diversity and strong growth of palatable, nutritious plants.

103. All these effects of rotational grazing are the result of simply allowing the pasture vegetation to grow unmolested by grazing livestock for most of the season. Pasture rotation is designed to maximize pasture growth on a grazed pasture without reducing the number of animals. It solves the problem of overgrazing and stops pasture degradation; pasture condition will improve. [Trying to induce livestock owners to reduce the number of animals to match a calculated carrying capacity is rarely successful. It usually aggravates the smallholder unless he is convinced of higher income as a result, which is unlikely to happen. A negative attitude from PUU members, created by a stock-reduction programme, makes it even harder to persuade them to change their grazing management practices.]

104. Why should we use rotational grazing management? The answer is simple: More forage; more root growth with roots extending deeper into the soil; higher infiltration of rainwater and more water stored in the soil profile; less erosion; more diverse vegetation that includes a variety of perennial forage species; and an increase in carbon sequestration.

Carbon sequestration implications

105. Degraded pastures in Kyrgyzstan have a measured standing forage yield between 0.5 and 1 ton DW/ha. Conservatively, the potential yield of biomass on Kyrgyz pastures is at least 3 tons DW/ha. This figure is less than some recorded amounts in Kyrgyzstan (e.g., 9 tons at Bazar Korgon) but it matches the yield from exclosures in similar environments in Tajikistan, where the 2017 average yield across 37 demonstration exclosures was 3.4 tons DW/ha. If Kyrgyz pastures can be managed so that growth approaches this level while they still provide forage for grazing livestock, as recommended in this section on a new grazing strategy, the contribution to carbon sequestration is substantial.

106. However, if belowground growth is also taken into account, the carbon sequestration potential is magnified. A recent study of 3 perennial grasses in the northern Great Plains of America, including *Bromus inermis* that is also native to Kyrgyzstan, found that root:shoot ratios for 0-120 cm soil depth averaged 2.54. The Great Plains environment experiences very cold winters and hot summers, not unlike the Kyrgyz climate. Soil temperature is important to root:shoot ratios. The ratio increases when soil temperature goes above or below an optimum temperature (defined at maximum shoot production), according to an Australian study of 8 pasture grasses conducted on a research station at 1000 m elevation. The base root:shoot ratio in that study was 2.0.[1] For conservative carbon accounting purposes, the above-ground biomass with a root:shoot ratio of 2:1 can be multiplied by 3 to express the total plant

[1] Northern Great Plains study reported by Sainju et al., 2017, Field Crops Research 210:183-191.
Australian study reported by Davidson, 1969, Annals of Botany 33:561-569.

biomass. The calculated increase in total Kyrgyz pasture biomass (shoots and roots) rises from 1.5 to 3 tons DW/ha in a degraded condition to 9 tons DW/ha when growth approaches the potential.

Detailed description of pasture rotation

107. The following description of pasture rotation identifies a small portion of the pasture that is rested for an entire year in order to speed ecological recovery. The year-long rest is rotated around different segments of the pasture from year to year, gradually extending the benefit of a complete year's rest to the entire area.

108. Pasture rotation takes the current pasture area and the livestock that use that area and simply changes the way in which livestock harvest the pasture forage. Instead of the entire pasture being exposed to grazing animals all the time, livestock access is restricted to small portions grazed by the herd for short periods. After a short grazing period, the herd moves to another small grazing unit. The first grazing unit is allowed to recover and grow freely for the remainder of the season.

109. The *grazing period* is the number of days that livestock are concentrated into a small area of the pasture, the *grazing unit.* The grazing period is quite short (2-3 days) for a unit grazed in early spring. During that short period when the grass is relatively short, the vegetation is mowed down, but then the grazing unit has the remainder of springtime to recover and a tall stand of forage is available by early summer. The grazing period is longer (6-8 days) for a unit first grazed in early summer at the end of the spring growing season. Grazing times increase gradually over the course of the spring growing season. By the end of spring the stand of forage is close to potential production. It can withstand heavy utilization because it will not be grazed again, or only once more before the end of the year.

110. When is it time to move the livestock herd off a grazing unit and on to the next grazing unit? This decision is based on experience and common sense. A patch of pasture can tolerate heavy grazing for a short time if it is allowed to recover for a long time. The pasture manager should not view a heavily grazed patch of pasture or grazing unit in a rotation in the same way he observes a short pasture created by overgrazing. An overgrazed area is the endpoint of a an extended period of livestock impact, during which plant parts are removed, then the remaining leaves re-grow, then they are removed again by the grazing animal. The plant material is progressively diminished and the store of carbon reserves steadily depleted over time.

111. The ideal grazing plan grazes an individual grazing unit only once per year. For pastures used in spring and summer and perhaps early autumn, however, the grazing plan could include two grazing periods per year: once during spring and once during the summer-autumn dormant season. The pasture grazing-year in Kyrgyzstan lasts about 210 days from April to October, although seasonally restricted pastures, such as remote summer pastures, are used for shorter seasonal periods. For a once-a-year grazing, the pasture is grazed for 2-10 days and rested for the remainder of the year. If there are two grazing periods per year, the pasture is grazed for a total of 12-15 days and rested for the remainder of the year. Degradation is unlikely to take place under a grazing regime that provides such long rest and recovery periods.

112. Grazing should be delayed at the beginning of spring so that plants are free to produce shoots and leaves that initiate plant growth. If animals remove shoots and leaves when the environment is still cold, recovery from grazing is slow. A general rule is to delay grazing in spring until 1 April. This date could vary depending on climate and geography. Climate change could move the onset of spring to an earlier start to the grazing season. Choose units for the first spring grazing where growth is more advanced than in other areas of the pasture. However, it is important to avoid grazing the same small area of pasture at the same time every year. The timing of grazing should vary from year to year, as illustrated in the figures below. Units grazed in early spring one year are grazed in late spring the next year. Units grazed in early summer one year are grazed in late summer the next year, and so on.

113. The main risk in timing of a pasture rotation is excessive grazing pressure in early spring when re-growth is slow. Pastures should not be grazed before leaves are > 6 cm tall; 1 April is a useful date for deciding whether a pasture is ready for grazing. The first few grazing periods should be kept short so that

some leaf biomass remains when the animals move to the next grazing unit. Recovery and re-growth rely on the photosynthetic capacity of residual leaves, plus a warm environment favourable to leaf growth. A second risk is leaving animals on a grazing unit for too long. Livestock should not be able to graze the re-growth that occurs in response to an initial defoliation at the beginning of the grazing period. That re-growth is usually more palatable than older leaf material. A safe grazing period during spring is approximately 7 days before the re-growth shoots are long enough to be grazed. By mid-summer, the grazing periods can be safely extended to 10-12 days.

114. A good pasture rotation plan assumes that there is sufficient winter fodder from fodder crops and hayfields to feed livestock in winter housing from late October until 1 April when they go onto pasture. Available technology in crop production can produce perennial, high-yielding and nutritious fodder crops such as sainfoin, lucerne and wheatgrass. A good rotation plan also assumes that livestock can go to farmland in autumn and graze crop residues until late October or even into November. The rotation plan on grazed pasture is part of an overall livestock management plan that calculates feed requirements for twelve months. The annual plan takes into account the higher nutritional requirements of lactating females with offspring (calves, foals, lambs and kids) that come from births in winter or on spring pasture. Individual households manage their livestock in winter. For pasture grazing, livestock holdings are combined from many households to form large herds that graze the pasture according to an intense rotation. The pasture rotation requires careful management, and it is recommended that the PUU or village leaders appoint a Grazing Supervisor familiar with the grazing plan and the community pastures. He or she decides where the herder should take his livestock and for how long the herder should let them graze there before moving to a new area.

115. Pasture rotation is best understood by looking at an example, described here and illustrated in the figures that follow. In the two spring months of April and May, grazing periods average 4.3 days spread over 14 grazing unit areas. For many villages, the herds then move onto summer pastures where a new rotation begins, and return after summer to graze on post-harvest crop residues. For pastures used in both spring and summer, grazing periods average 7 days in June (about 4 grazing units), 8 days in July (another 4 grazing units) and an average of 10 days in August-September (6 grazing units) for a total of 14 grazing units from June to the end of September. By moving the herd from one small unit area to another, the entire pasture is eventually grazed in each season, except for one unit that is rested for the entire year for rehabilitation purposes. There are 15 grazing units in this hypothetical pasture. This example is merely an illustration of how a grazing plan might be developed. Specific plans for particular pastures will be based on local circumstances, and on access to seasonal grazing and how much post-harvest feed is available on hayfields and cropland.

116. Pasture rotation as described here does not require a significant investment. It may be necessary to put in more drinking water-points on the pasture landscape to ease the burden of walking from grazing unit to water source. Funds may be available from donor projects and the MoA and ARIS, combined with PUU resources, to accomplish better water-point distribution. Fencing is expensive; however, with good herders it is not necessary to fence individual pasture grazing units. Grazing unit boundaries can be distinguished by natural features of the landscape such as specific slopes, ridges, valley bottoms, a group of trees or prominent rocks. There may be a cost in training sessions to prepare PUUs and specifically the traditional herders on how to implement pasture rotation and care for the environment.

117. If farmers and livestock managers change their perspective from exploitation of pastures to protection of pasture productivity, they can still harvest livestock products while considering themselves not only as users of nature but also as trustees of the natural environment.

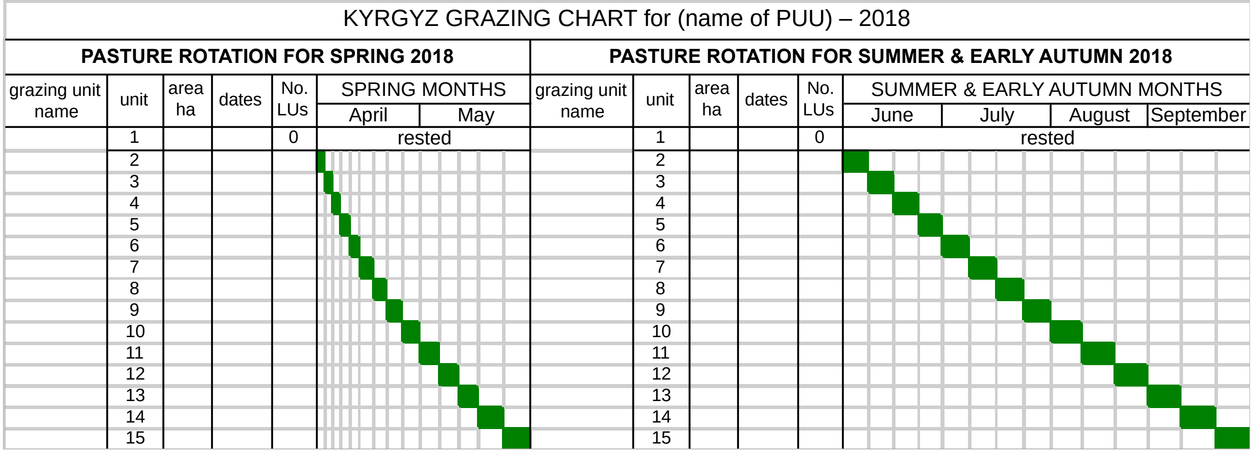

FIGURE 1. An initial Grazing Plan for 15 grazing units, of which one is rested for the year. This Plan could be for two different pastures (spring pasture and summer-autumn pasture) or for one pasture grazed in both spring and summer-autumn. Grazing periods at the beginning of April are short, just 2 days. The length of the grazing period increases gradually to 7 days in June, 8 days in July and 10 days in August-September. This is a simple example; individual situations will vary for different PUUs. [LU = Livestock Unit.]

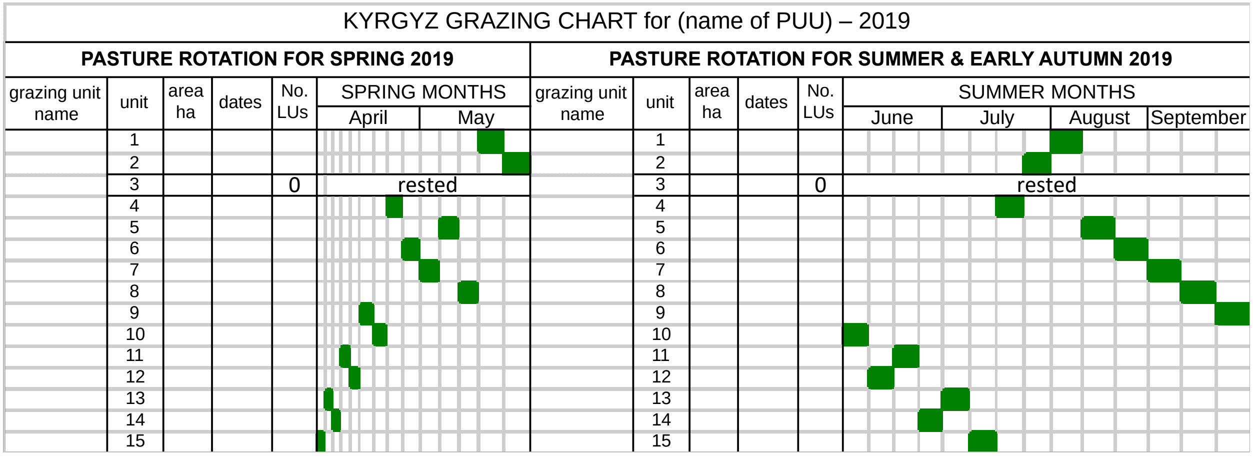

FIGURE 2. A Grazing Plan for the second year following the initial grazing year (Figure 1). The calendar dates of individual grazing units shift from year to year so that the same area is never grazed at the same time in consecutive years. The lengths of the grazing periods follow the same pattern as in Figure 1. The unit receiving a full year of rest is now unit 3 instead of unit 1.

Institutional aspects and implementation arrangements

118. Community pastures associated with a specific village are part of the State Land Fund and are governed by the law On Pasture (2009). Under this law, households in a village become members of a Pasture Users' Union and elect an executive Pasture Committee. Among other responsibilities, the Committee issues tickets that assign to households the right to use pastures with a certain number of livestock, and receives a fee for the ticket. In current practice, the tickets specify an area of pasture where the ticket-holder can graze their livestock, and these areas tend to be locations where the same household or group of households have traditionally grazed for many years. In this case, traditional practice results in widespread overgrazing. In order to achieve the changes in grazing management, forage yield and pasture condition described below under *Expected benefits*, the system of pasture allocation will need to adjust to an intensive pasture rotation. That will require a change in grazing management philosophy, which means a collective agreement by the community to adopt intensive pasture rotation, and the ability of the Pasture Committee to implement the new grazing system.

119. In Tajikistan, 203 PUUs have already adopted intensive pasture rotation in hilly pasturelands similar to those in Kyrgyzstan, often at lower elevation and drier. They have been using this grazing

system for 3-4 years and on annual reviews they consistently report bigger animals and higher milk yields. The change in Tajikistan was from a relatively unregulated system of communal pasture use to a highly regulated system of pasture rotation. In Kyrgyzstan, livestock owners are already accustomed to a well-regulated traditional grazing system on community pastures, one that gives unacceptable results of overgrazing and poor livestock production. The Kyrgyz law On Pasture contains language that would allow the PUUs and Pasture Committees to mandate an intensive pasture rotation to protect the pasture resource, improve livestock production, and increase carbon sequestration. A change of this magnitude will not happen without technical advice and training, support to initiate implementation, and incentives. The CS-FOR project has resources to devise an appropriate programme of incentives to nudge Pasture Committees in the direction of better pasture management.

120. Grazing lands on State Forest Fund lands lie outside the MoA jurisdiction that oversees the PUU system of decentralized pasture management. Responsibility for management of SFF land lies with the State Agency for Environment Protection and Forestry (SAEPF), but SAEPF has not yet established a framework for regulation of grazing-land use. Tickets for livestock grazing on SFF lands are issued every year, but there are no conditions that set grazing management guidelines or impose controls on the livestock. In consequence, stocking rates are generally far higher than the land can tolerate without experiencing severe degradation. Uncontrolled livestock consume tree seedlings and that interferes with forest regeneration and plantation success.

121. The CS-FOR project presents an opportunity to reverse this process of forestland deterioration. Under the aegis of CS-FOR, the SAEPF will be encouraged to develop grazing land-use protocols and social mechanisms that introduce a management arrangement analogous to the PUU/Pasture Committee system. Community pastures in the State Land Fund and grazing lands in the State Forest Fund are both utilized by the same villages.

122. The goal of a coordinated approach is an integrated management system in which the two sets of regulations cover livestock grazing on the two pasture domains in one Community Grazing Plan. Revenue from grazing tickets would go to the PUU or the SAEPF according to the pastureland allocation. However, livestock owners could expect the SAEPF to exercise a grazing-land regeneration and forest conservation programme with control over where and when livestock can graze similar to the pasture rotation scheme implemented by PUU Pasture Committees. The four target Districts of the CS-FOR project can serve as a pilot area to trial the introduction of grazing management regulations on SFF lands, and the integration with livestock grazing management on SLF pastures.

Expected benefits

123. The following enumerated benefits from intensive rotational grazing are drawn from the experience of pasture rotation in the Khatlon region of Tajikistan for the past four years. Kyrgyzstan does not yet have a comparable record of pasture rotation and there are no local results to draw on. That should change once the CS-FOR project is implemented. The expected benefits include:

(1) A greater amount of standing vegetation is observed, increasing carbon stocks and protecting the soil surface.
(2) Ground cover by vegetation increases rainwater infiltration and reduces erosion.
(3) A shift in species composition of the vegetation towards greater plant diversity, including palatable perennial species.
(4) More forage of better quality available for grazing.
(5) Higher grazing capacity.
(6) Bigger animals, including a faster growth rate of young calves, foals, lambs and kids.
(7) Higher milk yield, up to 100% increase in peak milk production.
(8) Healthier animals ascribed in part to better nutrition. Better quality feed.
(9) Internal parasite loads drop, partly due to long rest periods interrupting stages of the life cycle of internal parasites outside the host.
(10) More cows conceive and deliver a calf every year. Longer reproductive life of cows.
(11) A rising population of cows due to higher birth rate and lower mortality.

(12) Higher income for village households.

124. In the Tajik example, reports of higher milk yield came from the women who are responsible for household milking. The extra milk above household requirements was sold fresh or processed and sold in local markets, giving women a cash income that was not experienced before adopting pasture rotation.

125. An incidental benefit of pasture rotation is the ability to plan ahead, especially when rainfall and plant growth are below expectations. Because livestock are absent from most of the pasture, the amount of future forage resources can be estimated by observing vegetation on grazing units waiting to be grazed. The experience of pastoralists using rotational grazing in North America and Australia indicates that this planning benefit gives them a tactical advantage over producers who keep livestock on pastures continuously.

Monitoring and evaluation

126. Kyrgyzstan has several pasture monitoring methods that can track changes in composition of pasture vegetation and biomass production, the latter monitored by clipping quadrats in temporally fenced exclosures. Monitoring methods will not be reproduced in this Working Paper. The reader is referred to technical papers from ARIS/LMDP, the World Bank project (Pasture and Livestock Management Improvement Project), CAMP Alatoo, the Kyrgyz Livestock and Pasture Research Institute and Kyrgyz National Agrarian University. KLPRI has capability to assess pasture quality. The State Design Institute Kyrgyz Giprozem carries out research on pasture monitoring.

127. Measuring change in pasture species composition will monitor climate-change expressed as trends towards more arid or more temperate environments. In a drying trend, species adapted to more arid environments will replace temperate species. This also occurs from overgrazing where two processes are involved: (1) The most grazing-tolerant plants increase at the expense of less grazing-tolerant species, and root systems shrink towards the soil surface reducing access to deep soil water storage. Grazing tolerance is generally linked to drought resistance. (2) A decline in plant cover with increased exposure of bare ground promotes run-off of rainwater and less water infiltration, which creates a deficit in soil water storage (more aridity) compared to moderate grazing conditions. For these reasons, it is difficult to distinguish the agent(s) of changes monitored in grazed vegetation.

128. In the context of pasture rotation, however, the monitoring task is simplified. The grazing episodes are short, followed by or preceded by long periods without livestock grazing pressure. Pasture vegetation can be evaluated after a long rest period, and a complete picture of composition and productivity status assessed from year to year. Pasture-rotation sites can be compared with traditional continuous grazing sites. This may still not offer a clear picture of climate change and grazing management impacts, because of the high variability in climate confounding the effects.

129. The CS-FOR project has adopted an evidence-based approach to project evaluation using Remote Sensing/GIS to measure change in resource condition as a result of project activities. A new pasture management strategy (rotational grazing) is the project's mechanism to achieve positive change in carbon sequestration and resource productivity over 500,000 ha in the four target Districts. Software developed for the project records change in NDVI across landscapes of the focus PUUs in the Districts. The primary metric is trend in NDVI over time, but in order to express these trends relative to on-ground conditions, reference areas are necessary.

130. In Kyrgyz pastures and SFF grazing lands there are few ungrazed areas of sufficient size (at least 20 ha) to serve as reference sites for NDVI assessment. Several candidate areas have been proposed from second-hand reports, such as 1500 ha fenced since 2016 in Maady PUU (in Kara-Suu District), and a 120-ha area fenced for 5 years in Sary-Bulun PUU (Toguz-Toro District). During the FAO's April mission for GCF, a number of PUUs reported that their remote summer pastures were inaccessible due to poor infrastructure and therefore could be ungrazed, unless trespass livestock took advantage.

131. An indirect but ultimately more useful monitoring strategy is to track changes in livestock. This is the dimension of pasture management in which households will be most interested. Milk yield is an

obvious parameter that should reflect feed and forage supply, amount and quality. Also, live weight can be determined for a sample of livestock using the tape-measure method. Measurements for monitoring purposes should be taken from the same household herds and from livestock of known age and reproductive status and matched to herd management, including grazing management.

132. A particularly sensitive index of feed and forage conditions is the growth rate in the first six months of life. The tape-measure method can record weights at birth and at weaning for a sample of offspring. The early growth rate (g bodyweight gain per day) integrates the amount of milk produced by the mother during lactation as well as birth weight – animals heavier at birth tend to be heavier at weaning. A higher birth weight is a function of better nutrition of the mother in the last third of pregnancy, which in turn is an indicator of pasture and fodder conditions. Third, herd records of births, sales and mortality will show whether the livestock numbers in the village are rising or falling. Finally, disease incidence is a signal of nutritional status, and therefore of the effects of different pasture and livestock management systems. Because livestock parameters integrate both management practices and the effects of nutrition, they point to the general impacts of climate change and the result of mitigation efforts.

Risks and their mitigation

Risk	Mitigation
Communities, PUUs and PCs resist changing their traditional grazing practices.	CS-FOR provides an incentive scheme, coupled with training and instruction materials. PCs visit other PUUs that are implementing pasture rotation successfully.
Implementation of the Grazing Plan and rotation schedule is defective or only partially put into practice.	Capacity building on appropriate rotational grazing practices and on the importance of following the Grazing Plan exactly.
The Grazing Supervisor appointed by the Pasture Committee is not qualified or not diligent.	Training and technical assistance is made available, especially on the use of GIS maps.
As forage resources increase, the village livestock population grows to eventually exceed carrying capacity, even an enhanced capacity under pasture rotation.	Cull unproductive females and dispose of surplus bulls at 2 years of age. Improve breed quality to achieve higher yield per head, compensated by fewer household livestock. Introduce regulations that empower the PUU/PC to limit livestock numbers. Promote income diversification to replace sale of livestock products.
There is a lack of cooperation at the Ministerial, District and local government levels to implement pasture management reforms.	A Coordination Committee supported by CS-FOR project arranges and directs collaboration among different government entities within a sustainable use and climate-change mitigation framework.
The SAEPF does not have a policy and regulatory framework for managing grazing on SFF land.	CS-FOR promotes policy revision and conceptual framework for SFF grazing-land regulation, with formation of a regulatory environment & statutes.
The SAEPF is unwilling to delegate to Leskhozes a sharing of grazing management authority with local communities.	Revisions of Forest Code stipulate decentralized management of grazing lands along the lines of the law On Pasture.
Agencies and communities fail to reach a cooperative agreement for joint management of grazing on SLF and SFF lands.	CS-FOR facilitates and supervises discussions among parties to prevent and manage conflicting situations within a legal policy framework endorsed by MoA and SAEPF.
There is a shortage of reliable data on pasture monitoring, forage production, grazing ecology and grazing management.	Relevant agencies establish grazing exclosures on representative areas. KLPRI is empowered to gather monitoring data from a broad network of stations. Grazing research is carried out on pasture rotation at a community scale.
There is insufficient information available on climate data to help villages understand climate dynamics and plan accordingly.	A network of meteorological stations is established. National and regional meteorological data are made available to villages.

Sustainability

133. Three objectives converge in the management practice of pasture rotation: more productive pasture and livestock, resilience to climate change, and increased carbon sequestration. The successful implementation of pasture rotation depends on the adoption of specific new grazing management practices. Sustainability of the new grazing strategy relies on the commitment of members of the PUU and particularly the Pasture Committee. If rotational grazing is applied to community pastures, it will likely result in higher animal productivity in the form of more milk and meat. Household incomes should rise significantly, leading to better financial security. These positive outcomes provide a sound basis for continuity of pasture rotation, and guarantee sustainability of better grazing management.

134. These indicators will be analyzed against the background of the meteorological data of the nearest weather station. Under the authority of the MoA, and in collaboration with SAEPF, informational seminars and trainings will be held for villagers, PUUs and Pasture Committees. Educational literature on the rational use of landscapes and pastures, and grazing management, will be written and distributed. Booklets documenting SEP NRM project experiences will be disseminated for community edification.

(b) Establishment of windbreaks and shade-shelter

135. **Rationale**. Research has shown that rows or groups of trees and shrubs in a grazed pasture have health benefits for livestock. The trees ameliorate the environment by lowering wind velocity and thereby reducing cold stress in cool periods of the year. Trees also provide shade during the middle of hot summer days. Shade protection has been shown to reduce heat stress with positive production benefits for livestock. There are associated benefits in terms of enterprise diversification and carbon sequestration.

136. **Description of the intervention**. The terms *windbreak* and *shelterbelt* are often used synonymously. In this report, the term *shelterbelt* is replaced with *shade-shelter* emphasizing either a copse or row of trees that provides shade protection. With somewhat different functions they may need to be established in different locations and with different tree species. Rows of trees to form a shelter for shade should be planted in a southeast to northwest orientation, giving maximum shade from noon to mid-afternoon. For a group of shade trees in a copse, compass orientation is not important but location on the landscape may be; preferably in a hollow where soil moisture is enhanced. The availability of shade is one of four elements that direct movements of livestock, the other three being topography, locations of drinking water and preferred grazing sites. Make sure that the only protection from wind and sun in a pasture is not close to the main water-point where trampling damage can be excessive.

137. As a general rule, windbreaks should be planted in rows perpendicular to the prevailing winds, especially winter winds. Air flows down mountain valleys from glacier fields need to be taken into account. No matter where a windbreak is located, in the northern latitudes of Kyrgyzstan it is likely to also provide shade in addition to protection from cold winds. Similarly, a shelter intended for shade is also likely to ease the force of winds. In herded situations livestock movement can be controlled by the herder, so convenience of the locations of shade-shelter is more important than using location to influence movement over the landscape of free-ranging animals. During winter, livestock are kept in barns or graze close to the village. Windbreaks need to be strategically located to maximize protection on winter pasturelands near villages, whereas shade trees should be spread over the spring and summer pastures.

138. The distribution of windbreaks and shade shelter should be considered in relation to the distribution of grazing units in a pasture rotation. Windbreaks should be placed initially where the strongest cold winds occur, and where they can do the most good in winter, such as on pastures close to the village. The natural topography of hilly pastures will create wind protection in depressions in the lee of hills and ridges. Shade shelter should be widely distributed, but is most beneficial on warm south- and south-west facing slopes that receive the greatest amount of incident sunshine. Before embarking on a tree-planting initiative in pastures, make a careful plan on a GIS map of the area, identifying where rows or groups of trees should be planted in order to be most effective. Consider the two purposes of wind

protection and shade shelter. Also identify the species of trees and shrubs to be planted, and from where seedlings may be sourced. Potential for multi-purpose species such as walnut should be a major consideration.

139. The two objectives of wind break and shade protection generate different prescriptions for ideal plantings. A windbreak should have a solid wall of foliage produced by a combination of different layers of evergreen woody plants: tall trees plus one or two layers of lower-growing shrubs that fill in the gaps near the base of tree-trunks. Seedlings of the different layers can be planted concurrently. The longer the windbreak row, the greater the interruption of wind flows will be. A series of parallel windbreak rows separated by corridors of pasture 20-50m wide has the best effect on mitigating cold wind. Trees planted for shade can be solitary individuals, but a group of trees with contiguous canopies is better. There is no need to consider a layer of shrubs beneath shade trees; livestock seeking shelter from the sun will cluster together under the tree canopies. Livestock are likely to nibble at leaves within their reach, even if the tree leaves are not particularly palatable, creating a browse line and removing obstacles to easy movement under the trees.

140. Trees and shrubs intended for windbreaks should be evergreen, maintaining their foliage through the winter season when winds can be most debilitating. Windbreaks may be composed of evergreen species such as Schrenk's spruce (*Picea schrenkiana*) and Juniper (*Juniperus* spp.). The Forest WP notes that poplars (*Populus* spp.) are used for windbreaks, in addition to providing timber and construction materials. However, they are deciduous trees, so their effectiveness for windbreaks in winter is quite limited, although when planted close together in parallel rows they will offer some windbreak benefit. Poplars are tall and leafy in summer, fast growing and serve well as shade trees. Preferably, in order to give shade a tree should have a spreading crown of dense leaves. Broad-leaf deciduous species are suitable for shade-shelter, such as willow (e.g., *Salix caprea,* goat willow, and *S. purpurea,* basket willow); walnut (*Juglans regia*); birch (*Betula* spp.); apple (*Malus* spp.); and ash (*Fraxinus* spp.), chosen according to local environmental conditions.

141. Choose trees and shrubs for windbreaks and shelter that have some economic value, in addition to their sheltering features. They might produce fruits or nuts that can be harvested for home consumption and sale. The leaves of Mulberry trees can support a cottage silk industry. Trees could also be selected because of the quality of their timber. Another consideration is providing a habitat for wildlife, especially birds. If tourism is a potential ancillary village activity for enterprise diversification, windbreaks and shelter trees can beautify the landscape and attract wildlife that appeal to tourists. A forestry expert could provide useful advice.

142. **Institutional aspects and implementation.** Obviously it will take several years for tree plantings to reach an age and size at which they provide effective shelter, even fast-growing species. Therefore, the establishment of windbreaks and shade-shelter requires leadership from the Pasture Committee and Leskhoz, a reliable work plan with transparent budgetary implications, and a long-term commitment from the community. For at least the first five years, seedlings and young trees and shrubs will need to be protected from livestock. Herders need to be prepared to keep animals out of the way, but a physical fence is the most reliable barrier. A combination of careful herding and a fence of some kind is most likely to afford protection of young plants from being grazed. Electric fencing is easily erected and can be readily moved, but electric fencing may not be available in Kyrgyzstan, with either battery or solar power. Windbreaks and shade-shelter tree plantings may need hand-watering in the first two to three years, but it would depend on the location of the planting on the landscape. If planted in a swale or depression where rainwater and snowmelt accumulate, the soil may be deep enough and of good quality to provide enough soil water storage for young trees to survive the summer months. Similarly, on the northern, northeastern or northwestern slopes, the topography and low incident sun exposure will reduce evapotranspiration and enhance tree establishment without irrigation.

143. Both electric and conventional fencing are expensive, and communities will need financial support, as well as technical support on fence construction and maintenance. Pasture Committees could appeal to NGOs and international donor organizations for assistance. The project will support individual

PUUs and Leskhozes to make collective agreements (INRMCRP), sponsored by an institute such as ARIS, to collaborate on seedling supplies and fencing materials. Growth of woody species will capture and store carbon and enhance carbon sequestration, so planting windbreaks and shade-shelter copses is aligned to the primary objectives of the CS-FOR project. Resources from that project may be available to encourage a tree-planting programme on pastures of both SFF and municipal lands. Tree establishment and management on community pastures will train communities to care for similar plantings, and even large plantations or tree regeneration efforts, on SFF land.

144. **Expected benefits**. Households can expect healthier animals if cold stress in autumn/winter and heat stress in summer are reduced. Research has indicated that protection from cold wind and midday sun reduces metabolic maintenance costs and increases livestock productivity.[2] In addition, tree plantings could be designed to provide alternative incomes from tree-harvest products and tourism, such as bird watching. Finally, and most important from a climate-change perspective, establishing windbreaks and shade-shelter copses and belts will increase carbon sequestration.

145. **Monitoring and evaluation**. From the time of planting, seedlings and young plants will need to be monitored for vigour and survival. Dead plants will need to be replaced. A drought in the first year or two after planting may require watering individual plants to keep them alive. Once established, the effectiveness of shade trees and windbreaks can be judged by the behaviour of livestock. If they seek protection from midday sun in the shelter of a row of trees or a copse, or huddle behind windbreaks in winter to avoid cold winds, the tree plantings have fulfilled their purpose.

146. Exploiting tree plantations for harvest products or other benefits can be assessed from an economic perspective. The degree to which carbon stocks are augmented in windbreaks and shade-shelter trees can be calculated from wood density estimates and trunk measurements to determine wood volume and biomass.

147. **Risks and mitigation.** The main risk with a windbreak and shade-shelter programme is that there is not sufficient community will and commitment to carry it out. It requires a vision of what the pastures could look like in the future, and that takes leadership from the Pasture Committee and Ayil Okmotu. This risk can be mitigated by a capacity-building effort by the CS-FOR project with training illustrated with examples of how pasture landscapes can be augmented to achieve a more benign environment that enhances livestock production, enterprise diversity and pasture scenery.

148. At the technical level, there is risk that tree and shrub plantings will be unsuccessful for biological or ecological reasons. Seedlings may not be available, and those that are planted may not thrive. The same problems apply to reforestation and afforestation activities in Leskhoz forest enterprises. SAEPF forestation and a windbreak/shade-shelter programme create an undertaking of such magnitude that it is necessary to establish specific nurseries to supply seedlings to Leskhozes and Pasture Committees that need them. This calls for Private-Public Partnerships in tree nursery enterprises.

149. Another technical risk is that fences protecting tree plantings will not be secure. Any livestock producer will testify that fence maintenance is an on-going and never-ending task. Herders must remain vigilant and look for ruptures in the protective fence around tree plantings. When a break occurs, it must be repaired immediately before small ruminants – goats are the most inquisitive – become aware of access to the protected area. PUU personnel need to be trained in fence-mending skills, and have the appropriate equipment at hand.

150. There is a risk that protected tree plantings will be opened up to livestock access before it is ecologically safe to do so, and be destroyed as a result. Technical consultants should be engaged to make the determination of when to remove fences, and how to manage the plantings soon after opening.

151. Finally, once the windbreaks and shade-shelters have been exposed to livestock, there is a danger that they will suffer heavy use and be degraded to an ineffective state. Pasture rotation simplifies

[2] E.g., Bird et al., Animal Production Australia 15:270-273, 1984; Bird, Agroforestry Systems 41:35-54, 1998; Williams, The Rangeland Journal 39:461-476, 2017.

custodial work. Pasture rotation is focused only on trees exposed in the particular grazing unit stocked with livestock. The condition of open windbreaks and shade-shelters needs to be monitored. If necessary, fences may need to be re-established to allow recovery from misuse. Managing tree plantings that are used by livestock is a learning process. Nevertheless, the rewards of vigilance and careful management are worth the effort involved.

152. **Sustainability.** Maintaining tree plantings on grazed pasture is a challenge. The benefits will not materialize for at least 5 years, maybe more. In the meantime, the PUU, Pasture Committee and herders must persevere with extra care of seedlings and young trees in the first three years after planting, repair fences when necessary, and exercise custodial management of established plantations. The investment is sustainable if community leaders preserve the vision of a future pasture with trees in rows and copses. The most direct benefit to villages will likely come from windbreaks protecting livestock from cold winter winds. They will see this close to their household dwellings and see the effects in better animal condition. Observations like this and the potential harvest of tree products will help to keep the vision of a healthier environment alive, and so foster the sustainability of the intervention.

(c) Climate-change friendly improvements in livestock production

153. The previous discussion on rotational grazing focused on increasing forage production and carbon sequestration. The recommendation concerning windbreaks and shade-shelters addressed environment amelioration, carbon sequestration and animal health. This third recommendation focuses on reducing Green-House Gas (GHG) emissions such as methane from livestock grazing natural pastures. Low-methane-emission livestock husbandry should be tested in the CS-FOR target districts.

154. This portion of the Working Paper on Pasture endorses sections in the Working Paper on Livestock regarding the development of livestock production with less methane emission per kg of animal products. Methane is a powerful GHG with 34 times the potency of CO_2 (IPCC 2014). The appropriate methods are: 1) to reduce the number of unproductive animals in the herds and flocks; 2) to replace current low-yielding livestock breeds with more productive breeds; 3) to adopt better manure management practices; and 4) to stimulate and increase enterprise diversity to compensate for smaller herds of grazing livestock. Biogas technology employs anaerobic digesters to capture methane gas from manure and use it for fuel for heating and cooking, and even in combustion engines. The products of methane combustion are carbon dioxide and water. Biogas technology has been developed for large livestock enterprises but is less cost-effective at a small-farm scale. Nevertheless, appropriate technology for harnessing biogas designed for farms in India and elsewhere could be tested in Kyrgyzstan.

155. Herds of cattle currently contain a relatively high proportion of males 1-5 years old that will eventually be sold. Meanwhile, they contribute methane GHG to the atmosphere. Unproductive small ruminants should be sold at 1 to 1.5 years of age and at least 80% of male cattle sold at 2 years old. This will not only reduce the proportion of males in the herd, it will increase overall livestock productivity by at least 10%. Not only will unnecessary GHG emissions be reduced but grazing pressure on community pastures also will be less. Better market price can be obtained if young males are fattened in a feedlot environment before sale. The owner can estimate live weight (using the tape measure method) before negotiating a sale price. A faster turnover of male stock usually means more income from this component of the herd.

156. Low-yielding livestock breeds should be replaced with higher-value breeds with more rapid growth rates and higher milk yields. Milk yields could double from a peak of 5-6 litres per day to 12-15 litres with better nutrition under disease-free conditions. Daily weight gains of cattle could rise from 300-400 g/day to 650-700 g/day. Reaching the potential of higher productivity will require better nutrition: intensive pasture rotation provides a taller stand of forage; plant species diversity ensures a diverse diet of quality forage. The Working Paper on Livestock describes a number of breed options that generate higher returns per head, justifying a smaller herd size to achieve the same levels of production and income. It is not necessary to cross-breed cattle to achieve higher productivity, although the availability of

semen of Brown Swiss and Black Angus bulls delivered through artificial insemination makes cross-breeding attractive to livestock owners who are looking for a “silver bullet” to solve production issues. Equally effective is an aggressive culling programme within herds of indigenous cattle, selecting cows for milk yield and the growth rates of their calves. A strong selection protocol could be combined with cross-breeding. Big fat-tailed Ghissar sheep introduced from Tajikistan and Uzbekistan are already a common component of Kyrgyz flocks. However, slaughterhouses are expressing a preference for thin-tailed sheep like local forms of Merino because there is less carcass waste such as experienced with the fat tails of Ghissar sheep that have low market value and are generally discarded.

157. The solution to the current problems of low-productive livestock and overgrazing is both more productive animals and lower grazing pressure on more productive pastures providing a higher plane of nutrition. GHG emissions per animal and per kg of product are higher when the diet is poor quality and animals are smaller.

158. Current winter-housing management could be magnifying the problem of GHG emissions. Livestock are often kept in enclosed barns with little ventilation. Manure and urine build up on the floor of these barns. Decomposition of manure under anaerobic conditions produces large amounts of methane gas, a very dangerous GHG with 34 times the potency of carbon dioxide. Urine breakdown releases ammonia gas. Ammonia is not a GHG but build-up of ammonia in the atmosphere creates unhealthy conditions for livestock in enclosed barns. Correct manure management practices could be introduced to the CS-FOR target districts. Manure can be excavated from barns and formed into patties that are dried for future use as fuel. The CO_2 released by burning is not as dangerous for global warming as the CH_4 released from anaerobic decomposition in the barn. Manure raked out of winter barns can be spread as organic fertilizer on crop or vegetable fields and nearby pastures. A sludge of manure stirred into water makes manure handling easier. Ventilation is readily enhanced by opening windows and doors on the leeward side of the barn away from prevailing winter winds.

159. Alternative livestock enterprises should be pursued to reduce reliance on cattle and small ruminants. The yak population in Kyrgyzstan has been declining in recent decades while conventional livestock numbers have been increasing. Yaks provide a unique opportunity for harvesting mountain pastures with low managerial input. They have better feed efficiency than cattle and small ruminants, with smaller feed intake needed per kg of animal product, and their high quality meat and milk products are in demand. Yak farming is a viable alternative that should be explored in the target project districts. Goat milk is in increasing demand, and yet the population of dairy goats is relatively small. Dairy goats can serve household milk requirements when cow milk is unavailable.

160. Poultry and turkey farming offer alternative enterprises that have high income potential. Chickens and turkeys do not produce GHG. They serve subsistence household needs for eggs and meat as well as providing market potential. Turkey farms are particularly profitable in meat markets. Finally, bee management for honey production has been a strong tradition in rural Kyrgyzstan, but honey yields have declined to one quarter of Soviet-era levels. This domain of agricultural production is very profitable and could be developed in rural communities of the CS-FOR target districts.

(d) Broadcasting seeds of forage species to improve pasture

161. The Kyrgyz Livestock and Pastures Research Institute has an on-going programme of pasture improvement on lands that can be lightly cultivated with harrows, i.e., relatively flat or gently sloping land. The land for broadcast seeding is cultivated with harrows in late October or early November before broadcasting, and often receives a second pass of the harrows after broadcasting to settle the seeds into the topsoil. A flock of sheep walking over the site can also achieve a sowing effect. On pastureland that is too steep for cultivation, an alternative to the KLPRI method is to broadcast seed into undisturbed natural pasture.

162. Palatable non-invasive native perennial grasses suitable for broadcast seeding include smooth brome (or awnless brome, *Bromus inermis*), cocksfoot (*Dactylis glomerata*), bulbous barley (*Hordeum bulbosum*), volga fescue (*Festuca valesiaca*), and sheep's fescue (*Festuca ovina*) on drier sites. A desirable perennial forage plant in the rose family is salad burnet (or sheep's burnet, *Sanguisorba minor* also known as *Poterium sanguisorba*). Burnet is both highly palatable and tolerant of heavy grazing, and remains green through the summer months. Two native rhizomatous perennial grasses are well suited to protecting eroding and vulnerable sloping sites: couch grass (*Cynodon dactylon*) and quackgrass (*Elymus repens*). Although the latter grows rapidly to hold the soil in place, it can be fairly aggressive with invasive properties. Two perennial legumes have been planted as fodder crops in Kyrgyzstan for a long time and are now naturalized, if not native: Sainfoin (or esparcette, *Onobrychis viciifolia*) and lucerne (or alfalfa, *Medicago sativa*). Both legumes have been successfully broadcast into natural pastures in other Central Asian countries. Seeds of indigenous forage shrubs can also be broadcast into pasture: some of the "shubak" (*Artemisia*) species such as "Belozemelnia" (*Artemisia terrae-albae*), "Teresken" (*Krascheninnikovia ceratoides*) and "Izen" (or forage Kochia, *Bassia prostrata*).

163. In addition to naturally available plant resources, KLPRI is undertaking selective breeding to produce grazing-tolerant varieties of native forage species for pasture improvement projects. In this regard, the creation of a national seed fund for high-quality grasses for grazing should play a key role. CS-FOR could become involved in this programme.

164. The success rate of broadcast seeding into existing vegetation can be quite low, but if only 1 or 2 plants are established per m^2 that may be a sufficient starting point to ensure that the species survives and spreads in the plant community. Under intensive rotational grazing, palatable perennial grasses have a competitive advantage in re-growth capacity after defoliation over less palatable and weedy species.

165. While seeds of sainfoin and lucerne are commercially available from local seed farms in Kyrgyzstan, only one farm is producing seeds of perennial grasses, namely, a 4-ha area managed by KLPRI. The Pastures Institute has initiated satellite seed production sites in Ak-Talaa and Loken Districts. The CS-FOR project could encourage PUUs to establish 1-ha fenced sites dedicated to perennial grass seed production, under the guidance of KLPRI. These sites must be sown to preferred species adapted to the area, and maintained free of weeds. Following the KLPRI model, grass seeds can be collected from natural stands that receive light grazing pressure, especially from grazing units receiving a full year of rest from grazing in the schedule of a pasture rotation, or a foundation batch of seeds may be obtained directly from KLPRI. Seed can be harvested by hand into bags attached to the waist of seed collectors, dried and cleaned. Stored seed is then spread by hand onto hillsides, beginning with environmentally favourable areas with good soil properties in terms of depth and fertility. Seed should be spread in October/November so that winter rain and snow can press the seeds down to the soil surface where germination takes place.

166. The KLPRI 4-ha area used for grass seed production is part of 8 ha of land managed by the Pastures Institute; the remaining 4 ha is used for research. The entire 8 ha is within a 200 ha area controlled by Kyrgyz National Agrarian University. The KLPRI seed production area could be expanded under project auspices through an agreement with KNAU.

CONCLUSIONS

167. Pastures and the livestock that depend on them are the main component of Kyrgyz agriculture, supporting up to 90% of the rural population. Pastures are overgrazed and degraded, and livestock production is poor; milk yield is only half the potential or less. The effects of degradation are ecological, social and economic, with the livelihoods of poor households most vulnerable. The current production system is in the grip of a vicious cycle. Overgrazing reduces available forage, which then reduces animal productivity, causing households to want more animals to compensate for less production per head, which increases grazing pressure and leads to more degradation. The downward trends in pasture degradation and livestock production have continued for the past two decades and conditions will

become worse under the adverse impacts of climate change. By adopting innovative grazing management strategies, these trends can be reversed, providing rest and recovery periods to restore pasture vegetation, increase carbon sequestration and reduce or eliminate erosion.

168. The core element of ecosystem recovery is a new grazing management strategy: rotational grazing. In addition, tree plantings for windbreaks and shade on pastures can improve animal health and augment carbon sequestration efforts. Introducing higher-performing livestock breeds into community herds can raise productivity per head and drive down herd size while achieving equivalent overall production. Better manure management in winter housing facilities can reduce methane emissions. Methane, a Green-House Gas 34 times more potent than carbon dioxide, can also be reduced without threatening livestock production by culling unproductive animals such as surplus males and barren females. Poor quality feed produces more methane per kg of production than high quality feed; rotational grazing practices increase both amount and quality of forage. Quality of pasture vegetation is naturally improved under a pasture rotation regime, but positive trends can be accelerated by introducing seed of native perennial forage species by broadcasting into natural stands of vegetation. Finally, enterprise diversification can reduce dependency on conventional livestock husbandry and increase resilience to climate change impacts.

169. Changing traditional pasture and livestock management practices is a challenge. However, the PUU/PC organizational structure in rural villages provides a mechanism for community commitment to planning and implementation that will achieve enhanced, more sustainable production. By addressing the threats inherent in climate change, farmers and livestock producers can increase the long-term profitability of their activities while contributing to both ecosystem health and poverty reduction. The ultimate goal is to restore and preserve the ecological integrity of pasture ecosystems.

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[i] In a widely cited review of research on rotational grazing on rangelands in the U.S., Briske et al. (Rangeland Ecology & Management 61:3-17, 2008) found no difference between the rotations and continuous grazing. In 2011, however, the same lead author acknowledged that those reviewed reseach trials «do not address livestock distribution in heterogeneous landscapes» (pages 21-74 in *Conservation Benefits of Rangeland Practices: assessment, recommendations and knowledge gaps*. National Resources Conservation Service, USDA, Washington D.C.) thus ignoring the spatial dimension to grazing management.